Sustainable Design in Massachusetts: Obstacles and Opportunities

A thesis

submitted by

Joanne Telegen

In partial fulfillment of the requirements for the degree of

Master of Arts

in

Urban and Environmental Policy and Planning

TUFTS UNIVERSITY

August, 2005

Advisor:
Rusty Russell

Reader:
Julian Agyeman

Abstract

Climate change, global warming, water and energy availability are just a few of the major environmental issues currently affecting the world. Initiatives have been created worldwide to help alleviate the problems caused by human actions. More locally, in Massachusetts, an effort has been undertaken to mitigate these issues on a smaller scale, including the Massachusetts Climate Action Plan, the State Sustainability Program, and the New England Governors/Eastern Canadian Premiers Climate Change Action Plan.

Building and construction projects use many resources and affect the public's health and wellbeing. Buildings account for about one-third of the energy consumed in the United States. Sustainable design is a school of thought that attempts to lessen the environmental, social, and physical burdens of buildings and construction.

Sustainable design philosophies and techniques have been employed by various private and public entities to build more environmentally responsible structures. Not only is the final building affected, but the process in which these buildings are designed and built is affected as well.

This thesis project begins with an introduction and background overview of the reason why sustainable design is important and continues with a discussion of some of the barriers to sustainable design including Education and Training, Financial Barriers and Incentives, and Vision and Leadership. Policies that could help eliminate these barriers are studied. A case study on the Cape Cod Community College's Lorusso Technology Center, the State's first certified green building, is presented.

The thesis concludes with a summary of recommendations to the Sustainable Design Roundtable for inclusion in its final report. Additional comments and lessons learned from the Cape Cod Community College vignette are also included.

Acknowledgements

I wish to thank everyone who assisted me with this project including my advisor Rusty Russell and reader Julian Agyeman. Additional thanks to the individuals willing to sit with me for interviews, including Aisling Eglington, Ted Anthony, Peter Fourtounis, Stephen Harper, Glenn Harper, William Reed, Barbra Batshalom, Mark Kalin, Leith Sharp, and David Berkowitz. Additional thanks to Brett Baden, my academic advisor at Tufts.

A special thank you goes to John DiModica and the people at DCAM who made this project possible.

And of course, thank you to Mom and Dad, Laura and Steven, Kate, and Andrew for supporting me all along the way. Extra special thanks to Josh.

This thesis is dedicated to David and Lorraine Telegen.

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Chapter I – Introduction to the Thesis Project: Why Sustainable Design?

> "We do not seek to imitate nature, but rather to find the principles she uses."
>
> -Buckminster Fuller

> "I was recently invited to give a lecture on sustainable design to post-graduate design and architecture students…After the professor introduced me, I said something to the effect of, 'Let's start by hearing your definitions of sustainable design.' I glanced around the room with that expectant air teachers get when asking a question that's close to rhetorical. Instead of answers, I was greeted by empty stares and absolute silence…What was wrong here?…As the class went on, it became clear that the students were aware of the effects that buildings have on the environment. But their knowledge was tentative and offhand, a byproduct of their education, rather than a focus of it."
>
> (Talarico in Sustainable Architecture White Papers 2000, 201-2)

The anecdote described above in the quote from Wendy Talarico, contributing editor for the magazine *Architectural Record*, accurately described my lack of experience with sustainable design as a first-year graduate student enrolled in an urban planning, design, and policy program. After one full year of classes, I was unaware of sustainable design and its relationship to buildings. I had studied sustainable development and understood the importance of sustainability, but did not recognize design technologies or philosophies specifically.

It was not until the summer after my first year of graduate school when I embarked upon an internship search that I learned about sustainable design. While

interviewing for a Planning Assistant position at the Commonwealth of Massachusetts Division of Capital Asset Management (DCAM), I found myself engaged in a conversation about green buildings and photovoltaic panels embedded in building skins. At that moment, I realized I didn't know much about the subject, but I was intrigued. Even without this background, I was given the position and embarked upon what has become a major learning process.

Global warming and climate change are major environmental issues challenging the world today. These issues force the citizens of the world to think of innovations to reduce the human impact on global warming. One of these innovations is sustainable design.

The greenhouse gas carbon dioxide is one of the major contributors to climate change. Carbon dioxide is emitted when fossil fuels are burned. Buildings that have inefficient and/or outdated mechanical systems may directly and indirectly add carbon dioxide into the atmosphere, thereby increasing the possibility of global warming. Inefficient systems may put a lot of stress on electricity plants generating the energy necessary to keep the building warm, cool, or well-lit. Innovations in energy efficiency, including utilizing renewable energy sources and incorporating other sustainable design technologies into buildings, can help minimize the amount of carbon dioxide involved with keeping a building running and therefore reduce effects of global warming.

Building and construction projects use many resources and affect the public's health and wellbeing. Sustainable design is a school of thought that attempts to lessen the environmental, social, and physical burdens of buildings and construction. To combat

and remedy the detrimental effects of construction, and regular building use and maintenance, sustainable design practices focus on specific design techniques and measures intended to reduce harmful environmental effects brought about by the construction and operation of buildings.

The following statistics provide perspective on carbon dioxide emissions in Massachusetts and were provided by Ian Finlayson, State Sustainability Program Manager at the Commonwealth of Massachusetts Executive Office of Environmental Affairs. For the Commonwealth, in the year 2000, there were 86 million metric tons of carbon dioxide emitted by all sectors which include transportation, electric power, residential, industrial and commercial, both public and private sector. Of that 86 million metric tons, residential and commercial carbon dioxide emissions amounted to 21.5 million metric tons, or 25% of the total emissions. 1.16 million metric tons of carbon dioxide were emitted by state-owned operations. 92.3% of the total state-owned operations emissions were released by state buildings from the use of electricity, fuel oils, natural gas and coal, amounting to 1.07 million metric tons of carbon dioxide. The remaining 7.7% originated from state operated transportation activities. The State's twenty-nine state colleges and universities, including the five University of Massachusetts campuses, released 43% of the total state operated building emissions. State operated building emissions account for 1.24% (1.07 million metric tons/86 million metric tons) of the state's total emissions (Finlayson 2005)[1].

[1] Finlayson quoted material from EOEA's FY04 GHG Inventory and NESCAUM's "Fossil fuel C02 emissions by sector, Massachusetts 1990-2000" found on the Boston Indicators Project website (http://www.tbf.org/indicators2004/environment/indicators.asp?id=2272).

Reducing these percentages is an ongoing goal of the Commonwealth. One way to achieve such carbon dioxide reductions is to encourage sustainable design practices. Ideally, those involved in building construction, like designers, architects, and construction company professionals as well as the media, would accept progressive sustainable design techniques. There are many professionals who do indeed embrace the sustainable design philosophy and who are working hard to ensure they maintain a continued presence on the mainstream design and construction scene. However, there are also multitudes of barriers that prevent these tenets from being widely accepted.

The main question this thesis will address is "What are the barriers and solutions to sustainable building in public construction projects?" This question pertains specifically to Commonwealth-owned public buildings. A secondary question is "What are the state policies that can be used to eliminate these barriers?" These questions will help illustrate the current sustainable design situation in Massachusetts.

In this thesis, I intend to provide more background on the relationship of climate change and sustainable design, including a discussion regarding the scale of the issue. Chapter III describes the methodology used to complete the research for the thesis. In the fourth chapter, I will complete an in-depth study of three barriers to sustainable design in public construction in Massachusetts. I will also present a series of policy mechanisms that are used in Massachusetts and elsewhere to encourage sustainable design in Chapter V. Using case study methodology in Chapter VI, I will write a vignette on Massachusetts' first certified green building that was built with State funds—the Lorusso Applied Technology Center at Cape Cod Community College in Barnstable, MA.

Chapter VII completes the thesis with recommendations stemming from barrier and policy research from previous chapters.

Chapter II: Background – A Look at the Relationship between Global Warming, Sustainable Design, and Massachusetts Public Agency and Policy Drivers

This background chapter will define sustainable design and identify it as one of many solutions for mitigating climate change. A discussion of global warming will help frame the issue and illustrate the importance of sustainable design to society. Global warming affects local, national, and global environmental health and welfare. The scale of this problem, including a more localized view from Massachusetts, will be studied.

This chapter will also provide information on the United States Green Building Council and will give an overview of the Massachusetts public policy agencies responsible for moving sustainable design forward. Current Massachusetts and New England initiatives and policies to curb climate change and encourage sustainability will be introduced. The purpose of the discussion of the policies and agencies responsible for the progress of sustainable design in Massachusetts is to illustrate their influence and potential. Lastly, this chapter includes a discussion of Massachusetts' attempts to encourage green building.

Global Warming and Climate Change and the Relationship to Sustainable Design

> According to the National Academy of Sciences, the Earth's surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is new and stronger evidence that most of the warming over the last 50 years is attributable to human activities… Scientists expect that the average global surface temperature could rise 1-4.5°F (0.6-2.5°C) in the next fifty years, and 2.2-10°F (1.4-5.8°C) in the next century, with significant regional variation. Evaporation will increase as the climate warms, which will increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent. Sea level is likely to rise two feet along most of the U.S. coast.

(USEPA, 2000)

> On May 19, 1997, John Browne, the chief executive of British Petroleum—then the world's third-largest, now its second-largest, oil company—announced at Stanford University: 'There is now an effective consensus among the world's leading scientists and serious and well informed people outside the scientific community that there is a discernible human influence on the climate, and a link between the concentration of carbon dioxide and the increase in temperature…We must now focus on what can and what should be done, not because we can be certain climate change is happening, but because the possibility can't be ignored.'
>
> (Browne 1997 in Hawken 1999, 241)

> Buildings account for over [50% in the UK, 41% in the EU and 36% in the USA] of greenhouse gas emissions and thus have a major potential role to play with respect to climate change. Furthermore, buildings and cities are, and will increasingly be, affected by the consequences of climate change.
>
> (Steemers 2003, 7)

Impending global warming and climate change. Increased pollution and emissions. Intensified reliance on fossil fuels and other natural resources. Decreased health and wellness. These critical issues all play a major role in the current state of the world's environmental health, but also pertain to the Commonwealth of Massachusetts.

Because global warming and climate change are both world-wide issues, any further discussion of sustainable design must take into account the multiple scales—local, state-wide, national, and international—that these issues transcend. On all scales, global warming and climate change have been recognized as serious problems that can no longer be ignored. Human actions have exacerbated and accelerated the declining state of the atmosphere.

On an international scale, specialists from NASA, Columbia University and the Department of Energy co-authored a recent study, providing data that shows human

actions are affecting the global climate: “Earth is now absorbing so much heat from the sun that the soot and greenhouse gases that humans are putting in the air appear to be the only reasonable explanation for the warming trend” (Bustillo 2005). Another source states, “Earth is absorbing much more heat than it is giving off, a conclusion they say validates projections of global warming.” The article continues:

> If carbon dioxide and other heat-trapping emissions instead continue to grow, as expected, things could spin "out of our control," especially as ocean levels rise from melting Greenland and Antarctic ice sheets, the researchers said. International experts predict a 10-degree leap in Fahrenheit readings in such a worst-case scenario’…There can no longer be genuine doubt that human-made gases are the dominant cause of observed warming,’ said Hansen, director of NASA's Goddard Institute for Space Studies at Columbia University's Earth Institute. ‘This energy imbalance is the `smoking gun' that we have been looking for.’
>
> (Hanley 2005)

The report clearly places accountability onto the shoulders of humans. Once responsibility is accepted, remedies and countermeasures such as reducing greenhouse gas emissions should be put into place, and indeed, many already have.

Building construction contributes to the degradation of the environment as mentioned in the quote and study by Steemers. Professor Vivian Loftness of Carnegie Mellon University provides additional supporting data:

> The building sector is the biggest ‘player’ in the energy use equation and can have the greatest impact on addressing climate change…The U.S. Green Building Council has summarized the energy and environmental importance of this sector of the economy: Commercial and residential buildings use 65.2% of total U.S. electricity and over 36% of total U.S. primary energy. Buildings use 40% of the raw materials globally and 12% of the potable water in the United States. Building activity in the U.S. also contributes over 136 million tons of construction and demolition waste (2.8 lbs./person/day), and 30% of U.S. greenhouse gas (GHG) emissions (USGBC 2001).
>
> (Loftness 2004, 1)

Construction projects contribute greatly to greenhouse gases via activities such as the destruction of natural habitats through building siting, landfilling of construction and demolition waste, and the use of natural, non-renewable energy and materials to create and control the climate of the buildings themselves. Completed buildings also contribute to greenhouse gases as the energy that is used to heat, cool, ventilate, light, and operate systems within the structure usually comes from a non-renewable energy source. Since buildings and building construction utilize a significant amount of energy and resources, they should be considered important players in attempts to reduce greenhouse gas emissions in order to stem climate change.

The energy and resource issue can be addressed from a direct, primary perspective as well as a secondary, indirect perspective. From the direct perspective, attempts at reducing greenhouse gas include encouraging using renewable or cleaner energy sources like wind, solar, or natural gas. In this example, changes are made at the source. From an indirect, secondary perspective, acknowledging the importance of building orientation and window placement helps increase natural sunlight and reduces the need for large electrical loads. Environmentally preferred products like energy efficient lightbulbs for example can also help reduce greenhouse gas loads.

The solutions listed above are all part of a building philosophy categorized as sustainable design. One definition of sustainable development states, "Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987, 4). Sustainable design builds upon this philosophy.

Often, buildings that incorporate sustainable design technologies are called green buildings or high performance buildings. Whereas the concept of sustainability in general stresses the importance of maintaining the continued capability of natural and cultural systems over time, the concept of sustainable design pertains more distinctly to human settlements and physical objects. Sustainable design for construction projects concentrates on specific design measures intended to reduce harmful environmental effects brought about by the construction and operation of buildings. The combination of using energy efficient products while trying to use cleaner energy combine to make a strong effort to reduce greenhouse gas emissions and thereby affect the larger climate change issues.

It is important to consider the affect on the environment that construction and building use exacts. Building construction is often an environmentally deleterious affair in the United States and abroad:

> Nationally, buildings account for 49% of sulfur dioxide emissions, 25% of nitrous oxide emissions, and 10% of particulate emissions, as well as 35% of carbon dioxide emissions, the chief pollutant blamed for climate change.
>
> - The U.S. has more than 80 million buildings and will construct another 38 million buildings by 2010.
> - Buildings use 1/3 of all the energy consumed in this country & 2/3 of all electricity generated.
> - Building construction generates 136 million tons of waste per year in the U.S.
> - Buildings account for one-quarter of the world's wood harvest."
>
> (The Green Roundtable 2004, 4)

Having statewide legislation, regulations, policies, and agency practices in place could help to streamline the development process and potentially create incentives for developers, contractors, and building owners both in the short and long term.

Why Massachusetts?

How does global warming pertain to Massachusetts specifically? The Commonwealth is one of the largest landlords in the state in terms of acres of land and building square footage. The Commonwealth is responsible for planning, designing, constructing, maintaining, and leasing almost 90,000,000 gross square feet (GSF) of building space and almost 600,000 acres of land (Commonwealth of Massachusetts Division of Capital Asset Management 2004, 12). Additionally, the Commonwealth of Massachusetts/Division of Capital Asset Management manages approximately "$230 million annually in new construction and renovation projects" (DCAM 2005).

At the current rate of development and construction, major environmental issues like global warming, climate change, increased pollution, and continued reliance on fossil fuels may worsen. Massachusetts could be directly impacted in many ways. Coastal changes, weather events, economic impacts, water resource availability, fish and ocean impacts, additional natural resources, and human health and comfort may all be affected. Severe weather events may become more frequent, loss of beachfront may occur, change of temperature in the ocean may drastically affect sealife, tourism, agriculture, and diverse ecosystems may suffer, and drier conditions, heat waves, and droughts may become more frequent (Massachusetts Climate Protection Plan 2004, 6-7).

Although the state's GHG emissions are not rising as fast as those of some other states, Massachusetts's aggregate emissions are significant, especially when considered on a global scale. Here are a few facts about current development rates, GHG emissions and Massachusetts:

> Massachusetts GHG emissions relative to population and economic activity are significantly lower than the national average. In 2000, Massachusetts had 2.2% of the US population and produced 1.3% of national emissions, or 14.9 metric tons of CO2 equivalent per person, compared to the national per capita average of 24.9 metric tons per person. Relative to economic output, Massachusetts generated 0.03 metric tons of CO2 equivalent per dollar of gross state product in the year 2000, compared to the national average of 0.07 tons per dollar of total gross domestic product.
>
> Total Massachusetts GHG emissions increased by about 5.4% from 1990-2000; during the same period, US GHG emissions increased by over 14%. Massachusetts' economy already is much less GHG-intensive than the nation as a whole.
>
> On the international level, if Massachusetts were a country, its GHG emissions in 2000 would have ranked 15th among industrialized countries worldwide, below Greece but above Portugal.
>
> (The Boston Indicators Project website, 2005)

There is certainly room to improve Massachusetts' environmental scorecard, especially on an international scale, although some of the above statistics suggest the state is not the worst offender in the nation. However, the state's contributions to climate change in the form of GHG emissions can not be disregarded. If attempts are to be made at reducing GHG emissions, the State as a landlord has a duty to uphold responsible development and maintenance plans.

Sustainable Design Leadership and Metrics: The United States Green Building Council (USGBC) and Leadership in Energy and Environmental Design (LEED)

How can sustainable design be measured? Is it possible to have a metric or rating system to measure the successes and failures of high performance buildings? In order to provide organization, stability, and consistency to the metrics of sustainable design, a standard measuring system and governing body was created. The United States Green Building Council (USGBC), a coalition of the country's top building and construction leaders, was formed in the mid 1990's to provide these benefits. The USGBC is charged with encouraging environmentally friendly building practices without compromising usability and comfort.

To measure and reliably document different levels of sustainability, members of the USGBC created a rating system called LEED (Leadership in Energy and Environmental Design). There are other rating systems in the United States and abroad, but they are neither endorsed nor maintained by the USGBC. Examples of these rating systems include CHPS (The Collaborative for High Performance Schools, used mainly for building sustainable schools), Labs21 EPC (a rating system for laboratory construction that is based on LEED), and Green Globes, a "web-based, commercial green building assessment protocol" (Green Globes website 2005). Canada's BEPAC (Building Environmental Performance Assessment Criteria) program measures the environmental performance of new and existing buildings. In England, the Building Research Establishment Environmental Assessment Method (BREEAM) conducts building performance assessments and then rates those buildings as either "pass", "good", "very good", or "excellent".

In the United States, LEED is the dominant green building recognition and rating system with over 2000 buildings registered with the USGBC (Enermodal Engineering

website 2005). Additionally, "LEED has considerable acceptance in the institutional and government sectors, and is the 'de facto' green building standard in the US" (Yudelson 2005).

Professionals involved in the design and construction of a building may apply for LEED certification. There are four levels of certification: Certified, Silver Certified, Gold Certified, and Platinum Certified. These different levels are attained by earning points. Points are earned based on the sustainable design characteristics incorporated in the completed project. The more points earned, the higher the certification.

At this time, LEED is a voluntary rating system for public and private buildings in Massachusetts. There are nine states that have LEED policies in place (Engineering News-Record 2005). In California, measures in the Executive Order include "designing, constructing and operating all new and renovated state-owned facilities paid for with state funds as 'LEED Silver' or higher certified buildings". (California Executive Order S-20-04). In Arizona, state-funded buildings constructed after February 11, 2005 "shall meet at least the 'silver'...LEED standard." (Arizona Executive Order 2005-05). Currently, Washington and Nevada are the only two states that have passed legislation requiring government buildings to be LEED-rated (Libby 2005).

On occasion, an organization or professional will decide to erect a building based upon LEED qualifications, but will not pursue certification from the council. Even though they may have built the project according to LEED specifications, they may have no intention of applying to become LEED certified. For example, some agencies may not want to involve a third party in the process of constructing a building. Others may not wish to deal with the additional administrative work that traditionally comes with

submitting an application to the USGBC for certification. There are also additional costs that are associated with registering for LEED certification.

In order to LEED certify a building, the building must first be registered with the USGBC. Projects incur costs at this stage. The fee schedule for registration is as follows: For buildings less than 75,000 square feet, the fixed rate is $750 for USGBC members and $950 for non-members. For buildings that fall within the 75,000 - 300,000 square feet category, the rate for members is $0.01 per square foot and the rate for non-members is $0.0125 per square foot. Buildings greater than 300,000 square feet are charged a fixed rate of $3,000 for members and $3,750 for non-members. Once the building is registered, the certification phase may begin.

There are fees associated with certification as well. These fees are generally double the above numbers—i.e. for buildings less than 75,000 square feet, the fixed rate is $1,500 for USGBC members and $1,875 for non-members. For buildings that fall within the 75,000 - 300,000 square feet category, the rate for members is $0.02 per square foot and the rate for non-members is $0.025 per square foot. Buildings greater than 300,000 square feet are charged a fixed rate of $6,000 for members and $7,500 for non-members (USGBC Registration website 2005).

Actually putting together the documentation to send to the USGBC to apply for LEED certification has a price. There are administrative costs, including staff time and effort, that must be acknowledged. LEED consultant William Reed has estimated the cost of LEED documentation to be around $8 - $20 K, depending on the size and scope of the project and accuracy of the designs.

There are logical ways to keep the cost down, including getting an early start: "The earlier you start the documentation process, the less it will cost. The design consultants should consider the documentation part of their design process – it's minimally different than they would have done anyway. It's when they have to reverse engineer the work already designed that the costs increase" (Reed 2003). Another source has estimated the administrative cost to document, manage and report project compliance for LEED certification to range from $10,000 to $60,000 per project (Syphers et al. 2003, 6).

If the project manager does apply for LEED certification and the building is accepted as LEED certified, it will ultimately receive a plaque that may be mounted on the wall of the building. The agency or person responsible for the building project may use this designation as a positive source of marketing and public relations. The positive impact such a designation can impart can be cause enough for an application.

Massachusetts Public Policy Agencies and Drivers

In Massachusetts, there are several agencies responsible for implementing and encouraging sustainable design in public construction projects. The Commonwealth of Massachusetts Division of Capital Asset Management (DCAM), a state agency located in downtown Boston, is responsible for renovating, purchasing, and leasing buildings as well as new construction. State and community colleges, recreation facilities including parks, pools, and ice-skating rinks, office buildings, courthouses, and correctional facilities are all projects that DCAM manages. DCAM also manages the state's surplus

land as well as over 500 lease agreements. Projects follow the traditional planning, design, construction, and maintenance progression.

In addition to renovating older buildings that are in need of repair or updating, the agency also focuses on capital improvements that target energy use and efficiency. The Office of Planning, Design and Construction (OPDC) is part of DCAM and employees are responsible for conducting research and development for all phases of state building project management, design, and construction. Within OPDC are two services that provide organization to the agency: Programming and Construction and Design.

Construction is an industry that constantly taxes and challenges the natural world. To help minimize these effects, DCAM houses the Energy Efficiency and Sustainable Design Group (EESD). This group of five full-time staff members is responsible for integrating sustainable design practices into new building design, construction, and renovation as well as managing the state's energy contracts. Part of EESD's goals are to get designers and construction teams to focus on the entire life-cycle cost of a building instead of looking at individual, one-time costs and to reduce costs in the long run. Another goal is to reduce costs of sustainable design. The group works with project managers within DCAM who then connect with outside contractors, designers, and construction companies. This process is sometimes difficult because everyone does not share the same sense of environmental stewardship and concern. Sometimes, professionals on all sides of the industry are all working towards common environmental benefits. When this synergy occurs, sustainable design is easier to achieve.

Members of the Energy team also assist with interpretation of construction specifications. Mark Kalin, a specification writer for Massachusetts, has written a new

set of construction specifications—instructions and directives that developers, contractors, and architects must follow in their projects. These specifications provide guidance for everyone involved in the building project and were rewritten in 2005. These new specifications contain the sustainable design directions within the main text instead of in a separate appendix, making it easier for the builder to access them. The complete set of specifications is over 1600 pages long and took two years to complete (Kalin 2005).

Prior to this new set of specifications, construction guidelines were located in a document provided by DCAM known as Form 9: Instructions for Designers. These specifications were made available to the design and construction companies that conducted business with DCAM and had to be precisely followed. Within the general specification document, there is an appendix listing required and suggested sustainable practices: Appendix N – Sustainable Design Elements. This appendix contains instructions regarding sustainable design that must be followed as well as additional recommendations that construction professionals may or may not choose to follow.

For example, a specification for interior furnishings may dictate use of products that do not exceed a certain level of low-emitting VOCs. The additional recommendation may go a step beyond, suggesting even stricter compliance with a lower maximum. These additional recommendations are merely suggestions, not requirements. In order for developers to proceed successfully with a DCAM project, they must follow the instructions included in Form 9 and Appendix N. Failure to do so may result in loss of a bid for a project or early termination if procedures are not being followed during the project.

There are other agencies within the Commonwealth of Massachusetts that play major roles in the sustainable design process. These agencies include the Office for Commonwealth Development (OCD), the Executive Office of Environmental Affairs (EOEA), the Department of Environmental Protection, and the Massachusetts Technology Collaborative/Renewable Energy Trust Fund. Additional agencies play secondary roles, implementing sustainable design techniques but not necessarily participating in the creation of new policies. These agencies include the MBTA, Massport, the Massachusetts State College Building Authority, the Massachusetts Environmental Policy Act Office (MEPA, located under the EOEA), the General Services Administration (on the Federal level), the Department of Housing & Community Development, the Department of Education, and others.

Often, the support provided by the interaction of multiple agencies is beneficial. Sometimes the interaction of these agencies can actually be feeding beds of bureaucracy. For example, recycling construction and demolition waste, a policy that was created to advance sustainable design, frequently causes tense situations between the Department of Environmental Protection (DEP) and DCAM. A project manager from DCAM described a situation when construction workers were thwarted when trying to recycle construction waste. At issue was the purity of the material to be recycled. The DEP would not allow certain waste to be recycled because it was not separated to their standards—standards that were different from those of DCAM. To resolve this kind of obstacle, DCAM and DEP need to agree upon common standards.

Despite the issues that may arise as a result of agency overlap, there are many benefits that may be gained including added expertise and guidance. Integration between

agencies is an important aspect to successfully implementing sustainable design policies and programs. When executed well, this integration can play a key role.

Current Massachusetts and New England Initiatives and Policies: The New England Governors/Eastern Canadian Premiers Climate Change Action Plan, Massachusetts Climate Protection Plan, and The Massachusetts State Sustainability Program

In addition to Massachusetts state agencies affecting the future of sustainable design, there are also current Massachusetts, New England, and Canadian initiatives and policies that have helped guide recent efforts. The Conference of New England Governors and Eastern Canadian Premiers, established in 1973, consists of the Governors of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. From Canada, members include the Premiers of New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Québec. This conference was established to bring two nations together to encourage:

- The expansion of economic ties among the states and provinces;
- The fostering of energy exchanges;
- The forceful advocacy of environmental issues and sustainable development; and
- The coordination of numerous policies and programs in such areas as transportation, forest management, tourism, small-scale agriculture, and fisheries.

(The New England Governors and The Eastern Canadian Premiers website 2005)

In 2001, the Conference issued the New England Governors/Eastern Canadian Premiers Climate Change Action Plan. This action plan serves as a guideline to current policymakers, providing them with a solid reference marking the region's commitment towards reducing greenhouse gas, and examines the impacts of global warming and climate change. The main purpose of the plan is to reduce regional greenhouse gas

emissions. It aims to do so in such a manner that encourages a long-term paradigm shift rather than short-term, temporary patches. Regional objectives include:

- Reducing other pollutant emissions that threaten human health and the natural environment;
- Maintaining a reliable supply of reasonably priced energy within our region;
- Reducing dependence on energy imports to the region, thereby keeping energy dollars in our regional economy;
- Reducing our collective vulnerability to energy price shocks; and
- Providing 'early adoption' opportunities to enhance the competitive advantage of our region's technology industries.

(New England Governors/Eastern Canadian Premiers Climate Change Action Plan 2001, 4)

Action Items were listed in the plan. Each item applies to the guiding principles listed in the preamble of the plan. These items include:

- 1: The Establishment of a Regional Standardized GHG Emissions Inventory
- 2: The Establishment of a Plan for Reducing GHG Emissions and Conserving Energy
- 3: The Promotion of Public Awareness
- 4: State and Provincial Governments to Lead by Example
- 5: The Reduction of Greenhouse Gases from the Electricity Sector
- 6: The Reduction of the Total Energy Demand Through Conservation
- 7: The Reduction and/or Adaptation of Negative Social, Economic and Environmental Impacts of Climate Change
- 8: A Decrease in the Transportation Sector's Growth in GHG Emissions
- 9: The Creation of a Regional Emissions Registry and the Exploration of a Trading Mechanism

(Ibid., 8-18)

Massachusetts has acknowledged its role in the global community and identified a course of action through the Massachusetts Climate Protection Plan (the Plan), a document created through collaboration between multiple Commonwealth agencies that was released in 2004. The purpose of the document is to set long-range goals and pass along stewardship to future generations (Friedman 2004). The Plan's goals are identical

to the New England Governors/Eastern Canadian Premiers Climate Change Action Plan's goals. The Plan's priority items are also similar.

The Plan highlights many of the same issues that are affecting the world today and organizes recommendations into accessible chapters. Goals and solutions are presented in an attempt to ***do*** something to assuage the affects of unchecked development and progress rather than merely ***talk*** about the problems at hand. Massachusetts Governor Mitt Romney states, "Rather than focusing our energy on the debate over the causes of global warming and the impact of human activity on climate, we have chosen to put our emphasis on actions, not discourse" (Massachusetts Climate Protection Plan 2004, 3).

The Plan serves as the first step towards reducing greenhouse gases in addition to "improv[ing] energy efficiency in the Commonwealth…It presents a comprehensive set of near-term actions that will protect the climate, reduce pollution, cut energy demand, and nurture job growth through the development of sustainable energy resources and advanced technologies" (Ibid., 5). The Plan also serves as a commitment made by the Commonwealth to "implement the regional climate change plan adopted by the New England Governors and Eastern Canadian Premiers (NEG/ECP) in August 2001" (Ibid.). Included in the Plan are discrete overall goals for Massachusetts:

- Short-term: Reduce GHG emissions to 1990 levels by the year 2010.
- Medium-term: Reduce GHG emissions 10% below 1990 levels by the year 2020.
- Long-term: Reduce GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions as much as 75-85% below current levels.

(Ibid., 13)

Several of the chapters in the Plan relate to sustainable design elements to some extent, but one chapter in particular, "More Efficient Buildings: Reducing Pollution through Sustainable Design and Construction" deals specifically with green buildings and energy efficiency. The goal of this particular chapter is to "incorporate appropriate sustainable design techniques and approaches into all renovation and construction projects at state agencies and authorities. Promote such strategies in other public and private construction projects" (Ibid., 33). Massachusetts has committed to lessening the burden placed upon the environment from construction projects by investigating sustainable design technologies, programs and building philosophies. Environmental agencies within the state are intensifying efforts to incorporate sustainable design in future projects.

EOEA, the office of the Secretary who is in charge of all major state environmental programs, runs the Massachusetts State Sustainability Program. On July 23, 2002, the Program was established with the passing of Executive Order 438. The executive order created a Coordinating Council to govern and manage the program. Sixteen agencies and offices staff this council. Both the EOEA and the Executive Office for Administration and Finance serve as co-chairs for the council.

The Program's purpose is to "help state agencies minimize the environmental impacts of their operations and activities, and to promote innovative sustainable practices in Massachusetts" (EOEA State Sustainability website 2005). Additionally, the Program ensures "that state government remains in compliance with all environmental laws and regulations, while serving as a model by promoting sustainable practices that reduce the state's environmental impact and save taxpayer dollars" (Ibid.). There are monthly State

Sustainability Council meetings to keep members informed and active with efforts to achieve the goals of Executive Order 438. Also, the program has published a guide entitled, "State Sustainability Planning and Implementation Guide" in addition to other reports and documents. Reducing statewide greenhouse gas emissions, reducing waste, sustainable design and construction, investigating and purchasing of environmentally preferred products, energy and water efficiency and conservation, and integrated pest management are all activities on which the Council and Program focus their efforts.

The Commonwealth of Massachusetts Sustainable Design Roundtable

The Commonwealth of Massachusetts has a timely opportunity to become a leader in sustainable design and green buildings. The Commonwealth has already been active in this movement but more can be done to assure the public that the state is taking full advantage of the promise of green buildings. The Massachusetts Technology Collaborative, along with members of Massachusetts' government agencies such as the Executive Office of Environmental Affairs (EOEA) and the Division of Capital Asset Management (DCAM), have organized a statewide task force called "The Sustainable Design Roundtable".

This task force will assist in ensuring that conversations that were started with the Massachusetts Climate Action Plan continue between state agencies and is a direct result of the Plan. Members of relevant government agencies and the private sector design and construction industry will come together to create standards and develop practices that incorporate and encourage sustainable design. These "meetings of the minds" will help identify barriers and solutions as seen from the perspective of task force participants.

Expected deliverables from these meetings include recommendations and solutions to the identified barriers. In addition to these recommendations, a substantial amount of research will be conducted to support task force members' conclusions. This research is invaluable to the process as it provides a solid foundation and background from which to work. Part of this research includes looking at what other states and localities have accomplished in encouraging sustainable design and overcoming the associated barriers.

Many of the agencies that are working concurrently on sustainable design policies and issues have given presentations during Sustainable Design Roundtable meetings, held quarterly and attended by roundtable participants. These presentations allow roundtable participants to hear what the agencies are doing with regards to sustainable design. They serve as a source for positive agency integration.

For example, during a meeting to discuss the present and future of sustainable design in Massachusetts, Barbara Boylan, Director of Design at the MBTA, gave a presentation outlining the ways the MBTA has made a concerted effort to become more environmentally conscious. In her presentation, she mentioned a new fleet of low-emission transit vehicles was replacing diesel buses. She also mentioned the MBTA has participated with OCD on transit oriented development and that in general, the MBTA is making efforts to be environmentally conscious and that they are attentive to following sustainable design (Sustainable Design Roundtable Meeting Notes 2005, 6).

Aisling Eglington, MEPA (Massachusetts Environmental Policy Act) Analyst, also made a presentation at this meeting explaining MEPA's role in encouraging sustainable design. Eglington said that "MEPA is planning on creating guidance

documents for developers/consultants to ensure sustainable design is adequately addressed" and that "there are opportunities within MEPA to encourage sustainable design and some MEPA provisions that can be used to promote sustainable design." She continued, stating, "MEPA encourages integrated planning at an early stage, interagency coordination, public involvement, alternatives analysis, requirements to avoid and minimize impacts, mitigation requirements, and is broad in scope to facilitate consideration of additional options (i.e. looking at all options before choosing one)" (Ibid.).

Upon further research, Eglington was able to provide more in-depth insight into the MEPA process and how it may alter the state's sustainable design record. Some background on the MEPA process may be helpful. The MEPA Office is an agency of the Commonwealth of Massachusetts. It is part of the Executive Office of Environmental Affairs (EOEA). A description of the purpose and application of MEPA follows:

> The Massachusetts Environmental Policy Act - MEPA - requires that state agencies study the environmental consequences of their actions, including permitting and financial assistance. It also requires them to take all feasible measures to avoid, minimize, and mitigate damage to the environment.
>
> MEPA further requires that state agencies "use all practicable means and measures to minimize damage to the environment," by studying alternatives to the proposed project, and developing enforceable mitigation commitments, which will become permit conditions for the project if and when it is permitted.
>
> MEPA applies to projects above a certain size that involve some state agency action. That is, they are either proposed by a state agency or are proposed by municipal, nonprofit or private parties and require a permit, financial assistance, or land transfer from state agencies.
>
> (MEPA website 2004)

Additionally, the MEPA review process ensures that:

> A project proponent studies feasible alternatives to a proposed project; fully discloses environmental impacts of a proposed project; and incorporates all feasible means to avoid, minimize, or mitigate Damage to the Environment as defined by the MEPA statute. After completion of the EIR (Environmental Impact Report) process, the state permitting agencies (in this case the Massachusetts Highway Department and Department of Environmental Protection) must then issue substantive decisions on whether or not to permit those aspects of the project within their respective jurisdictions.
>
> (Certificate of the Secretary of Environmental Affairs on the Draft Environmental Impact Report, 2002)

Eglington added, "The purpose of the MEPA review is to make sure there is enough analysis for the state permitting agencies to make their decisions. And so the public has enough information to make comments" (Eglington, interview with the author, 2005).

An interesting issue to explore relates to the extent that MEPA has to encourage sustainable design. Does MEPA have the ability to enforce any laws to increase the number of green buildings in the state? At what stage does MEPA encourage sustainable design? There are specific provisions of MEPA that can be used to promote sustainable design. Those provisions are:

- *Section 11.07(6)(f)3* Requires an analysis of alternatives 'in light of…executive orders and other policy directives'
- *Section 11.07(6)(f)5* Requires discussion and rationale for alternatives ruled out
- *Section 11.07(6)(f)h* Requires assessment of impacts to include 'short and long-term impacts for all phases of the project…and cumulative impacts'
- *Single EIR provision as an incentive:* Includes criteria that 'planning and design of the project use all feasible means to avoid potential environmental impacts.'

(Eglington 2005)

None of these provisions may force sustainable design, but they can be used to require consideration of alternatives and environmental impact reductions.

MEPA has the power to "strongly recommend or encourage" sustainable design. This encouragement may be found in certificates issued by MEPA either after the ENF (Environmental Notification Form) is submitted or after the EIR is submitted, depending on what stage the developer is completing. The certificate serves as a guide to the developer telling them if they need to continue the process with an EIR or if the ENF is enough. MEPA also has the power to add conditions to the Certificate. At the end of the certificate, there is a summary of the major issues applicable to the project that frequently include traffic studies, storm and wastewater management, open space and habitat conservation, and sustainable design.

MEPA analysts like Eglington have the opportunity to enter their decisions via these certificates. Eglington mentioned that she always commends developers who include sustainable design techniques in their proposals. She also always tries to make recommendations for the developer to consider initial (if they have not included any) or additional realistic, feasible options for sustainable design techniques. Subsequently, sustainable design techniques could be applied to any project that crosses MEPA's threshold: "Pretty much any project that comes in, you could find some way to highlight a sustainable approach" (Eglington, interview with the author, 2005). This is more evident for projects involving mixed use, large-scale residential, and commercial where one might encourage transit-oriented development, although less so for a single-family residence.

An example of the language commending and encouraging sustainable design follows:

> The proponent has committed to incorporating components of sustainable design into the…project to minimize environmental impacts and reducing [sic] operating

> costs over the lifetime of the project. In addition to water conservation measures and the TDM program described above, the proponent is planning to construct a 20,000 sf roof garden on top of the subsurface garage. The proponent has also committed to minimizing light pollution across the project campus, installing energy efficient equipment of heating, ventilation and air conditioning, and incorporating occupancy sensors and other measures to minimize electricity use for lighting…Other sustainable design elements that the proponent has incorporated into project design include an emphasis on natural light and ventilation, below-grade parking to reduce impervious area, and use of xeriscaping to reduce irrigation needs…I commend the proponent for its commitment to sustainable design and encourage the proponent to consider other aspects of sustainable design including solid waste reduction; a user-friendly recycling system; an annual audit program for water consumption, waste streams, and use of renewable resources; use of sustainable building supplies and materials; LEED Certification; and reuse of wastewater.
>
> (Certificate of the Secretary of Environmental Affairs on the Draft Environmental Impact Report 2005)

Eglington explained further that, "[We] can incorporate language that says we strongly recommend or encourage you to look at sustainable design options…but they do not have to do it. Further along, a DEP permit might require them to implement a water conservation plan or something like that" (Eglington, interview with the author, 2005).

Whereas the certificate decision is binding and may include added conditions, these recommendations within the certificate are not contingent upon anything and are merely there for encouragement. Alternatively, if the developer's proposal includes sustainable design techniques, they would be required to stick to them if their proposal is accepted. If they did not follow through with their stated sustainable design intentions and were caught, they may be required to re-enter the MEPA process and file a Notice of Project Change. A third party such as a town or individual could also submit the Notice saying the project is not doing what it stated (Ibid.).

Additionally, there is a hook if a permit is involved. "If a client has submitted an EIR and has made specific commitments to mitigation—we can reiterate that in the

certificate to enforce their commitment. Follow up and monitoring is important. MEPA doesn't require the follow up so they could slip through. But the permit requirement level can require mitigation" (Ibid.). Therefore, another level of enforcement may be applied by the permitting agency.

Another way to encourage sustainable design through the MEPA process is via the alternatives analysis. Developers are required to provide alternatives to the main proposal in their ENF and EIR. "I think [the alternatives analysis] is one of the key parts of the MEPA process...that could serve as a hook for sustainable design" (Ibid.). For the alternatives analysis, developers are asked to look at on- and off-site alternatives and alternative layouts. "This is the opportunity to say, 'What are the other alternatives for design of the building?' [They could use] green building as the alternative to the standard approach" (Ibid.).

Additionally, some of MEPA's power is tied to jurisdiction. Eglington explained, "If the project is financed through the state, MEPA has broad jurisdiction. If there is no state funding involved, our jurisdiction is limited to the subject matter of the permit. For example, traffic management, wastewater. Some permits give broader jurisdiction than others" (Ibid.).

Eglington mentioned that MEPA will soon issue guidance documents to developers that will hopefully assist them in creating higher quality ENFs and EIRs. These guidance documents will likely direct developers to resources and tell them what they can do to meet some of the MEPA requirements while avoiding and minimizing impacts by looking at sustainable design and the Office for Commonwealth

Development's Sustainable Development Principles[2]. Eglington also mentioned that it would be helpful to incorporate the list of sustainable design guidelines as an actual part of the guidance documents (Ibid.).

The New England Governors/Eastern Canadian Premiers Climate Change Action Plan's influence is evident by the identical goals and similar priority items adopted by Massachusetts in its own Climate Action Plan. The LEED infrastructure put in place by the USGBC serves as a solid foundation on which many policies may be based. And without the leadership provided by DCAM, the state of Massachusetts' efforts to encourage sustainable design may be limited to the private sector. Instead, the public agency has stepped up its efforts to improve the state's environmental situation. Another Massachusetts agency, MEPA, offers opportunities within the MEPA process to encourage sustainable design and in the future, could potentially require sustainable design technologies.

The relationship between the policies and the agencies that create, implement, and enforce them is both symbiotic and synergistic to the extent that the total effect of the agencies working together is greater and more powerful than the sum of individual efforts. DCAM might not be making as strong a push for sustainable design if not for the Massachusetts Climate Action Plan and the State Sustainability Program, both of which incorporate executive-level directives. The new set of construction specifications might not stress sustainable design as much as they do if not for DCAM's drive. Finally, the Sustainable Design Roundtable's role was predicated around the need for

[2] The Office for Commonwealth Development's Sustainable Development Principles may be found in Appendix iii.

recommendations for overcoming the barriers to sustainable design, a mission statement, and organizing a statewide stance on sustainable design.

Massachusetts is moving forward with some success toward sustainability in planning, design and construction of public buildings, but there are many barriers that require innovation and wide-ranging cooperation to move beyond. With in-depth research and consensus approaches that are acceptable to the public and the affected industries, these barriers may be overcome.

Chapter III – Methodology: Sources, Resources and Other Useful Texts

This chapter of the thesis will explain why certain barriers were chosen for more detailed analysis. An overview of several key resources including books, journal articles, and reports is included as well as interview protocol. Finally, this chapter will provide insight into case study and vignette methodology. The vignette is part of the effort to draw larger lessons from a single project.

Discussion of Barrier Selection

There are many barriers to wider adoption of sustainable design to the public sector. In order to be more productive and ensure a more successful Roundtable process, Roundtable organizers narrowed the list of barriers from over a hundred[3] (gathered during a brainstorming session) to seven primary barrier categories into which most of the brainstormed barriers could be categorized. For the current Roundtable, concentration will focus on these seven barriers with the hope of providing a final report with recommendations for solutions to the governor.

The original Sustainable Design Roundtable organized by the Green Roundtable in 2002 listed five barriers to sustainable design: Education; Capital v. Operating; Bidding and Awarding Process; Planning, Vision and Leadership; and Financial and Other Incentives. The subsequent Roundtable organized by DCAM and EOEA and funded by the MTC expanded and changed some of the barriers on that list to include seven barriers: Education and Training; Capital v. Operating Cost; Bidding & Awarding

[3] This list is available in Appendix ii.

Process; Vision & Leadership; Incentives; Sustainable Design Metrics; Standards, Codes & Regulations. Lessons learned from the first attempt at a roundtable led to the expansion of certain barriers.

Since this thesis focuses on the barriers to sustainable design, concentrating on the barriers that the Roundtable has already identified is a logical place to start. They have already been through an intensive process to brainstorm, categorize, and narrow down an extensive list of barriers. For this thesis, Education and Training, Financial Barriers and Incentives, and Vision and Leadership were the barriers chosen for in-depth study[4]. These barriers were chosen because they were the ones with the most potential for a compelling analysis of their implications and opportunities for policy intervention toward the goal of enhancing the adoption of sustainable design by the public sector. The chosen barriers all have tangible components that will lead to more absorbing discussion and analysis.

The Financial Barriers and Incentives category is actually a combination of the Incentives barrier and aspects of the Capital v. Operating Cost barrier. This barrier was chosen for this thesis in part because the cost of sustainable design has been and continues to be a widely debated and misunderstood issue area. To explain the issues that arise, different reports written about the cost and benefits of sustainable design will be presented in Chapter IV. Additionally, inclusion of this barrier allows for a discussion of life cycle cost analysis (LCA). LCA is one of the most important aspects in proving the economic feasibility and worth of sustainable design. LCA takes all the mass and energy flows necessary to create a product a system into consideration and combines all the

[4] Due to a lack of time and space, it would be difficult to include analysis on all seven barriers.

factors for a final analysis of the manufacturing, use, and disposal of a product or system. Because of the role LCA plays in defining both economic and environmental consequences, it was important to include it in the thesis.

Since financial barriers and education and training barriers often overlap, it is no surprise that LCA is also part of the education process. LCA may play a role in changing people's misconceptions regarding sustainable design by providing a more-inclusive perspective of all economic and environmental factors involved in creating a good or system. It can be an eye-opening experience for some. Therefore, it is important to include it in the Education and Training barrier as well.

There are additional reasons to include the Education and Training barrier. One of the more frequently raised issues concerning sustainable design is consideration of the maintenance of a building and knowledge of its materials and systems. This issue not only relates to education, but also to financial barriers as well as maintaining a building with less familiar materials and systems may be more costly. Furthermore, education may allow a person to become more open to different philosophies and technologies. Education is one way to access people reluctant to change. Education and Training addresses one of the most pervasive obstacles to sustainable design: mindset.

Vision and Leadership was chosen as a barrier that deserved more in-depth study because without it, any significant push for sustainable design methods to be adopted by a state may be weakened. Examples presented in upcoming chapters will prove that such leadership may be critical in a change-seeking process. Evaluation of Vision and Leadership also allows for an investigation about the importance and usefulness of mission statements for successful campaigns.

Many aspects of the remaining barriers that were not a main focus of this thesis will actually be incorporated into discussion under other barriers. For example, Sustainable Design Metrics will be discussed in Chapter V. Elements of the Bidding and Awarding Process are discussed in the final Recommendations chapter. Parts of the Capital v. Operating Cost barrier, including life cycle cost analysis, will be included in the Financial Barriers and Incentives section. Other components of this barrier, including discussion on the way the State budgets and finances construction projects, was omitted. Aspects of the Standards, Codes and Regulations barrier are integral to discussions about building code and specifications throughout the thesis and in the final chapter.

Research Methods and Key Resource Review

In order to gather the most comprehensive information about the barriers to sustainable design and their possible solutions, introductory literature was collected and read. Informal interviews and discussions were conducted with professionals involved in the building and construction industry. These conversations, along with meetings with the thesis advisor, were beneficial in narrowing down a topic and thesis question. A subsequent stage of research was conducted based on insight gained during interviews and preliminary reading.

Research for this thesis consisted of literature searches both on-line and in libraries, reviews of meeting notes, and interviews. The internet was a great source of information and proved to be invaluable when looking up vocabulary and researching current information on various states' efforts to institute sustainable design and green building policies. Most of the material found online may be considered first-rate articles,

reports, and research authored by reliable academic sources and journalists that happened to be available online. Additional online research was culled from government websites like the EPA and DOE. Frequently, legislation and Executive Order language was quoted from state websites. Non-profit websites, like the NRDC, the Pew Center and The Green Roundtable were also utilized.

Magazine and newspaper articles helped flesh-out the issues at hand in various locations nationwide. Economic studies were also useful as they provided proof in the form of facts and numbers that were useful for documentation purposes. Caution was taken when analyzing conclusions and data from these economic studies—questioning information sources and a healthy bit of skepticism is always encouraged. Pamphlets and documents prepared and published by the Commonwealth of Massachusetts were key to illustrating past and present efforts such as the City of Boston's Roundtable committee process and the Massachusetts Climate Protection Plan.

Another helpful resource was the sustainable design library housed in the offices of the Division of Capital Asset Management. This library contains an exhaustive collection of articles, reports, and commercial information about sustainable design technologies, philosophies, and products. Half of the information in the library is organized by Construction Specification Institute (CSI) standards which are extremely useful when conducting research as the information is categorized into the major areas of construction like finishes, mechanical systems, electrical systems, plastics, wood, metal, masonry, and concrete. The other half of the library materials are general, authoritative documents that investigate many aspects of sustainable design. Many of the articles in the library have been collected over a period of years, providing both up-to-date

information as well as an interesting history of the issues, products, and progress of the sustainable design movement.

The Massachusetts Sustainable Design Roundtable was another source of primary information. The thesis author attended many individual task force working group meetings and took detailed notes. These notes were useful as they gave perspective from a more microscopic ground level. Additionally, notes taken at the more comprehensive Sustainable Design Roundtable were equally useful.

There were several books and articles that were especially helpful in gaining a background in sustainable design issues. For background information on sustainable design, "Cradle to Cradle" by William McDonough and Michael Braungart was an innovative and thought provoking resource. William McDonough is sometimes regarded as the "father of sustainable design". Eco-efficiency, diversity and monoculturalism, regulation, throwing things "away", recycling versus upcycling, the equity, economy, ecology triangle, and the concept of being "less bad" were all discussed.

These concepts are generally broad and more abstract than other resources that may describe more tangible concepts such as renewable energies (e.g. photovoltaic panels for capturing sunlight, wind turbines for wind power), green roofs, and daylighting, common sustainable design ideas. The book's importance in the field of sustainable design is unquestionable and provides a strong framework for learning sustainable design concepts and philosophies. "Natural Capitalism: Creating the Next Industrial Revolution" by Paul Hawken, Amory Lovins, and L. Hunter Lovins provided additional background information in a similarly regarded text.

Another source that is frequently cited in other sustainable design research is "Green Building Costs and Financial Benefits" by Gregory H. Kats. This report identifies and seeks to dispel the common belief that building green costs dramatically more (30-40%) than conventional building techniques. Data provided in the report serves to discredit the myth that "green buildings are commonly perceived to be a lot more expensive than conventional building and often not worth the extra cost" (Kats 2003, 3).

A similar study by Lisa Fay Matthiessen and Peter Morris titled, "Costing Green: A Comprehensive Cost Database and Budgeting Methodology" investigates budgeting, feasibility and cost as well as analyzes data on the cost of sustainable versus conventional buildings. The authors of the study contend that multiple factors contribute to choosing to build sustainably, but acknowledge this report concentrates only on construction costs. Construction costs are what most interest contractors. According to the authors, "It is our experience that it is the construction cost implications that drive decisions about sustainable design" (Matthiessen and Morris 2004, 3).

A study conducted by the U.S. Department of Energy, Federal Energy Management Program (FEMP) in collaboration with the Interagency Sustainability Working Group provides a national perspective on the cost of green design.

> Through integrated design and use of sustain-able materials and technologies, the first cost of a sustainable building can be the same as or lower than that of a traditional building. Through good planning and by eliminating unnecessary features, it is possible to offset the cost of more expensive sustainable features that not only meet environmental goals, but also result in lower operating costs…The Pennsylvania State DEP Cambria building is a good example of how first costs were reduced and long term value increased through integrated energy and design decisions. When designers first proposed an upgrade to high efficiency triple-glazed, double low-e windows, the developer balked at the $15,000 increase in cost. He was won over, however, when they were able to demonstrate that this upgrade would allow them to eliminate the perimeter heating zone for a savings of $15,000, downsize the heat pumps for another

> $10,000 savings, and gain $5,000 worth of additional leasable space as a result of smaller equipment and ducts.
>
> (U.S. Department of Energy 2003, 5)

The report's findings mirror the sentiments of David Berkowitz, Assistant Director of Design at DCAM. In an interview, Berkowitz mentioned that the State is certainly interested in investing in sustainable design technology like triple-glazed glass or low-emissivity glass as long as the product in question has a good maintenance record and a reputation for actual savings (Berkowitz 2005).

In another source, the Commonwealth of Massachusetts reported on its initial attempts in 2002 at creating a sustainable design roundtable to investigate the most critical barriers to building green. This document provides further background information about these common holdups. The more barriers and complications that are faced, the less likely designers and contractors may incorporate green design into their buildings: "Often, the process can be long and complex and the incorporation of sustainable design requirements is commonly perceived as further complicating the process" (Commonwealth of Massachusetts Sustainable Design Roundtable Meeting Notes 2002, 3). These barriers certainly play a role when contractors consider how to proceed with incorporating sustainable design techniques.

Case Study Explanation and Interview Protocol

The progression of the thesis from an introduction to sustainable design to discussing barriers and policies provided a natural segue for a narrative. It is logical to include information about a current public sustainable design project towards the end of

the thesis, after many facts and recommendations are presented. This ordering allows for the reader to become educated and to then see how the described barriers affect buildings and people in a real-world situation. Since the thesis is about buildings developed and financed by state agencies or other public entities, it is important to read about the progression of a public sustainable design project rather than a private project.

A choice had to be made about how to include this narrative in the thesis. It could have taken shape as a case study or as a vignette. The decision was made to explore sustainable design issues in Massachusetts through the use of an abbreviated case study, or a vignette. This conclusion was reached by researching the definition of case studies and vignettes, acknowledging the associated lengths, and analyzing the benefits each would provide.

There was not enough space in the thesis to accommodate a discussion of barriers to sustainable design, potential policy solutions, and a lengthy case study so the third feature, a full-length case study, was modified. It was important to retain certain elements of case study methodology while holding the length to about 10 pages. This could be achieved via a vignette.

There are countless case studies about sustainable design projects in circulation. They generally inform readers about the quantitative data and qualitative history, present, and future of the project. Case studies can range greatly in length but are generally somewhat lengthier and more in-depth than a vignette. The shorter vignette was the best option to highlight the issues and processes involved in taking a publicly constructed green building from design to construction to maintenance while keeping the length at a minimum and incorporating key case study techniques.

There are certain scenarios that require the use of case studies. "In general, case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" (Yin 1994, 1). Case studies do not require control over behavioral events but do focus on contemporary events (Ibid., 6). The design and construction process of the Cape Cod Community College's Technology building is a contemporary event. "How" and "why" the building was designed and constructed as it was are both questions that are addressed. These are all elements of a case study that were retained and included in the vignette.

Interviews were also an important source of information for this project in general and for the vignette. To prepare for the interviews, Tufts University's Institutional Review Board (IRB) approved a list of interview questions and reasons for research. Additionally, the Human Participants Protection Education for Research Teams online course, sponsored by the National Institutes of Health (NIH), was completed in accordance with IRB protocol.

Interview subjects included construction company contractors, resident engineers, project managers, and architects. Prior to the start of the interview, all participants were briefed on the purpose and benefits of the interview, confidentiality, their rights, and what to do if they wished to skip any questions or retract any statements made during the interview. They were also debriefed after the interview and given contact information for the primary researcher in case they needed to get in touch to withdraw or correct a statement. Interview answers were compiled and organized into the resulting vignette on

the state's first LEED certified project: the Cape Cod Community College Technology Building.

Additionally, some interviews were conducted via email communications. These interviews primarily provided information about the analysis of sustainable design policy. One interviewee in particular provided excellent perspective on the use of construction specifications and their connection with sustainable design in public construction in Massachusetts.

Chapter IV: Barriers to Sustainable Design in Massachusetts

By presenting a discussion on the barriers to sustainable design in Massachusetts, this chapter attempts to answer the first part of the main thesis question, "What are the barriers to sustainable building in public construction projects?" To ensure success of the Sustainable Design Roundtable, organizers chose seven barriers on which to focus efforts. There are a number of other barriers that impede sustainable design—in fact, there are over a hundred. The full list of barriers that emerged from a brainstorming session (part of the original Roundtable effort in 2002) may be found in Appendix ii.

Three years after the first attempt in 2002 to establish a Sustainable Design Roundtable, the effort to establish Massachusetts as a leader in sustainable design was renewed with a grant from the MTC that allows for a 20-month roundtable process. This time, there is money available for the individual barrier working groups to hire consultants to assist them with research and for another consultant to be hired to help lead this roundtable process. For this renewed effort, the final seven barriers addressed by the 2005 roundtable are Education and Training; Capital V. Operating Costs; Bidding and Awarding Process; Vision and Leadership; Incentives; Sustainable Design Metrics; and Standards, Codes, and Regulations.

Education and Training

There are multiple reasons why education and training are important to a successful sustainable design program. In order to get building professionals onboard and increase enthusiasm among laypeople, it is necessary for people to be educated about

the pros and cons of green building. Providing people with educational material allows them to make their own informed decisions.

One of the most common conclusions people make about sustainable design is that the costs are prohibitive or at least significantly more than traditional construction methods. There have been a few studies that have come out recently claiming that green building, on average, costs less than 2% more upfront (Kats 2003, 3). When the long-term lifecycle of the building is considered, this number may decrease, making it more economically sound to build sustainably.

This particular quandary will be discussed more in-depth in the Financial Barriers and Incentives section. The lesson here is that with education and communication between all involved parties and the public, this information can be disseminated on a wider scale. When people are properly educated, better decisions may be made.

To make these decisions, widespread access to resources and information is necessary. Without thoughtful, logical organization and easy access, attaining information might become too much of a burden and people may not be inclined to impart the necessary effort. Having multiple resources in one location would help resolve this issue.

In the Boston area, a resolution to this issue is in the works. The Green Roundtable, a non-profit organization dedicated to championing the green building cause, has neared completion on a sustainable design resource library that should be online by September 2005 (Green Roundtable website 2005). The resource center, called Nexus, will house exhibits on green design and construction, a resource library, showroom floor, educational opportunities, and social events. Admission to the center, which will be

located in downtown Boston, close to many public transportation options, will be free (Green Roundtable Newsletter 2005).

It is not enough to simply make information available. The information should come from a trusted source, and most importantly, it must be accurate. The opening of the Nexus center should create an access point for interested parties to find accurate, honest information on sustainable design.

While considering the resource center as a solution to the lack of accessible information and materials on sustainable design, the issue that there will still be an information gap persists. It would be irresponsible to urge the governor to adopt green building legislation, potentially requiring all Massachusetts public facilities to be built to LEED standards, without a solid, well-informed foundation of facts and figures. Since the green building movement is relatively new (within the last twenty years), it is necessary to be cautious and always ask questions. If a few studies claim green building increases costs by 2%, and a few other studies claim the cost increases are more at a 20% range, how will the roundtable know which claim is the correct one?

There is an information gap in sustainable design with regards to costs because critical information is not readily available. Examining the life cycle cost of a building also plays a role and can be tricky. It is not as easy to determine the exact overall life cycle cost savings a building may accumulate over the course of twenty years. Forecasts may certainly be made. Because of this, and because the green building movement is not robust in terms of years, it may be more difficult to obtain long-term data. This is where case studies and research play a critical role.

Many municipalities and a few states are moving forward with legislation requiring green buildings. These cities and states may serve as examples for the Massachusetts Sustainable Design Roundtable. Additionally, the Massachusetts Technology Collaborative has begun work on a database cataloging case studies and qualitative information on green projects that they have funded.

Money, specifically funding for education and training, is also a crucial element to this barrier. Training programs may teach people the benefits of sustainable design and also can be extremely useful in educating building managers and operators about how to most efficiently run their buildings.

Training programs in the form of subsidies to help professionals become LEED certified are conducive to promoting sustainable design education. There is an initial cost for a professional trying to become LEED certified. Aside from the cost of taking the test, the candidate may need to take a workshop that costs hundreds of dollars. A subsidy for these workshops and the test could assist professionals who are just starting out in their careers. A result of this type of program might be the increased availability of LEED certified professionals.

Additionally, there is a credit that may be earned when applying for LEED certification for a building. The credit is awarded if a LEED Accredited professional is a "principal participant of the project team" (Oak Ridge National Laboratory). The intent of this credit is "To support and encourage the design integration required by a LEED Green Building project and to streamline the application and certification process" (Ibid.). This is generally considered an easy credit to earn, but this credit relies on the accessibility and affordability of LEED Certified professionals.

Insufficient/lack of communication is another aspect to the education and training barrier. This includes a deficiency in the integration of various design and construction professionals (like architects, contractors, building users and owners, and engineers). When information sources can not connect with an audience, a rift is created and there is a noticeable lack of reliable information. Politics, turf and authority issues, and competing priorities round out this list of causes for this barrier.

Members of the Education and Training group raised the question: What is the state's role in design/construction professionals' training and education? This is an important question since this task force concentrates on the state's efforts and will produce a document with guidelines and recommendations on sustainable design to the governor. The question leads to further discussion on whether or not the state should organize classes or have an incentive for people to become LEED Certified. If the state offered a training class or incentive to become certified, it might make economic sense for people to strive for this rating. However, the rating provides its own benefits and it is not clear if the state should provide additional incentives or assistance.

An initial recommendation made by the Education and Training working group is to record lessons learned and case studies, perhaps in a database. Proof of green building successes could be tracked in such a tool. The MTC has begun work on a High Performance Database that gathers both qualitative and quantitative data in the form of case studies from projects they have helped fund. This database could become an innovative leader for future data recording as well as provide valuable experience in how to organize such data and make it available to the public. This recommendation will be explored in greater detail in Chapter V.

Providing training on operations and maintenance, in addition to increasing the life span of a building, allows owners and managers to operate the building in the most efficient fashion. This recommendation is akin to commissioning, the stage in the building process when systems like heating, ventilation, and air-conditioning, security, fire, and others are coordinated and are made sure to be in working order. If a system is improperly installed or is not in accordance to what the design specifications called for, the commissioning stage is when that type of error should be caught. Sometimes, construction agents may change the system at the last minute due to costs or availability, but if a specific system was ordered based on its efficiency and is not installed, that is cause to pause the construction process.

Commissioning agents are professionals who complete this stage in the building cycle. It is also important for building managers to understand the way the systems work in conjunction with each other in addition to understanding how to operate them most efficiently. It is possible for a building to be built with multiple sustainable technologies only to have the building operator not understand how to run the building smoothly or take advantages of its abilities to conserve energy or provide health benefits. With additional training, building managers would have a better chance of gaining this knowledge.

During an interview with David Berkowitz, Assistant Director of Design at DCAM, he made it clear that he thought the main barrier to sustainable design was maintenance: "The major issue is maintenance. That's where all these systems fall apart" (Berkowitz 2005). He continued, explaining that even if commissioning agents come into the building and make sure the systems are operating the way they were intended,

and are integrating well with each other, the commissioning agent at some point leaves the building and is no longer part of the project:

> After the agent leaves and DCAM leaves, who do you have? You have unionized employees at low pay grades who don't know what they are doing, operating these high-tech systems. If you can have a system that doesn't require any human input, then great. It's not just education and training…it's the whole culture. We [DCAM] provide people with surprisingly good buildings. Private industry is willing to pay $100K to have someone maintain a building. The state is willing to pay $40K.
>
> (Ibid.)

The discrepancy between pay grades that David mentioned is important to note. David provided an example of where this lack of knowledge and expertise can lead. He described a situation currently found on Long Island in Boston Harbor. The City of Boston erected a wind generator on the island at the firefighting training academy. Over the past ten years, the windmill has not rotated once (Ibid.).

Achieving agreement on standards, working towards a common long-term vision and language, and increasing public outreach and marketing strategies are additional recommendations. These recommendations tend to overlap with other working groups such as Vision and Leadership. As a result, working groups in the Sustainable Design Roundtable are encouraged to set up meetings with one another to explore the overlap, compare notes, and participate in discussions to eliminate confusion and cash in on the knowledge each group brings to the table. Synergies that may be outcomes of these meetings may help create even better recommendations.

Financial Barriers and Incentives

Another major barrier affecting the philosophies and abilities to encourage sustainable design is incentives and financial barriers. An incentive is defined as "something, such as the fear of punishment or the expectation of reward that induces action or motivates effort" (dictionary.com). Incentives can be positive or negative. Positive incentives can come in the form of a tax credit, a promise of being able to move through the zoning and permitting process more quickly, or increasing FAR (Floor Area Ratio)[5] for projects that meet certain qualifications. For example, in Arlington VA, bonus density and/or height is awarded for projects that meet LEED certification standards (Arlington Virginia Green Building Incentive Program website). Chicago also offers such an incentive: "The City offers density bonus for including green roofs in downtown buildings. They are also considering expedited permitting process for green buildings" (Building Design and Construction Magazine 2004, 23).

Negative incentives are more akin to punishment for certain actions or inactions. An example of a negative incentive would be having to pay extra money if a homeowner wanted to install something that is blatantly not environmentally conscious, like in Pitkin County, Colorado where Aspen is located. There, a "carbon tax" is charged for those who exceed a predetermined energy budget with projects like in-ground heated pools and heated driveway installations.

Randy Udall is the director of the Community Office for Resource Efficiency (CORE), the office that runs the carbon tax program. CORE's website states that "90% of the electricity we use in Colorado comes from burning coal" (CORE home page,

[5] "'Floor Area Ratio' is the total floor area on a zoning lot divided by the lot area of that zoning lot. For example, a building containing 20,000 square feet of floor area on a zoning lot of 10,000 square feet has a floor area ratio of 2.0." (New York City Department of City Planning Zoning Proposal Glossary, (http://www.nyc.gov/html/dcp/html/zone/glossary.html)

2005). The county is working to change that statistic by implementing and maintaining the "Renewable Energy Mitigation Program" (REMP) program. Under this program, homeowners are charged "up to $100,000 if they exceed the energy budget allotted to their property by the local building code" (Clifford, 2002). Udall then invests the money that is collected under REMP in energy efficiency and renewable-energy projects (Ibid.).

Detractors of the program argue that the REMP program "can be criticized for legitimizing wasteful energy use, allowing the rich in Aspen and Pitkin County to do as they please" (Ibid.). This criticism is on-target, but the program does also provide a service and directs money to worthy environmental causes. Some of the local projects that have been funded with the money collected via the REMP program are:

- "Zero-interest loans for homeowners who want to install solar hot water heaters and photovoltaic (PV) panels.
- A cash payment for grid-connected PV systems. 'We pay you 25 cents per hour for all the energy you produce for the first four years,' says Udall. This program has produced more grid-connected PV systems (20) in the local electrical co-op than in any other co-op in the nation.
- A solar hot water heater for a local affordable-housing development.
- Installation of a cogeneration turbine at the Aspen community pool and ice rink complex, which will increase the building's efficiency from 35 to 75 percent.
- A car-sharing program that allows participants the occasional, cheap use of a car when they need it, without actually having to own one."

  (Ibid.)

Additional success is identified by the city as their percentage of renewable energy use has increased. The City of Aspen now claims that they get 57% of their electricity from renewable sources at no additional cost to residents (City of Aspen Environmental Health Department website). The renewable energy comes from wind

farm and hydroelectric sources. The City of Aspen example is useful because it illustrates the potential for a successful incentive (or disincentive) program.

Perception that Green Costs More: Green Building Cost Studies and Reports

Within the construction industry, there are professionals who think that building with sustainable design technologies inherently costs more. There are also people who believe that while sustainable design may cost more up-front, overall, the benefits and energy saving measures, along with the health and wellness factors, combine to create savings over the course of several years.

There have been several studies over the course of the last decade that investigate and quantify just how much sustainable design costs. There are some costs that are not easily quantifiable though, like employee morale, health, and wellness. Even though the cost of building a green building may be presented, there are still external issues that may make a difference in the final cost.

Greg Kats has completed a study that serves to dispel the myth that sustainable design costs significantly more. In his report, Kats proceeds to explain that while building green may indeed incur more costs up-front (an average of 2%), it is usually a result of the more intensive design and construction process that is required in sustainable design projects:

> In order to determine the cost of building green compared to conventional design, several dozen building representatives and architects were contacted to secure the cost of 33 green buildings from across the United States compared to conventional designs for those same buildings. The average premium for these green buildings is slightly less than 2%, or $3-5/ft2, substantially lower than is commonly perceived. The majority of this cost is due to the increased architectural and engineering (A&E) design time, modeling costs and time

> necessary to integrate sustainable building practices into projects. Generally, the earlier green building features are incorporated into the design process, the lower the cost.
>
> (Kats 2003, 3)

Overall, the long-term, or lifecycle cost of the building also must be considered.

Kats also investigates positive qualitative impacts that are more difficult to measure such as increased productivity, morale, and better employee health: "Green buildings provide financial benefits that conventional buildings do not. These benefits include energy and water savings, reduced waste, improved indoor environmental quality, greater employee comfort/productivity, reduced employee health costs and lower operations and maintenance costs" (Ibid.). This report is a summary of a larger document entitled "The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force". The main report documents the difficult-to-measure benefits like enhanced worker and student productivity and reduced absenteeism and illness:

> • One study performed by the Heschong-Mahone group looked at students in three cities and found that students in classrooms with the greatest amount of daylighting performed up to 20% better than those in classrooms that had little daylight.
>
> • A study at Herman-Miller showed up to a 7% increase in worker productivity following a move to a green, daylit facility.
>
> • A Lawrence Berkeley National Laboratory study found that U.S. businesses could save as much as $58 billion in lost sick time and an additional $200 billion in worker performance if improvements were made to indoor air quality.
>
> (Greg Kats et al. 2003, viii)
>
> Kats continues in this report to document the reasoning behind his statement that

"Integrating 'sustainable' or 'green' building practices into the construction of state buildings is a solid financial investment" (Ibid., v). He continues:

> In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, this report finds that a minimal up-front investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment. For example, an initial up-front investment of up to $100,000 to incorporate green building features into a $5 million project would result in savings of at least $1 million over the life of the building, assumed conservatively to be 20 years.
>
> (Ibid.)

Lisa Fay Matthiessen and Peter Morris of Davis Langdon & Seah International wrote a similar document titled, "Costing Green: A Comprehensive Cost Database and Budgeting Methodology". This report attempts to answer the question "What is the cost of green design?" The authors compare the cost of meeting various LEED certification levels to buildings built without the intent of seeking LEED certification. This study concludes that there is "no statistically significant difference between the LEED population and the non-LEED population" when comparing the cost of projects pursuing LEED certification and those not pursuing it (Matthiessen and Morris 2004, 19). The authors used the Davis Langdon[6] database for their comparison data and concluded that it is possible for projects to be green within a budget or with a little extra money involved. Setting project goals and budgeting for them in the beginning, as well as making sustainable design a fundamental part of the building (like electrical wiring), is the best way to make room in the overall budget for sustainable features.

[6] Davis Langdon & Seah International is a consulting firm that provides cost planning services to architects and owners.

Another study by professionals at Kema Green, a green building consulting agency, have come up with a several factors that can contribute to varying degrees of cost to achieve LEED certification. These factors include:

- Type and size of project
- Timing of introduction of LEED as a design goal or requirement
- Level of LEED certification desired
- Composition and structure of the design and construction teams
- Experience and knowledge of designers and contractors or willingness to learn
- Process used to select LEED credits
- Clarity of the project implementation documents
- Base case budgeting assumptions.

(Syphers et al. 2003, 2)

This report stresses the fact that every building and project is different. Different factors may contribute to varying budget outcomes.

The United States General Services Administration (GSA) also commissioned a detailed study that was completed in 2004. This study compares the hard and soft costs of achieving LEED Silver and Gold for two GSA building types. The two building types were:

1. A new mid-rise federal Courthouse (five stories, 262,000 GSF, including 15,000 GSF of underground parking; base construction cost is approximately $220/GSF).

2. A mid-rise federal Office Building modernization (nine stories, 306,600 GSF, including 40,700 GSF of underground parking; base construction cost is approximately $130/GSF).

(Steven Winter Associates 2004, 1)

These two building types were chosen because they reflect a large proportion of GSA's planned capital projects over the next several years. The results of the study are listed in Table 1:

Table 1: GSA Study—Capital Cost Changes Associated with LEED

	LEED Level		
Projects Studied	**Certified**	**Silver**	**Gold**
New Construction	-0.4% to 1.0%	-0.03% to 4.4%	1.4% to 8.1%
Modernization	1.4% to 2.1%	3.1% to 4.2%	7.8% to 8.2%

Source: Steven Winter Associates (2004)

For both new construction and modernization categories, the GSA study estimates the capital cost changes to be in the 0-4% range for Certified and Silver, consistent with many of the other financial reports.

William Reed, AIA, Vice President for Integrative Design, Natural Logic and President of the Integrated Design Collaborative wrote a document titled, "The Cost of LEED Green Buildings" that helps explain the current state of the cost of a green building:

> In general, at the current state of integrated design expertise, design teams are achieving LEED certifications at 0% to 2% higher than conventional, initial cost budgets. These percentages are based on real numbers from a variety of projects. Also, the ranges of possible credits achieved by projects vary making an apples-to-apples comparison difficult until more projects are certified. Of course, one can spend significantly more if the credits being sought are not able to be optimized as a result of external conditions.
>
> These might be the cost of photovoltaic systems or a greywater system in areas where water rates and incentives do not support this level of efficiency.
> It is harder for large floor plate buildings to achieve "at budget" LEED Certification due to the difficulty of daylighting and cooling.
>
> (Reed 2003, 2)

Reed's comments remind readers that it is necessary to take all factors into account when compiling cost data for a project. Some cities or states might not have incentive programs like the feasibility grants or renewable energy grants that the MTC offers to subsidize the cost of renewable energy sources. Also, design costs for LEED projects

may be higher. There are several additional modeling reports as well as an increased knowledge base required among design and construction professionals. According to Reed,

> The design costs for LEED projects are higher. They can be even higher for more inexperienced teams. However, these costs are very low in comparison to the Life Cycle Benefits. These costs are general ranges based on an average scope of work for a building of office type occupancy. There are no 'rules' for determining fees, nor should there be. Additional scope of work will be determined by the additional skills and effort needed to support the design team in realizing high performance design.
>
> (Ibid.)

Energy and daylight modeling, integrated design consultants, LEED design consultants, materials research, moisture flow analysis, specification editing, commissioning, and LEED documentation are all processes and items that may contribute to higher up-front costs (Ibid.).

Life cycle cost analysis (LCA) is a useful process used in sustainable design construction to highlight the true cost of a building. It is often considered the best way to determine the real impacts of products. LCA is "a methodology for assessing the environmental performance of a service, process, or product, including a building, over its entire life cycle. Although the technique is still maturing, especially the aspects dealing with ultimate impacts on human and ecosystem health, it has become the recognized international approach to assessing the comparative environmental merits of products or processes" (Trusty and Horst 1999, 3). Various steps are required for a complete LCA including goal and scope definition, inventory analysis, impact assessment, and interpretation.

The lifecycle inventory analysis involves "detailed tracking of all the flows in and out of the system of interest — raw resources or materials, energy by type, water, and emissions to air, water and land by specific substance" (Ibid., 4). Some of this information may be difficult to obtain and the analysis can be complex as well. For example, it may involve "dozens of individual unit processes in a supply chain (e.g., the extraction of raw resources, various primary and secondary production processes, transportation, etc.) as well as hundreds of tracked substances" (Ibid.). Following the initial collection of data,

> The LCI data can then be characterized in terms of impact potentials (e.g., global warming, ozone depletion, etc.) and included in a series of measures called mid-point indicators. While the indicators do not answer the question of ultimate environmental impacts, they do provide a convenient way to summarize and compare the masses of inventory data, and at least make decisions on the basis of whether an alternative is likely to result in a reduction of flows from and to nature. The jury is still out on the best means of bringing mid-point indicators together in an assessment of ultimate, or end-point, impacts.
>
> (Ibid.)

Agencies like the EPA are using LCA internally to develop and implement decision-making tools:

> EPA has found instances where a technology intended to reduce wastes has created unanticipated impacts in other media and/or stages of the life cycle. LCA is being developed as a means to identify and deal with these impacts before they occur. LCA differs from other pollution prevention techniques in that it views all the resource and energy inputs to a product (Life Cycle Inventory), as well as the associated wastes, health and ecological burdens (Impact Assessment), and evaluates opportunities to reduce environmental impacts (Improvement Analysis) from cradle to grave.
>
> (Stone 2000)

There are actions building design and construction teams can take to avoid increased cost. Early incorporation of an integrated design process is one of the most

potent tools for this purpose. Bill Reed explains the qualifications that must be considered when discussing integrated design:

- Embrace green issues as a basic part of the project programming phase. If it is not part of the building program then include green issues before schematic design begins. Unless lucky, you will spend significantly more money achieving a LEED Certification when the project is in the design development or construction documents phase.

- Effective integrated design means that the design team and client will explore all the possible program possibilities, design permutations, and optimization of the many technical and natural systems engaged in the building, site, and watershed.

- The most successful integrative design process includes the Owner and Contractor. ALL the participants in the design process should be willing to think outside the boundaries of conventional practice.

  (Reed 2003, 1)

Reed continued, describing the benefits of open communication and the effects integrated design can have on the final cost of the building:

> When the design activities are considered as a whole with the construction activities – i.e., in an integrated fashion – the cost of the process can be significantly reduced because of a subtle but significant factor - people are talking with one another throughout the project. The design team is communicating in order to achieve these higher performance goals – the process is not business as usual. The US Navy, since incorporating an integrated design/build process to achieve green buildings has been experiencing a 90% reduction in change orders – more than enough to pay for any slight addition of high performance design features (even though these would have paid for themselves anyway).
>
> (Ibid., 3)

Further documentation of the benefits of life cycle costing is found in the following example:

> Designing a green building can add a 2-5 percent premium on construction costs (depending on the design and the level of greenness desired). Fortunately, such investments can pay for themselves 10 times over in life-cycle savings, according to a cost-benefit study for California's Sustainable Building Task Force…for example, the report says an initial investment of up to $100,000 to incorporate

> green building features into a $5 million project would result in a savings of at least $1 million over the life of the building, assumed conservatively to be 20 years.
>
> (Lipper 2005)

An example of a successful State project that improved upon a previously inefficient energy system took place at Mount Wachusett Community College. The campus was previously an all-electric campus that changed over to a wood-burning boiler. They used scraps and lumber byproducts from local sawmills and pellets to fuel the boiler and reduced their operating costs in the first year by $500 K (Berkowitz 2005). The College expects to save "3.3 million kilowatt hours of electricity per year—saving $300,000 annually in reduced energy costs—or enough power to serve 100,000 residential customers for a year…Because the wood chips are purchased locally, transportation related impacts are minimized, use of petroleum fuels is eliminated, and energy dollars are spent in the local economy" (Massachusetts State Sustainability Fact Sheet No. 2, 3).

Vision and Leadership

The Massachusetts Sustainable Design Roundtable has acknowledged the need for definitive and clear leadership from government officials in positions of power and additional key sectors. Encouraging these leaders to participate in the roundtable process and demonstrate a high level of support will help ensure that the sustainable design movement is brought to the forefront of Massachusetts policies and actions and that it is implemented for public construction projects.

Establishing any new program or bringing new technologies into mainstream society takes innovation, vision and strong leadership to be successful. Identifying a distinct direction where organizers and participants want to take the program is equally important. It is also important for members of government to be willing to commit to trying to make positive changes. If the roundtable submits recommendations to the governor encouraging a declaration, executive order, or other form of legislation, the governor should be willing to listen to the supporting documentation and make a decision. Without these criteria, the potential program may fail even before it has the chance to be heard.

Goals are necessary to ensure recommendations made by the roundtable are on the right track. Without goals as guidance, meeting progress and recommendations could veer off track because of a lack of direction. If the roundtable members are not sure of the desired outcome from all of the meetings over the year-and-a-half-long process, they could become disenchanted along the way and feelings of futility may set in. It is important for Roundtable leaders to stress the importance of members' participation and make sure they know their time and effort is appreciated and being used wisely.

Presenting pertinent information that can be used by the State's decision-makers is a responsibility that rests on the shoulders of the Roundtable leaders. Roundtable members and citizens of Massachusetts need to be led by example and strength of beliefs. Without a clear directive, the roundtable method may flounder. The roundtable needs the governor or a commissioner of a state agency, preferably from DCAM, EOEA, or OCD, to step forward and make a statement illustrating their hopes, desires, and visions for the Commonwealth in twenty, thirty, fifty, even a hundred years into the future. Without this

guidance, the direction of Massachusetts' environmental future is not clear. As of August 2005, there has not been any statement on the Sustainable Design Roundtable from Massachusetts state leaders.

Leading by Example: A History of Mayor Menino's Green Building Task Force

An example of leadership and vision contributing to a successful roundtable experience is the City of Boston's Green Building Task Force convened by Mayor Thomas Menino. Task force members included professionals from diverse backgrounds, all intent on contributing their knowledge and experience for the establishment of sustainable design guidelines. Task force participants met monthly for a year to discuss barriers, potential recommendations, and listen to presentations given by sustainable design leaders. Some task force members also traveled to Seattle and Chicago to get a sense of other cities' approaches to incorporating sustainable design techniques into their daily operations.

After a year of meetings, in the fall of 2004, the task force released "Mayor Menino's Green Building Task Force Report, Executive Summary—Everyone Benefits From Green Building". This executive summary presented information in an accessible, readable format so anyone could learn about sustainable design and its benefits. The city's task force set an example for Massachusetts to follow in the future—they set the bar fairly high. One of the major outcomes of the task force was a recommendation that the city commit to a LEED Silver rating for new construction and major renovation projects and to require a LEED Certified rating for city-supported projects (Mayor Menino's Green Building Task Force Report 2004, 15).

As a result of these recommendations, Mayor Menino announced the city will strive for LEED Silver in each of its future building projects. The city is currently involved in eight to ten city-supported green building projects according to Barbra Batshalom, Executive Director and Founder of The Green Roundtable (Batshalom 2005). There were also twenty-one completed green buildings in Boston as of August 2005[7] (MTC website 2005). Additional goals include amending Article 80 of the Boston Zoning Code to "require that all large projects built in Boston are LEED certifiable and that all City-supported building development projects are LEED certifiable" (Boston's Green Building Task Force Website 2005). However, these are only goals and are not laws and are not enforced as such, but the positive effects of the Citywide task force on advancing the sustainable design movement in Boston should be acknowledged as there are currently sustainable design projects in the works.

According to Barbra Batshalom, "It's really critical to engage decision makers in a way that gets them to be a champion for this. I definitely saw this in the Boston task force" (Batshalom 2005). Batshalom mentioned that the mayor was not completely involved or even interested in the beginning. But in the end, "he was much more aware, understanding, committed" (Ibid.).

The City's task force had four meetings with the Mayor. Although they only lasted fifteen minutes each, it was still enough to raise his awareness and enthusiasm for the cause. There were also four press events that he attended. Batshalom explained, "If we had dumped [our findings on him] at the end, he wouldn't have cared as much" (Ibid.). Because they kept him engaged throughout the process, they found him to be

[7] A list of these buildings may be found in Appendix iv.

much more receptive at the end of the process. "A key piece was that one of the Mayor's staffers who reported directly to him was a critical part of the process (Sarah Zaphiris). She was very effective, talking to the Mayor about this on a daily basis" (Ibid.). Critiquing the State's Roundtable, Batshalom continued, "That's a connection we had that we don't have on the State Roundtable" (Ibid.).

At the first Commonwealth of Massachusetts Sustainable Design Roundtable meeting held in January 2005, the process was kicked off by addresses from Doug Foy, Secretary of Commonwealth Development, Ellen Roy Herzfelder, then Secretary of EOEA, and David Perini, DCAM Commissioner. Their presence was noted, but as soon as their introductory speeches were over, they exited the meeting. Certainly, these people have extremely busy schedules, but their voice has not been heard by the Roundtable in the eight months since the process was established. Their leadership may be more evident in the daily operations of their respective agencies.

With direction and enthusiasm, the Roundtable can succeed in getting Massachusetts policy makers aware of the issues surrounding sustainable design. The overall success of the Roundtable depends on the reception of its final report. Organizers and members of the Roundtable will have been working for over a year trying to produce a final report that will get the attention of the Governor and/or someone with the ability to make change who will champion the cause. Hopefully, they will find this audience and the future of sustainable design in Massachusetts will be bright.

Chapter V: Taking Action: Policy Instruments That May Be Used to Make Change Happen

> High performance building design is dependent upon getting the best out of your people - as individual professionals and as members of the design team. Policy is a good way to apply new pressures on old processes and thereby force change. People are generally resistant to learning new ways of thinking, interacting and application. Policy is an essential means of igniting participation in large and diffused populations. And this is essential to environmental sustainablity.
>
> (Sharp 2005)

For programs to be implemented in state government for the purpose of inciting change, it may be necessary to enact legislation, promulgate regulations, sign Executive Orders and offer incentives. This chapter recounts some of the methods that Massachusetts may use to instigate change. Examples from other states that are leaders in the sustainable design movement will be presented.

Policy Instruments

In order to begin a discussion about the policies that may be applied to mitigate the barriers to sustainable design, an investigation of different policy instruments may be helpful. In the chapter, "Making Community Policy" found in the text, "Toward Sustainable Communities – Resources for Citizens and Their Governments," author Mark Roseland provides a thorough investigation into the different policy mechanisms that may be used to overcome barriers and obstacles found in mobilizing citizens to move towards sustainable communities. Roseland's research may be similarly applied to investigate solutions to the barriers of sustainable design.

Table two is a table of policy instruments divided into three categories:

The first is traditional regulations such as permits and licenses that have a legal basis. A second category is voluntary mechanisms of actions taken that generally do not require expenditure. The third is direct government expenditure such as money spent on improved infrastructure. Lastly, there are financial incentives such as taxes, subsidies, tradable permits, and rewards. Financial incentives do not require people to change their behavior or values and do not usually require as much enforcement as regulations.

(Roseland 1998)

Table 2: Policy Instruments

Categories	Instruments
Regulations	Laws
	Licenses, Permits, and Standards
	Tradable Permits
	Quid Pro Quos
Voluntary Instruments	Information
	Volunteers, Volunteer Associations, and NGOs
	Technical Assistance
	Expenditure and Contracting
	Monitoring
	Investment and Procurement
	Enterprise
	Public/Private Partnerships
Financial Incentives	Pricing
	Taxes and Charges
	Subsidies and Tax Incentives
	Grants and Loans
	Rebates, Rewards, and Surety Bonds
	Vouchers

(Roseland, 1998)

The subsequent policy discussion will utilize the above chart for categorization purposes.

Top Policy Mechanisms: Regulations

Policy instruments such as laws, licenses, permits, standards, tradable permits, and quid pro quos are all subsets of regulations. The following section investigates the different regulatory options available to state policy makers that may help alleviate the barriers to sustainable design.

Executive Orders and Legislation

An executive order given by a governor or president is one method of establishing sustainable design practices. Sometimes, the effectiveness or ability to enforce executive orders may be questioned. Are executive orders considered law? Are they required to be followed? Who has the power to enforce them? Who can create an executive order?

First, a definition of an Executive Order is necessary. According to contributing author Jeffrey C. Fox of Catawba College in "ThisNation", the American government and politics textbook,

> Executive Orders are legally binding orders given by the President, acting as the head of the Executive Branch, to Federal Administrative Agencies… Executive Orders are controversial because they allow the President to make major decisions, even law, without the consent of Congress… The use of Executive Orders is not just a presidential activity. They are also used by most state governors, who are the chief executives of their states.
>
> (Fox 2005)

A definition that is specifically addresses a Governor's Executive Order comes from the State Library of Massachusetts:

> The term 'gubernatorial executive order' is defined as any written or printed order, directive, rule, regulation, proclamation or other instrument promulgated by the governor of a state (a) in the exercise of his constitutional authority as 'chief executive' or 'supreme executive magistrate,' (b) in fulfillment of his

> constitutional duty to enforce state laws, (c) in performing constitutionally assigned duties relative to executive branch reorganization, (d) in the exercise of his constitutional responsibilities as commander-in-chief of the armed forces and civil defense forces of the state, as regulated by state law, and (e) in his role as 'agent'of the state legislature in exercising powers delegated to him by statute to implement and administer particular state laws and programs.
>
> (The State Library of MA 2005)

With regards to sustainable design, many Executive Orders focus on increasing energy efficiency and renewable energy sources. Some states like California and Michigan use Executive Orders and directives to mandate that buildings be built to a certain LEED specification. New York has an Executive Order that recommends state-built projects to conform to LEED. Washington and Nevada actually have legislation stating public buildings must be built to certain LEED requirements.

Executive Orders are not law and they do not give the public the right to bring legal action against them. They are more constrained than typical legislation but they may still be enforced by more subtle measures. These subtle measures may include management directives that allow for any employee who disregards an Executive Order to be dismissed.

Executive Orders have the useful ability to level the playing field. That is, it can make the design and construction process accessible and fair to all bidders as they know up-front what will be required in proposals, designs, or building materials. If all contractors enter the bid process with the knowledge of what the State is looking for, that makes the bidding process fairer.

When asked about her thoughts on Executive Orders, Barbra Batshalom responded that it depends on what the state does after it is issued. "I think they are great but they are only useful if they are enforced and have something behind them. I'm

against them if they are empty. Sometimes they just provide credibility" (Batshalom 2005). Although Executive Orders may be useful for declaration of intent and placing sustainable design in front of a wider audience, enforcement is still key.

Legislation is another option for encouraging (or requiring) compliance with sustainable design technologies. Laws may be enforced and have that distinct advantage over Executive Orders. There are two states in the US that currently have passed legislation requiring public construction projects to be built to LEED Silver standards. These two states, Washington and Nevada, are pioneers in this regard. Legislation to establish a green building income tax credit for LEED certified buildings was introduced in Massachusetts by Representative Jim Marzilli in January 2003. It did not pass.

Innovative Regulations: Bonus Densities, Green Building Funds, and Required Commissioning

Some places where innovative regulations have been introduced include Arlington County, Virginia and the state of California. Arlington County provides the incentive of allowing additional bonus densities for projects deemed sustainable. "The program allows developers to request a slightly larger building than would normally be allowed by County Code if the project receives official LEED certification from the USGBC at one of the four LEED award levels. The extra space allowed varies depending on the project and on the LEED award sought" (Arlington County Virginia 2005, 6-7).

The County also maintains a Green Building Fund for projects that do not become certified. If a developer does not wish to pursue LEED certification for any reason, they "are asked to contribute to the County's Green Building Fund, calculated at a rate of

$0.03 per square foot. This fund is used for education and outreach for the development community on green building issues. If the project achieves certification from the USGBC, the Green Building Fund contribution is refunded" (Ibid.). Although not a state, Arlington County's policies deserve to be examined because of their innovation.

Under the State of California's Green Building Action Plan (which accompanies Executive Order S-20-04), California requires a certain level of commissioning to take place for each public building built. In general, commissioning is beneficial because it greatly eliminates the possibility of a systems failure in the building or catches mistakes early, before they become more costly to fix. According to Patrick Branch of Astorino, "Commissioning is a systematic process of ensuring, through documented verification, that all building systems perform interactively, according to the documented design intent and the owners operational needs. It should begin in the design phase, last at least one year after project close-out, and include the training of operating staff" (Branch). Fundamental commissioning is a prerequisite for LEED certification. Pursuing additional commissioning may earn an additional LEED credit. To assist with understanding the commissioning criteria, the California Commissioning Collaborative (CCC), a non-profit 501(c)3 organization, was created:

> The CCC is made up of government, utility and building services organizations and professionals who have come together to create a viable market for building commissioning in California...Our purpose is:
>
> - To improve building and system performance by developing and promoting viable building commissioning practices in California;
> - To facilitate the development of cost effective programs, tools, techniques and service delivery infrastructure to enable the implementation of building commissioning processes;
> - To educate and inform concerning building commissioning processes; and

- To identify opportunities, establish priorities and promote solutions relating to building commissioning processes in California.

(California Commissioning Collaborative website 2005)

This collaborative is innovative because it proactively provides a resource to people who need help with the commissioning process. Since the commissioning process is so important to the success of a building, it is helpful to have a collaborative at the ready to interpret commissioning standards and practices. Instead of hiring private consultants, project managers can go to the collaborative for cost-effective assistance.

These regulations may be used in some form to shape recommendations for Massachusetts to help alleviate the Education and Training and Financial Barriers and Incentives categories. Incentives like increasing allowable densities according to the greenness of a building falls into the Financial Incentives category offered by Roseland and could affect the financial barrier by making sustainable design more enticing to developers. Starting a green building fund is a voluntary instrument that may be used to raise money for future education and training programs.

Top Policy Mechanisms: Incentives

Tax Credits

Some states offer tax credits to contractors who use certain products or incorporate sustainable design techniques into their projects. Generally, the tax credit is an incentive for the private sector rather than for the public sector. In public construction, there are no taxes charged on the project. Credits provide advantages to the private sector by encouraging developers to construct buildings using more sustainable

design techniques and incorporating greater energy efficiency than they may have previously if no tax credits were offered. Even though this is an incentive for private construction and this thesis is about public sector building, tax credits are a powerful instrument that warrants mention.

A second benefit of a tax credit is that it hopefully encourages more designers to choose more sustainable materials as the cost is offset. Thus, the initial cost of these materials decreases over the course of time as demand rises and the products become less of a niche item and become more mainstream. According to an article on the National Resources Defense Council (NRDC) website, "If the [tax] credit can help make green building materials and techniques viable for large projects, the demand these projects create may generate economies of scale that will make green building affordable for the small consumer" (NRDC 2002).

A disadvantage of the tax credit might be the loss of state funds normally culled from taxes. Also, the state enacting the credit may be open to lawsuits if the legislation is not completely clear. These lawsuits may force lengthy delays and may require funds to be spent in litigation. One lawsuit in particular was filed in 2000 against the state of New York for excluding vinyl flooring materials from the approved products list (building developers wishing to apply for the tax credit have to follow strict rules regarding material usage). The lawsuit was later withdrawn as New York agreed to include vinyl flooring in the list of approved products.

> On May 29, 2003, the Resilient Floor Coverings Institute (RFCI) withdrew a lawsuit challenging New York State's Green Building Tax Credit regulations…for excluding vinyl as an approved flooring material...The tax-credit regulation in question includes two compliance paths. The performance path allows users to choose their own materials, as long as they are consistent with the criteria. At issue in the lawsuit is the "listed material compliance path," which

> lists cork, concrete, recycled wood, and linoleum, among others, as approved floorcoverings. To qualify for a tax credit at least 50% of the building's noncarpeted floor area must use these materials. "What our litigation opponents sought was to have the listed material compliance path declared arbitrary, capricious, illogical, and nonsensical," said Assistant Attorney General John Sipos, adding, "they also wanted the court to list their product in that path."
>
> (Environmental Building News 2003)

Roseland categorizes tax incentives as a financial incentive policy instrument. They may be directly applied to the Financial Barrier and Incentives category as they serve as incentives to reduce the initial cost of sustainable design. Although tax incentives are more applicable to the private sector, their place in the policy realm is large enough to warrant mention.

Grants, Loans, and Other Forms of Financial Assistance

The Massachusetts Technology Collaborative (MTC) and Renewable Energy Trust (RET) is a rich source for grants and funding for studies and projects meant to encourage a permanent shifts towards using renewable energy. The RET is funded "through a small monthly charge on consumers' electric bills, averaging about 50 cents per month for residential customers" (MTC website 2005). Over 400 projects have been funded by the RET. The following are areas where the RET offers assistance:

- **Clean Energy**
  Public Awareness Activities
  K-12 Education Activities
  Predevelopment Financing Grants
  Massachusetts Green Power Partnership - Round Two RFP

- **Green Buildings and Infrastructure**
  Small Renewables
  Commercial, Industrial & Institutional Initiative Feasibility Study and Design & Construction Grants

- **Industry Support**
  Business Presentation Competition

- **Policy**

  (Ibid.)

There is also a searchable database of all awards. Funding types include loans, investments, feasibility study grants, design and construction grants, installation grants, development loans, development contracts, predevelopment loans, public awareness grants, planning grants, outreach funding, and financing.

Grants and loans are both financial policy instruments. They also apply to the Financial Barrier and Incentives category of obstacles to sustainable design. Grants and loans may be used to alleviate the upfront costs to sustainable design. They may also be catalysts for implementing more sustainable design technologies by allowing projects to eliminate the element of surprise by compiling feasibility studies before attempting to begin a project.

Recognition/Awards

Providing recognition to design and construction professionals who make it a goal to excel at sustainable design is a useful incentive. Barbra Batshalom of the Green Roundtable agrees with this assessment. She specifically recommends "using performance bonuses or some kind of non-financial incentive like a performance ranking so the contractor will have a leg up on future DCAM projects because they have been successful [with implementing sustainable design techniques]" (Batshalom 2005). She acknowledges that this might be difficult to implement because if it's a team effort, how

do you separate the efforts and assess which team members performed well? "It could be hard because if there are issues, how do you determine liability?" (Ibid.). It is also difficult because under the current bid process, the state must accept the lowest bidder and can not make any allowances for contractors with sustainable design experience.

DCAM does support an "Awards in Excellence" Program. This program "reinforces our commitment to providing outstanding service to the citizens of the Commonwealth by recognizing the projects, designers, and contractors that have achieved the highest professional standards in the planning, design, and construction of our state building projects" (DCAM website 2005). Since DCAM already has an awards program in place, one recommendation would be to expand the program to include a category specifically for sustainable design innovation.

Recognition programs and awards may help alleviate financial barriers. According to Roseland, the policy instrument applied in this case is "rewards" which are financial incentives. Contractors who are inexperienced in sustainable design may be more inclined to bid for a project if there is the possibility of gaining a reward. Recognition may provide them with more business and increased income.

Top Policy Mechanisms: Programs

Education and Training

Programs may also be used by states to make changes in the way buildings are constructed as well as the way the public and professionals perceive the prescribed changes. Education and training programs help people learn all aspects of green

building. In order for the public to become aware of these benefits, it is necessary for people to be able to access a repository of information. The Nexus resource center scheduled to be open in September 2005 should help fill this void.

According to Bill Reed, one of the best ways to overcome the education and training barrier is to "start bringing education into schools so that we have politicians, architects, and engineers who understand about this" (Reed 2005). By creating a foundation of knowledge and education, children of the state would get a head start on learning about the world's ecological systems and human impacts.

According to Roseland, education programs both in schools and municipalities are considered to be information policy instruments under the voluntary instrument category. These kinds of programs could directly influence the amount of information about sustainable design currently in the curriculum. The information gap could potentially be minimized.

Metrics

One of the areas where the Commonwealth of Massachusetts falls short of achieving maximum success is in measuring and accounting for past and present sustainable design implementations and successes and presenting this information in an accessible format to the public. There is a pronounced need for a decent metric system and/or case study template to assist with this education process (DiModica 2005).

Currently, there is no foolproof way to access data or information on past, current, and future public construction projects that have integrated sustainable design into their design and construction. To better document the progress, successes, and lessons learned

over the course of public construction relating to sustainable building practices, the state should utilize a combination of existing software infrastructure and new technologies. This can ultimately be classified as a database, tracking, and communication issue.

Presently, the state tracks sustainable design projects via the use of a very incomplete database and paper checklists haphazardly used by project managers in the design phase. Alternatively, the MTC and DOE uses a web-based data collection system that gathers qualitative and quantitative information input by a user which is then readily available for display as a case study. There is great potential for a successful statewide monitoring tool if the current data collection methods are linked to the already available documentation tool provided by the MTC and DOE to produce one master data source.

If this information was collected and housed in one place, it would make accessing data and information more streamlined and useful. Currently, there is no seamless and comprehensive way to obtain this information. Creating one place to find this information is critical towards ultimately advancing sustainable design for public construction as it would make the information more accessible for internal and external purposes, including understanding best practices, lessons learned, and to also facilitate the wider dispersal of accomplishments made in this area. It would also allow the public to be able to conduct their own research on the benefits of sustainable design. The more well known the successes and accomplishments, the more likely people will be open to incorporating more sustainable design techniques in their projects.

In order to proceed with this plan, staff time and resources must be dedicated to implement such a system. Funding should cover the costs of staff time to investigate the possibilities of combining the already existing resources and potentially incorporating

new ones such as the use of LEED checklists. Additionally, it would be critical to develop the system so information from new projects could be readily input into the database, effectively increasing productivity. The new system would help facilitate a seamless data collection effort routinely done as part of any design and construction project.

This new system could vastly enhance the incomplete data collection efforts currently in place at DCAM and other public construction agencies. Moreover, this effort has the potential to standardize case study documentation procedures for the state. Integration from multiple state offices is necessary to advance this idea, but it is certainly a viable option for a more complete measurement system (Potential Sustainable Design Project Database Memo 2005.) The Massachusetts' State Sustainability Program, a program that already exists, could serve as an umbrella for such a measurement program.

Mark Kalin, construction specifications writer for the Commonwealth, believes one of the best ways to analyze sustainable design policies and quantify their benefits is to "create project case histories. For example, the DCAM Cape Cod Community College New Technology Building may reach LEED Gold level. Costs and sustainable goals versus achievements should be documented" (Kalin 2005). Case histories, or case studies, provide background information as well as the current status and outcome of the project that would be useful for future projects so the lessons that were learned the first time are not forgotten and mistakes are not repeated.

Even with the availability of measurement tools, the infrastructure and ability to analyze these results must be present. There is minimal benefit to collecting data if that data is simply going to be stashed away in the depths of a computer's hard drive. Reports

need to be compiled and analyzed based on the data and other indicators. Those indicators should be predefined so the corresponding data may be collected from the beginning.

Implementing a case study and database system to audit building success is considered an information or monitoring policy instrument in the category of voluntary instruments according to Roseland. Keeping track of sustainable design projects may help alleviate the Education and Training barrier as it could potentially provide discreet quantitative information proving the benefits of green buildings. Case studies may also provide qualitative data.

Evaluating Policy Potency – Two Conversations with Sustainable Design Professionals

In this section, two sustainable design professionals share their thoughts and philosophies on sustainable design policy and analysis. Their contribution provides insight on evaluating the feasibility, potency, effectiveness, and stability of the policies that could potentially help mitigate some of the barriers to sustainable design.

Leith Sharp, Director of the Harvard Green Campus Initiative, believes the most potent policies the state can implement to overcome some of the barriers to sustainable design involve mandating a required level of LEED with regard to building performance. From her experience, Sharp believes LEED gold is a highly attainable goal:

> LEED gold would be a good start. From experience - LEED Gold is doable and need not cost the project any more. It just takes commitment, good teamwork, a willingness to invest in integrated design, good modeling and thoughtful analysis all the way through the design process. After participating in nine LEED projects, I can say that the most important determining factor is early and sustained committed to high performance design.

(Sharp 2005)

Construction specification writer Mark Kalin thinks the most potent policy would involve "requir[ing] energy performance of buildings to exceed code minimums. The engineering community interested in promoting sustainable design should set reasonable performance requirements" (Kalin 2005). Both are viable suggestions that the Sustainable Design Roundtable should consider.

Another important comment made by Sharp highlights the benefits an industry-wide declaration could offer: "By creating an even playing field - you can motivate the entire industry to improve the process of designing and constructing buildings" (Sharp 2005). This relates directly to the concept that if more designers and construction companies used more environmentally preferred products and implemented more sustainable design technologies, the market would adjust and these products would no longer be specialty items with higher price tags.

Accordingly, there are other benefits that may follow. Sharp commented that with her experience working at Harvard, she could envision "that the industry would mobilize very quickly and would derive multiple unexpected benefits from their efforts [e.g.] better team performance, lower operating costs, heightened reputation, [and] better accountability systems for subcontractors" (Ibid.). These benefits would most likely be realized after an initial period of industry backlash (Ibid.).

The ability to analyze policies to determine what is working well (and not so well) and why is an important skill for anyone responsible for policy implementation. Knowing the policies, benefits, and costs inside and out provides for more balanced and informed governance. With regards to analyzing sustainable design policies, Sharp said

the indicators she would use to determine if a policy was helpful or harmful towards encouraging sustainable design include focusing "mostly upon net greenhouse gas emissions - per square foot AND per capita for each building. I would compare through time and across building typologies. I would also keep tabs on the proportion of building design and renovation projects that are formally registering their commitment to high performance design at pre-design or before" (Ibid.). Keeping track of projects with similar size and purpose, both sustainably constructed and more traditionally constructed, and then comparing their energy use, overall costs, and employee productivity over time could prove useful and could certainly be instrumental in reducing the effects of the Education and Training barrier.

Chapter VI: From Policy to Practice: A Green Building Vignette

The Lorusso Applied Technology Center at Cape Cod Community College, West Barnstable, MA

The Lyndon P. Lorusso Applied Technology Center at Cape Cod Community College (CCCC) in West Barnstable, MA is a 26,500 square foot building currently under construction that will contain classrooms, laboratory space, demonstration areas and offices. The building is expected to be the first LEED certified green building constructed with state funds in the Commonwealth of Massachusetts. For this reason, this building was chosen for the case study. Students, faculty, and members of the community will be able to enjoy the new Technology Center when it opens for use in the fall of 2005.

The total cost for this building has been estimated at $7.7 million. $5.7 million came from state bonding and the remainder came from private donations (Albright 2004). The project was awarded a $20,000 feasibility study grant from the Massachusetts Technology Collaborative's Renewable Energy Trust. Part of this money was designated to fund a report entitled, "'Green' Building Technology Analysis," written by the consulting group MOCA Systems, a cost/scheduling-based company located in Newton, Massachusetts that uses software and industry knowledge to work with contractors and owners to manage construction projects (DiModica, email, 2005). MOCA assigned costs and schedule impacts to specific sustainable design technologies and building scenarios and summarized the results in the report. Their findings were critical to the final design of the building as the study helped determine whether or not photovoltaics, fuel cells, and

microturbines would be feasible by analyzing the resulting impacts on time and costs. The grant money was also used to determine if other LEED credits could be earned.

MOCA Systems' report is broken down into four cost and schedule impact cases: "1) standard equivalent building, 2) standard equivalent building with natural light enhancement features, 3) DiMella Shaffer (the architecture firm) design with all green building features, and 4) DiMella Shaffer design with all green building features" and a different indoor air quality sequence (Slaughter 2005). Using these four cases, the designer was then able to decide which sustainable design technologies to include in the project.

Several years prior to the MOCA Systems report, an additional document was produced using funds from the MTC Renewable Energy Trust Fund's "Green Building Initiative." This report was published in 2002 and is a precursor to the more recent report. The older document identifies desired building systems.

Some of the major green technologies used in the building include:

- Grey water system and storage including roof and perimeter drains
- Renewable energy in the form of photovoltaic panels on the roof and in sunshades in the skin of the building
- Lighting control system with daylight sensors that controls the inside lighting, combined with occupancy sensors
- Minimized site disturbance
- Operative windows and VAV box sensors[8]
- Daylighting (with a clerestory)
- Ecophon ceiling tiles (acoustic ceiling tiles—also help provide daylighting because of their reflectance. These tiles have the highest reflective factor and highest recycled content.)
- Recycled interior design materials (e.g. carpet)
- Gypsum used is 90% recycled
- Tremendous amount of local and regional material used, including brick
- High energy performing glass (double layer most efficient)

[8] VAV box sensors are used to automatically turn off heating or cooling systems if windows are opened, preserving energy efficiency.

- Educational kiosks
- Locally produced brick
- Recycled construction waste

(Fourtounis 2005)

When tallied as LEED credits, the items on this list will most likely add up to a LEED Gold rating for the College. The college declined to implement a microturbine and fuel cell in this project although there is a fuel cell elsewhere on the campus and they may consider installing a microturbine in the future.

Four design and construction professionals were interviewed for this overview of the Lorusso Center's evolution from concept to completed building. Each professional provided a different perspective on sustainable design and on the specific building itself.

Ted Anthony, Design and Construction Project Manager, DCAM:

Ted Anthony is the Design and Construction Project Manager for DCAM. He has been with the agency for seventeen years and has been involved with the Lorusso Center project from the beginning. The history of the project began with the College identifying the need for a new technology center. The Board of Higher Education concurred with the College's needs assessment. A study was requested and funding was identified for design and construction. The building was designed, put to bid, and is now in the construction phase (Anthony 2005).

Ted brought up the subject of the difficulties of balancing the capital budget with the operating budget, one of the primary barriers investigated in Chapter IV. Ted stated, "There is a tight budget associated with this project. There are only limited dollars. For a state agency, you need to look at the list of projects that have to get done as opposed to

what you have funding for. At CCCC, they were trying to figure out what the cost is for green. A lot of people are willing to spend an additional premium for green. We have to find out what that max number is" (Ibid.).

Ted did not feel didn't feel that he had to persuade or convince others involved in the project to accept certain sustainable design elements. This is because "everyone on the project wanted to do it" (Ibid.). He did mention that the contractors had some trouble as "they were not used to dealing with the extra paperwork involved with the…LEED certification process...It really depends on the quality of the contractor you are working with. It's the learning curve with all the LEED work that is the most difficult. Once the contractor becomes familiar with what needs to go on, the process will move more smoothly" (Ibid.).

The decision on which green items to include in the final design was determined by DCAM's programming office. The project architect, Peter Fourtounis of DiMella Shaffer, did much of the research for the items.

As of late spring 2005, the building was 40% complete. The main structure framing, brickwork, and HVAC systems were in place. The shell was also in place and interior work was currently being finished but the roof was not yet in place. Ted mentioned that the contractor did not get off to a good start. "They got into the winter without have the building framed. That extended the date to the end of August" (Ibid.). The current estimated completion date has now stretched to the end of November 2005.

Scheduling issues are relevant to the issue of green design because any delay can increase the final building cost. This additional cost could be blamed on sustainable design when there are really other factors. In this project, the contractor had no

sustainable design construction experience which may or may not have played a role in the building's delay, depending on who is providing the opinion.

When asked about budgeting issues, Ted acknowledged that extra funding was required for the sustainable design technologies: "Additional funding is required for the green stuff. John [DiModica, DCAM] secured money from the MTC. The school raised a lot of money on their own—the school put in over $1 million. $216,000 provided by the MTC to go towards green stuff" (Ibid.). This does not include the feasibility grant money.

When asked how he would describe his relationship with the other major players involved with the project, Ted said he had an "excellent working relationship with the college and designer" and that his relationship with the contractor was "decent" (Ibid.). An interesting aspect to the partnership between the professionals came in the form of a "partnering conference" where all parties involved in the project signed a contract stating their commitment to teamwork and high quality construction. Ted stated, "We had a partnering conference before construction started to make sure everyone was on the same page. We had a midterm one as well. They were more of a preventative measure" (Ibid.). The contracts produced during these partnering conferences—somewhat like mediation documents—are hanging on the wall of the construction trailer onsite. There may not be discrete proof available to document the benefits of these contracts, but they are a constant reminder of the desire to work as an integrated team.

Glenn Harper, Resident Engineer DCAM

Glenn Harper serves as the resident engineer for DCAM for this project. His

office is located onsite in a temporary construction trailer. He has worked on many projects with this college and has had good experiences both with their project manager and in general. For this project, his primary responsibility is to oversee the building as it is constructed. Glenn is responsible for all of the mechanical, structural, sitework, drainage, and sewage systems. He is also the one who justifies any change orders that arise.

Glenn is also responsible to a certain extent for budgetary concerns. He stated that he has to "write a letter justifying all money spent beyond contract cost—either approving or disapproving" but that he doesn't necessarily have to agree with anyone. "I approve or disapprove all the money each month for the requisitions.[9] I do the percentages complete—like if the electrician is 60% complete, he will get paid that percentage amount. I check all the materials coming on to the site with the submittals handed in by the contractors to make sure everything is correct" (Glenn Harper 2005). When asked if there were any major budgeting issues, Glenn replied, "No…We've had issues as far as not agreeing on the cost of a change order, but that's only happened once. We haven't really had any cost issues."

Regarding sustainable design, Glenn's position is that "it's good". Glenn continued, "I think it will be more expensive to build, but they will get a return on their money at some point. It's good for the environment obviously because you are saving water, energy, etc. The facility will get a return, the state will get a return. The taxpayer will pay initially" (Ibid.). When asked if he would personally prefer to include more sustainable practices into a building, his response was, "Yes. We're talking government,

[9] Requisitions are what the contractor submits to get paid.

not private industry. It's easy when you can give the bill to the taxpayer. I'm sure private industry wants to build it as cheaply as possible" (Ibid.).

Glenn has worked both on buildings that incorporated sustainable design technology as well as buildings without such technologies. Comparing the two, he commented that sustainable design "certainly helps the environment. It's just the cost… There's more to it, more to watch out for" (Ibid.). There are certain aspects to a LEED project that Glenn noted make the process more difficult in the short term. For example, the restriction on the size of the site has led to some difficulties due to the lack of space: "This site is restricted, and there are six Dumpsters—what little space you have is taken up by Dumpsters. You don't have as much open space as you do with non-LEED projects" (Ibid.). Stephen Harper, the contractor for the project, agreed. "The construction area is so tight that you can't move equipment around—but that's to protect the trees" (Stephen Harper 2005).

Glenn believes LEED certification can be used as a positive marketing tool but thinks "it's got to be probably 15% more to build a LEED project [than to build using traditional construction methods]" (Glenn Harper 2005). He acknowledged that it is more work to build a LEED certified building, but thinks in the long run that it will be a beneficial experience for the contractor: "After the contractor goes through [the LEED process], he will be able to get more money and jobs. He's been pulling his hair out. The office time is a lot more work. It was all new to the subcontractors too…It's a learning process for everyone" (Ibid.).

Project leaders are now aiming for building completion in the end of November. They had to give the contractor a contract extension partly because of the snowy winter,

which caused a lot of weather delays. Other issues arose, such as having to relocate all the power and communications lines, which took three weeks longer than expected. They did know about the relocation of the lines as it was on the plan, but "there was a problem with the switches when they needed to shut down the power to make the switch over" (Ibid.).

With regards to working relationships between other professionals involved with the project, Glenn stated that "everyone was pretty cooperative, everyone was trying to do a good job" (Ibid.). He did not encounter resistance from other parties when trying to encourage green practices. His relationship with the other professionals has been good. Glenn acknowledged his issues with the LEED administration process: "My problem has been with the paperwork…I knew nothing about it before, didn't know what to expect. Yeah, it was a real pain in the ass. Sometimes, [the contractor] submitted [products] two or three times and they kept making him resubmit because they didn't have enough information—like the concrete issue.[10] No one has all the information" (Ibid.).

Peter Fourtounis, Project Manager for DiMella Shaffer, Project Designers

Peter Fourtounis was involved with the Lorusso Center as the project manager for DiMella Shaffer, the architecture firm charged with designing the building. In addition to being involved with the final project, he was also involved with the study phase which won a DCAM programming award. Peter's background with sustainable design is

[10] During the project meeting the author attended at CCCC on May 17, 2005, a conversation about concrete and reflectivity arose. Discussion ensued as to which concrete the contractor should use to meet the LEED requirement. There was confusion as to who would be able to provide guidance and information on this matter since Boston Sand and Gravel, a company large enough to be aware of this issue, had no comment.

extensive and includes work on the Youville House, North Shore Community College, and the Massachusetts Fire Fighting Academy Expansion in Stow, MA. His basic philosophy is that "sustainable design is good design." Peter has been LEED certified for two years.

Peter reflected the sentiments of both Glenn and Ted regarding the overall experience working with the other main professionals involved in the project. Specifically speaking about his experience working with DCAM, Peter said is has been "very good! It has been great. We've been able to develop some systems in-house that are tailored to public bidding and the DCAM process that help in the construction documentation and the construction phases" (Fourtounis 2005).

In terms of the level of dedication towards sustainable design that CCCC brought to the project, Peter said they were "really fortunate in that we had a client that came to the table [seeking a high standard of sustainable design]…CCCC was way up there, both DCAM and DiMella Shaffer had to rise to their level" (Ibid.). This had a lot to do with Bob Cleghorn, facility manager at CCCC. "[He was] dealing with all the energy issues, waste, septic. He was dealing with all those problems and was seeking to change the way buildings were being built on the campus. He was a leader, [he] had a vision" (Ibid.).

When discussing common barriers to sustainable design, Peter said he did not find resistance to green practices on the part of other professionals involved with the project. "It was a unique opportunity. Traditional barriers were not present. It was more of a battle with the engineers to think outside the box. That was the challenge" (Ibid.).

Regarding project managers in general, Peter said the best type of manager is "someone who has practical knowledge in construction…You have various levels of

expertise and it depends on who you get…it would help for them to be LEED certified. They understand that in the end you have to build a building and there are costs associated with that. You make compromises and not sacrifices. A good manager recognizes that and can make compromises and get the building done on time" (Ibid.). Peter summed up his feelings in one concise statement: "[You] must rely on the other professionals you are working with to help you" (Ibid.). A successful construction process is about being a team player.

Plans for monitoring the building after completion include the use of kiosks to measure and educate about building performance. The overall purpose of the kiosks is to help understand the building and provide information for education purposes. "The intent was to have the students and faculty have a way to measure the data. There will be an awareness. What is our consumption? How do we make it better? We are learning from it. It's a tool, the whole building" (Ibid.).

CCCC will also develop a course using the information collected from the kiosks. The course will be on various systems and will comprehensively cover sustainable design technologies like fuel cells, solar energy, and wind turbines. Also, the College plans to disseminate up-to-date building system information on the web.

Many sustainable design technologies were studied for inclusion in the building, but some were determined not to be feasible at the time. "The school was aggressively looking at a fuel cell, but the cost was prohibitive so they settled on the photovoltaic system. They had a fuel cell already, but were looking for a new one" (Ibid.). The school also decided not to erect a wind turbine. "The College is ahead of the curve because they are dealing with these issues on a local level. They have enormous energy

costs, parking issues—they are coming to the table and [already] understanding these issues" (Ibid.).

Delays and timing became issues with the building's construction. There were also funding issues that put the project on hold for a year. Another obstacle to overcome was the state of the economic environment in the commonwealth. As a result, the firm was "a month or two away from completing the documents for bid, then economic recession delayed the process" (Ibid.).

Budgeting issues that arose included having to increase the original $6.5 million number by $600,000 due to the "sustainable design strategies and what they [CCCC] wanted to achieve to get a Gold rating" (Ibid.). There were other factors as well, including market influences. "We had escalation due to delays and market factors like steel. One of the buildings was being built when the price of steel was increasing by 20%"[11,12] (Ibid.).

Life cycle cost analysis (LCA) and energy modeling were used to help design the building. For the LCA, they looked at various traditional and renewable energy systems and interior and exterior design items like choosing between brick and tiles. "It's an educational facility that's going to be around for a while so you want the materials to be around for a while. There is a sense of the quality of design too. We were looking at it as being an education facility so the materials have to last and be relatively maintenance-

[11] "China's ravenous appetite for steel has more than tripled selling prices, turning gluts into shortages". (The Associated Press, "China both consumer, competitor", June 23, 2005).

[12] "Consolidation and restructuring has made the steel industry leaner, stronger and more profitable. But what's been good for the steel industry has been painful for steel consumers, who say tariffs and Chinese competition are causing steel prices to rise and forcing companies to declare bankruptcy. "It's been a nightmare over the last two years. Most Americans don't understand what an impact steel pricing is having on U.S. manufacturing," said Bill McKibben, vice president of marketing and product development for Michigan auto supplier Pridgeon and Clay Inc." (The Associated Press, "Pain for steel consumers", July 4, 2005).

free" (Ibid.). Overall, they "used more common sense and context," utilized a 20-year payback, and assumed a 60-80 year lifespan (Ibid.).

Energy modeling and efficiency were priorities for the project. Designers had a goal of having the building operate a certain percentage above the state energy code. It ended up being 35% above code, a direct result of the modeling exercise (Ibid.).

The commissioning process for the building was established as soon as the earlier study was released. The commissioning agent, Shooshanian Engineering, Inc. (SEi), was involved from the very beginning, providing stability to the process. According to Peter, "commissioning is one of the [LEED] prerequisites, so the sooner you start that, the better…We started with commissioning, talking to Shooshanian right during schematic design…They were involved throughout the whole process. Everyone had to interact with the energy modeling [stage], so that information had to be disseminated" (Ibid.). Part of the commissioning process includes coordinating all the documentation and providing it to the commissioning engineer who then organizes the protocols that are used for functional testing. Commissioning in earnest—the actual testing—should commence in the summer of 2005.

Lessons were learned during all phases of the project. One lesson in particular involved insulation: "As we were working on the envelope design there was something we learned—that adding more insulation does not necessarily provide better energy savings" (Ibid.). Two inches of insulation maxed-out the energy savings—"otherwise, they would be using more energy to ventilate the building…they could have actually increased energy costs if they kept throwing insulation in there" (Ibid.).

More general lessons were also realized, such as the notion that sustainable design requires a steep learning curve. Peter noted, "It should be easier the next time around" (Ibid.). Another lesson learned is the necessity of finding out which professionals and which services are on the cutting edge of sustainable design like solar design specialty firms or waste treatment system companies. "Knowing who/where those consultants are is important as is the need to be more critical with the hiring of additional firms. There are not that many firms we can turn to. If it's a team, we bring them to the table" (Ibid.). The concept of being a team has been important to the Lorusso Center's entire construction process from the very beginning. Peter's concluding statement stresses the importance and responsibility of being a member of this team.

Stephen Harper, Contractor, APW

Stephen Harper (no relation to Glenn Harper), Senior Project Manager for APW (A.P. Whitaker and Sons, Inc.), the general contractor for the Lorusso Technology Center project, had a different perspective on sustainable design than the previously interviewed professionals. His company bid on the project and won, but Stephen had no previous LEED experience. They had done some prior research on LEED in preparation for participation in future sustainable design projects, but the sustainable design construction process and requirements were still new to Stephen and APW.

Stephen did a lot of work to learn about LEED requirements and sustainable design philosophies in general. As the leader for the project from the general contractor's perspective, he had his work cut out for him. It was necessary for him to figure out the requirements needed not only from his perspective but also from each sub contractor. He

also had to train the subcontractors regarding requirements for product submissions. Throughout this process, he had to keep cost implications in mind.

If he had not completed the background work to learn LEED and sustainable design techniques, Stephen said, "We'd be in big trouble. We are always well prepared when we go into a project" (Stephen Harper 2005). Echoing Peter's sentiments on the learning curve, Stephen added, "My next LEED project will be easier…whenever you are trying to learn something new, there's a learning curve and you can't just pick things up on one project...the more and more you do these projects the easier it will become" (Ibid.).

Stephen's position on sustainable design is positive. "I think it's a great idea personally. I feel that the industry still has a lot of issues it needs to work out because it's so new. There are plusses and minuses for the taxpayers and contractors and professionals that construct the projects. In general, it's a good idea" (Ibid.).

Stephen was asked if he would prefer to include more sustainable practices into a building that he was constructing. His immediate answer was, "From a taxpayers standpoint, no" (Ibid.). He continued, explaining the reason for his answer: "I have not seen any major benefits to the taxpayer. I don't think the taxpayers are going to see a return on their investment. I think the costs are going to outweigh the benefits. In the future, I'm sure that gap will close—you have to start somewhere. I suppose we are starting at the beginning and no one said it is going to be easy, but there is a cost attached to sustainable building designs" (Ibid.).

One area Stephen sees as having the potential for saving money is in recycling. However, he was quick to point out the drawbacks. "There is a cost to [recycling] too—

the amount of time a project manager puts into this additional task…and due to others on site who are not paying attention—they may throw items into the wrong Dumpster. This happens often. You then have to pay someone $30-40 an hour to climb into the Dumpster to remove the items and put them into the proper Dumpster. Worse case scenario, it's probably a wash" (Ibid.). Even with this added level of difficulty, overall, Stephen believes that "it is a good idea to pursue recycling" (Ibid.). Stephen mentioned the biggest single item in a project one can utilize is recycled steel, mostly because China has created a crunch. Referring to this particular subject, Stephen commented, "In the industry—if it's cost effective, they are going to do it" (Ibid.).

Construction specifications and product submissions were the source of a lot of administrative time, bureaucracy, and headaches for Stephen and his team.

> As part of the LEED building certification process, there are mountains of paperwork and documentation on almost every product that goes into the building that must be prepared by us and forwarded to the LEED architect (consultant hired to put together the final package for submission of and to obtain the gold certification rating from the USGBC)…As part of this, APW keeps a submission log. This log records in summary format each and every product submittal that has been documented for every product and/or building material that will be used in the building.
>
> For example we put together a submittal for sheetrock that included the following: complete specification data for the gypsum panel including who makes this particular panel, the size of the panel, the type of panel, the fire rating, and shop drawings if required…Since it is a LEED project, we also have to submit and include in our submittal package certain information as required by LEED…so we included as additional documentation a LEED material credit documentation sheet…This includes the address of the manufacturer and an attached map with the calculated mileage proving that it is less than 500 miles.[13]
>
> The product must also be delivered to the site with the proper factory code proving that this product did in fact come from the stated location. You also have to list the percentage of recycled materials that go into each material that you will

[13] To obtain LEED credit 5.1 for local/regional materials, the material must have come from a location within a 500-mile radius of the jobsite.

> use on the project broken down to the percentage of post consumer and post industrial content for credit 4.1. You then attach the appropriate signed documentation from the manufacturer of the product stating this rate of recycling for their product and must attach this sheet to the credit sheet also. You need to do the same for credit 3.1, salvage or refurbished materials, stating and documenting the origin of the materials with the appropriate backup attached…
>
> One submittal does not get you the credits you are looking for…it takes many products and many LEED materials credit documentation sheets to obtain credit from one credit category. After you produce all of the required information, you need to compile all of this information into the LEED letter template of which in the end is a statement on your company's letterhead stating that you have met all of the requirements for each credit. Attached to this is all of your backup that is submitted to the USGBC along with the rest of your required LEED submissions to obtain the Gold rating.
>
> (Ibid.)

To qualify for LEED certification, the contractor must keep a submission log, or product data sheet, that is ultimately sent in to the USGBC for approval. The log for this project contained over 70 pages and 300-400 entries. "It's an enormous task. Administration-wise, it's *a lot* of work, and I don't think people realize what it takes to put this together" (Ibid.).

The State, architect, and the USGBC all have product specifications that must be met. One of the most frustrating and time-consuming things for Stephen and his team was the lack of coordination between the LEED specifications and the architect's specifications:

> It's up to the State, the architect, and the architect's specifications writer to come up with a project specification that is written around the required products that will meet the LEED requirements. Per state law, they must list at least three products that are equal and will meet the requirements of the specification. Items specified for the project…did not meet the LEED requirements as they should have. This added additional confusion on what exactly they were looking for and added much additional administration time…to purchase certain materials and produce the appropriate material specifications and backup that would in fact meet the LEED specifications. This information had to be submitted to the architect for approval.

> Sometimes, we would submit an item or material that was specified by the State and the architect for approval with all of the backup only to have it come back not approved. We would then have to find another product that would meet the requirements that they were looking for. This should not have happened because the specification should have been written 100% around building materials that meet all of the LEED requirements.
>
> (Ibid.)

For example, the architect's and state's specifications must list three equal flooring products in the flooring specification section. Stephen claimed that some of the products submitted by APW were on the State and architect's list but were rejected "due to not having enough recycled content". Stephen believes that it's due to the "issues/problems with the specifications writer and how well he knew the products" (Ibid.). He also claimed that "there were things in the specs that the architect specified that maybe didn't meet LEED" (Ibid.). He also mentioned that this happened frequently and consumed much administrative time and also held up the project in other areas. Glenn Harper, who was sitting in on the interview interjected, saying, "they had to submit things four times sometimes!" (Glenn Harper 2005).

To clear up confusion, Stephen suggested rewriting the construction specifications for clarity. "It would help if there were better instructions up front" (Stephen Harper 2005). He also suggested that on the next project, "the architect should use a specification writer that is very much in tune with LEED building products to minimize these issues the current writer had and maybe review the project specification more carefully before it goes out to bid the next time" (Ibid.).

Stephen continued, saying, "There were a lot of additional statements that seemed to be added to the specs after the original spec was written. These 'add-ons' were sent to

us in addendum form right before the project was bid upon. This only added to the confusion. Better explanation of the project in the design phase would make things go easier. And better coordination between the architect and the spec writer" (Ibid.).

Stephen wished to point out that he is not blaming any one person or event for the headaches he encountered. He is trying to "point out an area of the process that could be made much better and clearer and that would help reduce much administrative time" (Ibid.). He advised not to place blame on anyone but rather acknowledge that this is a new process for many of the people involved. "They really don't know how the LEED aspects of building specs should be written. In the short run, I believe this will cost the Massachusetts taxpayers to get [professionals] up to speed. In the end, the environment will be better for it, and our children, but there is definitely a learning curve" (Ibid.). The MTC acknowledges this learning curve: "The process of applying for rebates and certification may also add to costs and extend schedules for first-time green building teams" (MTC Energy Information website 2005).

Stephen views LEED certification as a positive marketing tool. He believes that hiring a LEED certified professional in his firm and having a completed LEED building in his portfolio will also make his company more viable when seeking future contracts. When asked if he would take another LEED project in the future, Stephen responded,

> It's been a very tough year for me. It's not a large project but it was a very important one to APW and myself and I know to many others. Yes I would accept it—you do what you have to do. Sometimes the more difficult projects are the more rewarding ones in the end. However, I would approach the project differently. I would sit down in the beginning and come up with parameters…We now have a better idea about what is involved and would be able to put our experience and know how to use for the next LEED project. We are in the trenches.
>
> (Stephen Harper 2005)

Stephen ended with the following sentiment, “Everybody’s been professional, everyone is trying to do a job. I think this project will be successful, the building will be beautiful, and it will be a great marketing tool” (Ibid.). Stephen was confident that with the experience gained from this project, the state will “choose us over somebody else” for future sustainable design projects (Ibid.).

Conclusions

Several themes reappeared in each interview. Everyone agreed that sustainable design is beneficial for humans and the environment and that there is a learning curve to participating successfully in sustainable design projects. Teamwork was another theme that was highlighted.

The contractor encountered setbacks during the construction process, but these setbacks can be applied to future sustainable design construction projects to improve the process. Issues arose that can be used as learning tools including the need to clarify the submittal process. This process caused many difficulties for the contractor resulting in a several month building completion delay. There were other sources for the building completion delay as well including weather, market activity, and difficulties relocating the power lines.

From the beginning of the project, the College was a strong advocate for sustainable design technologies. Prior to the introduction of this project, there was a presence of renewable energy technologies located in other buildings on campus. The

new Technology Center will help the College become a leader both in sustainable design education as well as improve daily building operations.

Having the reassurance that the College was in full support of including advanced sustainable design technologies was critical as it allowed all members of the design and construction team to do their best to ensure the building became a model of environmental sustainability. This was possible to do without having to force certain aspects of the building when it came time to negotiate for the final design. Even without completion status, the project has already received an award for Massachusetts DCAM Programming Excellence.

Contractor Stephen Harper provided a poignant summation of this project: "If you have a good foundation to build on, whether it's a building or philosophical, whatever you are building will come out great in the end" (Stephen Harper 2005).

VII. Final Conclusions and Recommendations

The climate for sustainable design in Massachusetts has changed over the past twenty years. Progress has been made in the form of public buildings that are now being constructed with energy and water efficiency, awareness of the origins of building and interior design materials, indoor air quality, external air pollution, and other sustainable philosophies in mind. These efforts can be attributed to the movement for energy efficiency and high performance building to reduce climate change and global warming and maintain healthy ecological systems. In some cases, the buildings are earning LEED certification. But there are still barriers that are preventing widespread acceptance from all design and construction professionals.

The barriers studied in this thesis (Education and Training, Financial Barriers and Incentives, and Vision and Leadership) as well as those not discussed in detail have at least one thing in common—there are policies, programs, and legislation that can be implemented to overcome them. Several examples of these solutions were presented in Chapters IV and V. Some are feasible and applicable to public construction in Massachusetts and others are not. Some of these recommendations have been effective elsewhere in the country.

Barriers, Policy Instruments, Recommendations

Table 3 is a chart based on the work of Mark Roseland that organizes suggested recommendations and objectives to mitigate the barriers to sustainable design according to the Barriers, Policy Categories and Policy Instruments in which they fit.

Table 3 – Recommendations for Barriers to Sustainable Design and Their Associated Policy Instruments

BARRIER	POLICY CATEGORY	POLICY INSTRUMENT	RECOMMENDATIONS and OBJECTIVES
Education and Training	Voluntary Instruments	Information	Implement education curriculum in schools
	Voluntary Instruments	Information	Implement education curriculum in municipalities
	Financial Incentives	Subsidies	Subsidize LEED training programs and LEED testing; subsidize energy modeling, life cycle cost analysis, sustainable design education programs for architects and engineers
	Voluntary Instruments; Expenditure	Information; Monitoring	Implement a case study/database system to audit building success
	Voluntary Instruments	Information	Increase overall sustainable design product knowledge
	Voluntary Instruments	Information	Create statewide awareness about need for water and energy conservation
	Voluntary Instruments	Information	Educate, inform and lobby politicians and agency heads
Financial and Incentives	Financial Incentives	Reward	Awards/Recognition system for remarkable sustainable design professionals/organizations
	Financial Incentives	Reward	Award incentive to contractors who build on-time or faster
	Expenditure	Expenditure and Contracting; Investment and Procurement	Change criteria for State's bid process (from lowest bid to most qualified bidder)
	Financial Incentives	Subsidies and Tax Incentives	Tax Credits; revolving funds; bonds
	Financial Incentives; Regulations	Reward; Permits	Fast-track permits and inspections
	Expenditure	Expenditure and Contracting	Allow room in budget to hire more experienced building managers
	Voluntary Instruments	Technical Assistance	Create a program similar to DCAM's House Doctor but with sustainable design consultants
	Regulations	Standards	Required commissioning
	Financial Incentives; Voluntary Instruments	Rebates; Grants and Loans; Information	Better publicity of energy efficiency incentives and utility rebate opportunities
	Financial Incentives; Voluntary Instruments	Grants and Loans; Information	Better access to grants, financing, and funding options (start with MTC)
Vision and Leadership	Voluntary Instruments	Information	Produce a succinct mission statement from Roundtable inception
	Voluntary Instruments	Information	Position Massachusetts as a leader in sustainable design
	Voluntary Instruments	Information	Engage politicians and other people in positions of power

Table 3 – Continued

Vision and Leadership	Regulations	Standards	Better coordination between state agencies
	Voluntary Instruments	Information	Better direction from "above"; Buy-in from agency heads and higher
	Regulations	Standards	Better coordination between State, architect, and USGBC specifications; easier submission process
All Barriers	Regulations	Laws	Executive Order or legislation for all buildings to be built to LEED certification or a certain % above code

The following sections provide a discussion based upon the recommendations and objectives presented in the above table.

Education and Training Recommendations

The Education and Training barrier provides a rich source for recommendations. There is an acute need to educate professionals about building maintenance, incentives that are available for sustainable design, and the general benefits of sustainable design. To minimize this information gap, the State should consider offering subsidized LEED training programs and testing. This would make professional LEED accreditation and building project LEED certification more accessible. Additional education opportunities for architects and engineers on the tenets of sustainable design would also be beneficial. This could also include training on life cycle cost analysis and energy modeling.

Implementing a rigorous education program in all school systems is another recommendation. Education opportunities exist within communities as well. The state could offer information sessions and training programs to help spread the word about sustainable design on a municipal level to attract more of an audience. Educating the

citizens of Massachusetts to the level where they can understand why they need to conserve energy and water and how conservation relates to sustainable design is included in this recommendation.

The media can be useful in disseminating information. There have been several newspaper articles written recently about sustainable design and green buildings, especially in the Boston Globe[14]. Those articles help publicize sustainable design. Going a step further and reaching out to local news stations to run a segment on the latest public green building project or contacting WGBH to do a show on sustainable construction on "This Old House" would also be a way to educate the public.

Furthering the public's education about the differences between a traditionally constructed building compared with one built with sustainable design technologies is another recommendation. The State could document sustainable design projects and measure their success with a database. Comparing the two construction techniques could be an interesting research project for the future. This comparison would be more feasible after the database is set up and populated with data from existing projects.

Based on Roseland's policy analysis in "Toward Sustainable Communities – Resources for Citizens and Their Governments," the policy instruments that may be used to educate citizens about sustainable design and provide courses for professionals are subsidies and information. Information provided to the public will allow people to potentially become better informed. This in turn may lead to people making better decisions.

[14] In the past year, there have been several articles on green building in the Boston Globe including articles on July 8, 2005; May 29, 2005; February 27, 2005; November 18, 2004; November 10, 2004; November 6, 2004; October 21, 2004; October 14, 2004; October 12, 2004; September 30, 2004; September 12, 2004; and September 6, 2004.

Financial Barriers and Incentives Recommendations

Fast-tracking building and construction permits and inspections that are associated with sustainably designed projects is a recommendation based on regulatory relief that addresses the Financial and Incentives barrier. The greener the project, the more expedited the permitting process. This kind of reward and incentive policy instrument has been used in Arlington County, Virginia as well as in Scottsdale, Arizona and is offered for further consideration in Mayor Menino's Green Building Task Force Report Executive Summary. While this incentive can be useful for private developers, it might not be as useful for state projects. Another incentive that falls into this same category is the tax credit. Although these incentives do not apply to public construction, they should be mentioned because they could be powerful tools to encourage private design and construction projects.

Providing recognition to those designers, developers, and construction professionals who consistently strive for environmental sustainability in their work is an incentive that may be used in public construction. If there was a rating system or commendation list that would allow project managers to differentiate between professionals with experience and those without, it might drive contractors to bid upon and win more green building projects. Essentially, this system would capture some of the market-based allure to LEED certification (both certified professionals and buildings). LEED's market-based allure relates to its capability to be used as a marketing tool both for the company inhabiting the building as well as the building itself. As DCAM already has an awards program in place, a more specific recommendation would be to provide a

separate award for sustainable design construction projects. This reward policy instrument could potentially improve upon the program.

Implementing a required level of commissioning would help alleviate the high cost of maintenance. The commissioning process should extend into the daily operation of the building instead of coming to an end before or soon after the building opens. Identifying systems failures earlier in the building process can save both time and money. A related recommendation is for the State to focus more of its budget on hiring qualified, experienced building maintenance workers. The policy instrument utilized in this case is expenditure and contracting.

DCAM's house doctor program serves as the basis for a recommendation regarding guidance, education, and financial issues. At DCAM, a house doctor is an on-call designer, ready to help out with a project as needed. DCAM could implement a similar program with sustainable design consultants as house doctors. As the program takes shape and becomes more established, it is possible that professionals at DCAM will gain increased expertise in sustainable design technologies and philosophies as they work side-by-side with a consultant. This in turn has the potential to reduce costs incurred by inexperienced project team members. Ideally, at some point, the house doctor program would become obsolete. This recommendation falls under the technical assistance policy instrument category.

Awareness of available incentives is another issue. The Massachusetts Technology Collaborative (MTC), which is a quasi-public agency, does an excellent job of posting incentive opportunities on its website. The list of past funding awards is exhaustive. However, there might be some professionals and Massachusetts citizens who

don't even know the MTC exists even though they support the agency via their electric bills. An information gap exists between the public and sustainable design funding opportunities. A recommendation would be to better publicize and organize available grants and incentives. Similarly, energy efficiency incentives and rebates exist from the electric and gas utilities that could be more widely advertised and taken advantage of.

There are certain things DCAM can do to make changes. One suggestion is to change the criteria for which the contractor is chosen. Currently, the contractor and subcontractors are chosen by selecting the ones with the lowest bid. . Instead of requiring the state to choose the contractor with the lowest bid, some leeway could be allowed to take past experience and qualifications into account. A contractor with experience may be more likely to finish a project on time than one without the experience. If this is the case, the final budget of a project could be affected as project delays cost money. Another option is to provide an incentive for a contractor that finishes a project on time or ahead of schedule. That allows for contractors with no sustainable design experience to prove they can do the job.

Another reason to change the bid process is to ensure early integration of team members. According to Barbra Batshalom of The Green Roundtable, "In the public sector, there need to be critical policy changes in terms of procurement and Chapter 149. This policy is a direct barrier because you can't put together a team until after the bid. Architects and designers are on board, and then the contractor comes on board. And it's always the lowest bid. That's one that needs to be changed" (Batshalom 2005). It is important for the contractor to be involved with the project at an earlier stage because the architect provides the materials specifications. The sooner the contractor can access that

list, the more likely they will be able to find the specified materials and the fewer surprises that may arise further along in the project.

Vision and Leadership Recommendations

One of the more critical recommendations associated with the Vision and Leadership barrier is to make an effort to reach out to key politicians and policy makers. Without their leadership and participation, the change seeking process may fall short of its goals. To accomplish change, people with the power to make that change happen need to be informed and involved in the process to the greatest extent possible. Excellent candidates for these leadership roles include Commissioners and Secretaries of Massachusetts agencies like the Division of Capital Asset Management, the Executive Office for Administration and Finance, the Division of Energy Resources, the Executive Office of Environmental Affairs, and the Department of Environmental Protection (under EOEA). Politicians like Representative Jim Marzilli should also be tapped for their ability to make change. Marzilli has a proven track record for introducing environmental legislation.

The next recommendation continues along a similar political vein: positioning Massachusetts as a leader in environmental policies. Massachusetts currently has a middling status in terms of environmental leadership. If the importance of being a leader was communicated to the citizens of Massachusetts by putting the environment into perspective and making it a personal issue, that would be beneficial. Sustainable design proponents and politicians could make the environment less of an external issue and more of a personal issue, like showing citizens the environmental connection to the increased

rate of people with asthma in Massachusetts[15] and pointing out how many people in the state purchase bottled water (Ibid.). Sustainable design is also about the money and energy savings, increased productivity and higher indoor air quality. It is important for State leaders to stress these positive outputs and push for change.

Better coordination of the efforts of State agencies like MEPA, DEP, EOEA, MBTA, and Massport is a recommendation that will require someone with extensive leadership skills. During the Sustainable Design Roundtable Meeting held on June 9, 2005, Barbara Boylan of the MBTA gave a presentation on the MBTA's efforts to be more environmentally aware. In her presentation, she said "To help the MBTA follow the Office for Commonwealth Development's Sustainable Design Guidelines, it would be helpful if it was easier to implement the techniques and if they were not arguable. That is, if the guidelines were required and there was no way to get out of including them" (Boylan 2005). Essentially, Barbara was saying the MBTA is willing to implement the design guidelines, but they need to be told what to do. This calls for leadership. MEPA also has a vast amount of potential to implement policies, but without strict guidelines, it makes it more difficult to enforce recommendations to developers. Additionally, better coordination of the State specifications, architect specifications, and USGBC LEED requirements is also recommended. Ensuring that materials on the State and architects' specifications list are maintainable is important as well.

[15] "Asthma rates in Massachusetts are higher than the national average…Several studies have linked air pollution with asthma and additional studies provide evidence that a reduction in air pollution would reduce the number of asthma episodes…The current percentage of people with asthma in Massachusetts is higher than the national average (9.4% vs. 7.1% in 2001)...The Massachusetts DPH has indicated that ambient air quality is a factor leading to higher rates of asthma in some cities over others. They cite improving air quality as one of their goals to reduce the burden of asthma in Massachusetts" (Asthma Fact Sheet).

Composition of a succinct and poignant mission statement that identifies the purpose and direction of the group is a recommendation that is directed towards the Sustainable Design Roundtable itself. The mission statement should include both an immediate and long-term mission. Discussion should center not only on the "what" of the Roundtable but also the "how".

This recommendation comes in hindsight that the Roundtable has been working for seven months before a draft Statement of Purpose was created. Essentially, for half of the existence of the Roundtable, there was no guiding mission statement. From a participant's perspective, this contributed to a lack of direction. Members continued asking what the purpose of the Roundtable was—was it to make policy recommendations to the Governor? And if so, what were those recommendations and how were they going to research the correct ones?

Finally, a draft mission statement surfaced in mid July. The Statement of Purpose reads as follows:

> Through research, collaboration, and deliberation from January 2005 through February 2006, the goal of the Massachusetts Sustainable Design Roundtable is to develop a set of recommendations that, if adopted, will ensure incorporation of sustainable design and construction techniques and technologies into new construction projects that are funded, built, or overseen by state government. In conducting its work, the Roundtable will focus on elements of sustainable design that include, but are not limited to, energy and water consumption, material and resource use, site design, indoor air quality and waste generation.
>
> When making its recommendations, the Roundtable will first consider those buildings that are built and/or funded by the Commonwealth, including projects under the jurisdiction of the Division of Capital Asset Management, all executive state agencies, state colleges and universities and public schools. Where possible, the Roundtable will also consider in its research other building projects that are overseen by state authorities as well as those that are reviewed by the Massachusetts Environmental Policy Act Office (MEPA).
>
> (Draft Massachusetts Sustainable Design Roundtable Statement of Purpose 2005)

This mission statement is broad and does not provide insight into how the Roundtable will operate and come to conclusions. As this is only the draft statement, there is still room for improvement. Consequently, "If you don't have a vision and a mission statement, where are you going to end up? They help frame the purpose and focus of the activities of the group is engaging in. It's important. If you don't have it you are assuming people are understanding a common mission and they might not" (Batshalom 2005).

Executive Orders and Legislation

A regulatory recommendation that spans all barriers is for the Sustainable Design Roundtable to make a suggestion to the Governor to declare an Executive Order requiring publicly constructed buildings to be built to LEED certification. An even more stringent recommendation would be to urge the Massachusetts legislature to create a bill requiring LEED certification. If this declaration were a law, it would be easier to enforce than an Executive Order. Additionally, Massachusetts could then join the ranks of the two pioneering states, Washington and Nevada, that have such laws on the books. According to Bill Reed, one of the nation's leading experts on green design, "All buildings should require a LEED rating" (Reed 2005). This would help Massachusetts retain its reputation for being progressive in its environmental record.

Another option is to require state buildings to build projects to certain levels of sustainability (including energy efficiency, maintenance, and overall performance) but not be required to meet LEED certification. Sustainability may be achieved by constructing a building that achieves a certain percentage of improvement above the

established energy code or by using the specifications in DCAM's Sustainable Design Guidelines found in the Instructions for Designers. Essentially, the current DCAM specifications serve as requirements for sustainable design. It is possible to tighten these specifications to make them achieve even more sustainable goals by making more of the sustainable design technologies and products baseline requirements instead of recommendations.

The State's first LEED certified green building

The Lorusso Center for Applied Technology at the Cape Cod Community College in Barnstable, Mass is the State's first LEED certified building. Its construction also presented an opportunity to compose a list of recommendations and lessons that stem specifically from that process. Those recommendations and lessons are:

- Investigate the possibility of hiring contractors with LEED experience.
- Integrate DCAM's construction design instructions with state construction specifications and LEED product listings.
- Stress the benefits of integrated design.
- Make the product submission process easier.
- A good study can be a good foundation for a good building, but does not guarantee a process free of budget or on-time issues.
- Having a team contract is beneficial.
- Take advantage of the initiatives offered by the MTC for feasibility grants and utility incentives and rebates.
- Have an excellent working knowledge of the materials and products being used in construction of the building. For example, the insulation at the Lorusso Center.[16]
- Increase the sustainable design education level of both contractors, architects, and DCAM project managers and resident engineers.

[16] From Chapter VI: "As we were working on the envelope design there was something we learned—that adding more insulation does not necessarily provide better energy savings" (Fourtounis 2005). Two inches of insulation maxed-out the energy savings, —"otherwise, they would be using more energy to ventilate the building…they could have actually increased energy costs if they kept throwing insulation in there" (Ibid.).

Survey of professionals' thoughts on the most potent barrier to sustainable design in Massachusetts

The following is a list of five professionals' interpretation of the most critical barrier to sustainable design:

- **Barbra Batshalom, Executive Director and Founder of the Green Roundtable:** "Mindset. More specifically, people not understanding that people thinking it's adding on stuff. If they can get over the mindset, then people can get over the cost issue" (Batshalom 2005).

- **Bill Reed, Integrative Design Collaborative:** "People's inability to think about [ecological] systems. It's not just about buildings. We're not just about buildings. Healthy habitat makes clean soil. Clean soil makes clean water. Saving money doesn't really motivate people. In reality, we are not sensitive to because we don't make the connections" (Reed 2005).

- **David Berkowitz, Assistant Director of Design at DCAM:** "Cost as a barrier is a myth…[it] is not the largest issue. It does play a role, whether by perception only, but it is not the main barrier, as commonly perceived by design and construction professionals…The problem is maintenance. Commonwealth of Massachusetts/DCAM is open to spending money on technology. We spend lots of money putting in energy saving systems. Cost is not the issue. The major issue is maintenance. That's where all these systems fall down" (Berkowitz 2005).

- **Peter Fourtounis, Program Manager, Dimella Shaffer:** "Biggest barriers are to get people to think outside the box, and that goes for clients, consultants, peers, you name it. Any one of those people may need to be brought along in the process" (Fourtounis 2005).

- **Stephen Harper, Senior Project Manager for A.P. Whitaker and Sons, Inc., General Contractor:** "Cost" (Harper 2005).

- **John DiModica, Program Manager, Energy Efficiency and Sustainable Design, DCAM:** "Integration of design efforts and lining up and leveraging the various incentives available. There are two separate issues. The first is related to the design process that often has architects and engineers operating in silos independent from one another. Better integration of such efforts will provide better results and more creative, comprehensive solutions to a wide range of issues related to sustainability. From energy to materials use, from indoor environmental quality to implementing the solutions with the lowest life cycle costs. Separately, the issue of utilizing and leveraging all available

> financial incentives will help to result in lower cost projects with higher returns on investment. Getting the financial incentives lined up will help to prove that sustainable design and construction *is* the ideal low-cost/high performance alternative" (DiModica 2005).

A few of the opinions expressed by the five professionals involved with sustainable design are similar. Batshalom and Fourtounis see the biggest barrier to sustainable design to be mindset and creative thinking. Both of these are psychological barriers and may be mitigated with education. Reed mentions the inability to see the earth's systems as a whole—this also relates to education. Harper, the contractor, believes cost is the main barrier. And Berkowitz emphasized the ability to maintain buildings and energy systems as another major barrier.

This survey was interesting because even though it only targeted five people, their professions vary as well as their opinions. It also provides insight into ranking the most critical barriers to sustainable design. Education and Training and Financial barriers are both represented in this brief survey.

Future Research Opportunities and Final Conclusions

An interesting future step would be to make a comparison between the construction process of the Cape Cod Community College project and future LEED certified state buildings. Since the Lorusso Center building was the State's first LEED project, a comparison was not feasible. Additionally, an analysis of the Roundtable process after its conclusion and the effect it has on the future of sustainable design in Massachusetts would also be interesting.

This thesis shows that while there has been much progress made with regards to sustainable design education, finances, incentives, vision and leadership within the state of Massachusetts, there is still much room for growth. There are many possibilities for future research and study on this topic as it is constantly evolving. The ability to enact change is available to those who wish to dedicate themselves to the cause.

Appendix i

IRB Proceedings

This thesis received an exemption from IRB review for the following reason: "Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior UNLESS the information is recorded in a manner in which the subject can be identified AND disclosure would place the subject at risk of criminal or civil liability or be damaging to financial standing, employability, or reputation. This does not apply where the subjects are children except where it involves passive observation of public behavior." (Helen Page, Institutional Research Board Administrator, letter dated February 15th, 2005).

Appendix ii

Commonwealth of Massachusetts Sustainable Design Roundtable Brainstorming Session: Full Text

The following is the full list of perceived barriers as identified by participants in the brainstorming session:

- Lack of awareness – what sustainable design is and what its benefits are
- Perception that it is always more expensive to design with sustainable strategies.
- Focus on programming space as a priority (over life cycle issues)
- The schism between Capital budget vs. Operation/maintenance budget
- Contractor/Subcontractor Qualifications
- Lack of follow through- Review & Process & Monitoring (to understand the impact of building operations financially and environmentally)
- Inappropriate payback expectations (short payback always more important – not considering other priorities)
- User groups have their own standards that have nothing to do with sustainability (and do not understand how sustainable strategies can address their needs)
- Lack of public education
- Misconception that green building HAS to cost more, don't understand that any building can be made more green.
- Misconceptions of product performance (think 'green' products won't perform as well)

- Lack of knowledge about building operations by design professionals and users.
- Risk aversion - business as usual is safer even if it is wasteful or unhealthy.
- Lack of shared knowledge of case studies (transfer of lessons learned).
- Typical time/schedule and fees allocated do not allow for an appropriate design process.
- No qualifications/standards exist for sustainable design.
- It is difficult to quantify productivity and link to design.
- Construction delivery system is a barrier to high quality and integrated design process.
- There is a lack of enforcement of the current laws, never mind higher standards.
- No standardizing of protocols for measuring performance exist.
- Financial decisions are based on fact (unreliable data). We don't record the facts - needs to have a central point of reference. Historical database needs accuracy.
- Deferred maintenance is a problem.
- No system of standards used – like implementing LEED™ and tying to SBA points for public schools.
- We don't use construction opportunities to model success (public buildings should be models).
- Political pressure from special interest groups.
- Lack of awareness about the enhanced productivity and improved air quality in green buildings.
- Frustrating sense of "re-inventing" the wheel with each new project.
- Voters are unaware of links between design decisions and impacts on environment, health and natural resources.
- No long-term monitoring of buildings exists, so we don't even know what we are losing.
- No mechanism or system exists to coordinate projects (and integrate sustainable strategies – manual or template).
- Lack of incentives for high performance buildings (financial or other).
- Agencies don't know where to go for additional info and funding.
- Design professionals need more education on sustainable strategies, building systems and energy modeling.
- Disconnect between state's goals and translation to local municipalities.
- New energy code doesn't have energy budget.
- No way to learn from other (states) successes and transfer that to our state.
- Insufficient resources. Need to increase staffing (at SBA).
- Taking care of existing buildings – There is no ongoing analysis of systems that work/don't work, no audits of current performance or wasted resources.
- Lack of awareness of larger issues (sprawl, energy use, etc) – need larger community awareness in taxpayer population.
- Fear of developed vs. undeveloped land.
- No balanced assessment of systems - an understanding of balanced performance.
- Need more effective partnering between public & private sectors. Lack of communication, need to avoid redundant systems, focus on adaptive re-use.

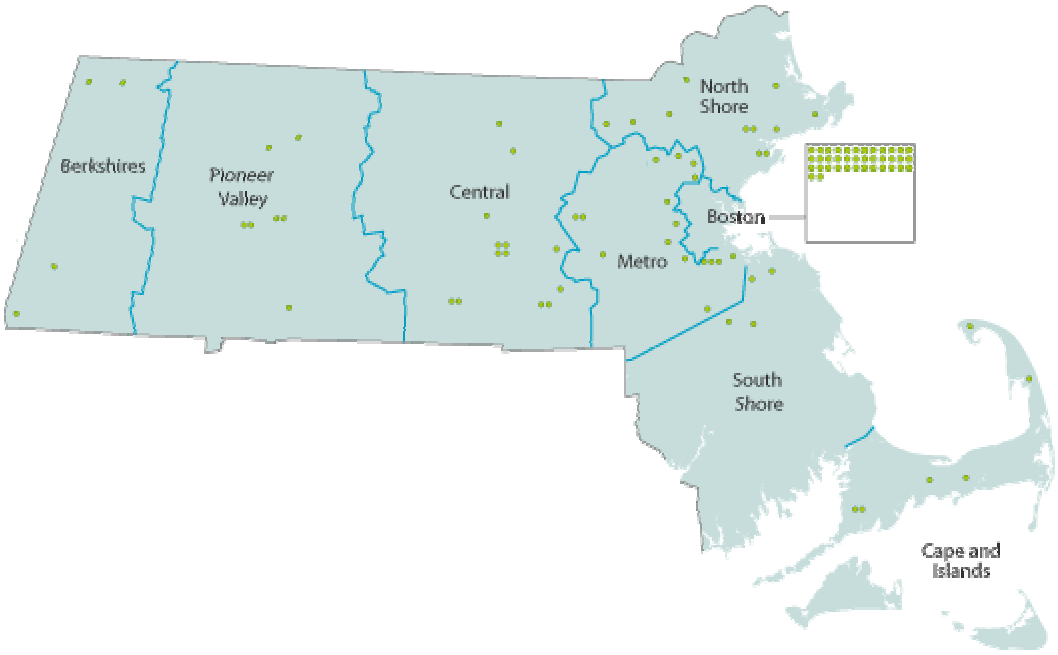
- RFP & bid language inadequate (schools and other) Don't know how to use language to set expectations and get responses for green design.
- Specific problems inherent to construction - no process to screen low bidders - creating adversarial relationships between bidders - can't pre-qualify bidders.
- Under-funded studies and research - little analysis.
- No requirements for an efficiency (performance) standard to receive state funding. No award/bonus program tied to performance.
- Lack of proactive community 'circuit Rider' - communities don't have time or expertise to make decisions.
- Too much complacency - Need to get back to a sense of "urgency."
- Lack of qualified suppliers - systemic requirements impossible.
- Sitting on old landfills - lack of open space.
- No timely input - user agencies don't have info early enough in process.
- End users don't see the overall (externalized) costs in the long run.
- Wasted infrastructure - Need to focus more on renovation rather than new construction.
- Public doesn't understand the problems and need for sustainability for their own benefit.
- Competing concerns by different stakeholders. Conflicting priorities.
- Need to expand grants and incentives.
- No education about this in the schools - lack of curriculum based programs.
- Fear of implementing the obsolete (evolution of technology).
- No way to effectively share risk/liability between contractors/all partners.
- Lack of support for life cycle decisions and processes.
- Not enough early commitment (and standardization) of rebate programs.
- Standard reimbursement rates for school construction not based on appropriate calculations, don't reflect real costs.
- Misguided value engineering and broader impacts on performance. Cost engineering of isolated elements, no bldg. System integration.
- Need for education for legislative leadership.
- Reliance on faulty infrastructure, assumptions that it is best solution.
- Not enough education and training for building managers and operators.
- Need to connect to passion for great building.
- Costs for high performance and building certification not included up-front.
- Fear of the unknown with new technology.
- Public misconception on public reimbursement. Need to educate cities and towns on state reimbursement.
- Language is a barrier. Green is "hokey." High performance is ok.
- Already greatly excessive building cost/sq. foot (lack of awareness that it is unnecessary).
- We follow failed planning models of southwest. We don't focus on the big picture of sustainability.
- We are afraid of regulation.

- Conflict between “smaller is better” and “economic efficiencies”. Difficult to spread costs on small projects.
- Need for performance goals as opposed to prescriptive standards.
- Very little incentive to promote mass transit and connection to site choice.
- Need to quantify social benefits of green projects and understand larger societal value.
- Need a more comprehensive outlook of life cycle costs and outcomes.
- Need to develop better communication channels between public agencies as well as between public and private sectors - central system?
- Lack of a widespread effort to bring “green” into mainstream practice.
- Inadequate communication: Don’t know who has done what and how.
- Lack of leadership in this effort. Lack of a champion.
- Lack of publicity to provide incentives.
- Designer selection/teams not having clear and measurable criteria for selection.
- Some more $ needed for maintenance. May need regional maintenance funds to overcome deferred maintenance.
- Comparison of “true cost” of NOT being sustainable (we don't understand externalized costs of current practices).
- Need for appropriate trained staffing in schools.
- The need for added design and lowered bureaucracy.
- Lack of shared knowledge (case studies).
- Need standardizing protocols for measuring performance of new and existing buildings.

(Commonwealth of Massachusetts Sustainable Design Roundtable Meeting Notes, Appendix B: Brainstorming Session: Full Text, p. 20-22, February 6, 2002)

Appendix iv

Boston Green Buildings as of May 2005



The projects listed meet LEED, CHPS, or equivalent green building standards:

Allston-Brighton CDC
Artists for Humanity Epicenter
Biosquare Research Building*
Center for Life Science*
Chinatown Neighborhood Community Center
Conservation Law Foundation Building Extension
Egleston Crossing I*
Egleston Crossing II*
Emerson College Piano Row Residence Hall*
Harvard School of Public Health at Landmark Center
Harvard University: Hamilton Hall*
Harvard University: One Western Ave.
Logan Airport Terminal A
Logan Airport Terminal B*
Manulife U.S. Headquarters
MATCH School
Maverick Gardens*
Museum of Science*
Suffolk University Somerset St. Residences
Third Sector New England
WGBH Headquarters*

Projects still in progress as of May 2005 are marked with an asterisk (*).
Source: MTC Massachusetts Green Building Projects website,
http://masstech.org/cleanenergy/facilities/facilitiesmapstategb.htm

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