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LEED in Ontario, Canada

Building industry actors' perceptions on barriers to LEED and its use as a mandated policy tool

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Abstract

The construction and operation of buildings is resource and energy intensive. As a sector buildings are responsible for roughly a quarter of all greenhouse gasses globally and represent a key intervention point in the fight against climate change. Energy and green building certification schemes are an example of tools that can be used in the design and construction high-performance buildings to help mitigate the negative environmental effects of the built environment. The US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) is a market-based third party rating and certification framework increasingly used in the design, construction and operation of buildings in North America.

In Ontario, Canada despite LEED's increasing use both as a government mandated policy tool and private sector certification scheme, the number of buildings registered and certified under the rating system remains small given the overall size of the Ontario building market. With this in mind this research was designed as a qualitative study to investigate what barriers and to what extent those barriers exist in the Ontario building market that prevent the wider implementation of LEED. The study also examined the perception of building industry professionals on the use of LEED as a mandated policy and the potential implications such a policy may have in the building market. Semi-structured interview with building industry experts from four actor groups build design professionals, owners and clients, construction professionals, and green building consultants were used for data collection. The data was analysed through the use of an established barriers to LEED framework.

The analysis confirmed the existence of barriers to LEED present in four categories, applicability, process, knowledge, acceptance, and cost. Cost was shown to be the largest barrier to the wider application of LEED while applicability was shown to have the least influence as a barrier. In addition, industry professionals viewed the mandating of LEED with apprehension citing a number of concerns relating funding and liability issues, and LEED being forced into a role it was not intended to fill.

Keywords: LEED, Barriers, Ontario, Mandate

Executive Summary

Buildings have been shown to exert negative effects on the environment and human health both directly and indirectly. In Canada it is estimated that buildings are responsible for approximately 33% of Canada's energy consumption, use 50% of its extracted natural resources, are directly accountable for 25% of all landfill waste and produce 35% of all domestic greenhouse gas emissions (OCGBDD, 2011). As a market sector, commercial and residential buildings are directly responsible for roughly a quarter of total green house gasses (GHGs) globally. In light of these facts, buildings have been identified by a number on non-governmental organisations, including the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), as a key intervention point in the fight against climate change. Energy and green building certification schemes are tools that can be utilised to address energy efficiency issues in the construction of new buildings and the retrofitting of existing buildings.

The Canada Green Building Council's (CaGBC) LEED green building rating system represents the most widely used certification framework in Canada and in Ontario. However, despite increased use of the LEED rating system the total number of buildings designed, constructed and certified using the system remains small given the overall building market in Ontario, Canada. It is in this light that the first research question sought to answer the following:

RQ1. (What are the barriers to the use and implementation of LEED in Ontario, Canada?) How are they perceived amongst the main LEED actors groups? These actor groups are:

- a) owners/clients;
- b) architects;
- c) construction firms, and
- d) project consultants.

The use of LEED as a mandated public sector policy tool has increased in Ontario since the adaption of LEED to Canada by the CaGBC in 2004. A number of municipalities have used LEED as performance criteria in procurement contracts for the construction of new buildings. Since 2007 the provincial government has also required that all provincially owned new construction meet at minimum LEED Silver certification. The use of LEED by public authorities to address the negative impacts of buildings was the departure point for the second research question:

RQ2. How do actors perceive the use of LEED as a mandated tool to address the negative environmental effects related to the built environment in Ontario?

A literature analysis and semi-structured interviews with industry professionals formed the methods used for data collection. Through an initial literature analysis, a framework to LEED barriers by Hanby (2004) was discovered and adapted to delineate the know barriers to LEED. A subsequent in depth literature analysis was utilised to determine if any unknown barriers outside of the framework have emerged in years following its publication. The interview data was then coded and analysed to determine the barriers to LEED and to what

extent they exist in the Ontario market. The interview data and analysis was also used in answering the second research question.

The interview process and analysis showed that all the barriers identified through a literature review were present within the Ontario market. The barriers were found to be in line with the framework used in the study and were delineated into five categories including acceptance, applicability, knowledge, process and costs. The costs barrier was found to represent the largest barrier to the wider use and implementation of LEED in Ontario. Interestingly, the cost barrier for the most part was not related to increased costs due to construction methods or technologies used but rather as a direct reflection of the LEED certification process itself. The practice of LEED-like and LEED shadowing whereby the LEED system is followed as a checklist in the design and construction of buildings but certification is not pursued, can be viewed as a consequence of the cost barrier in the Ontario market.

Barriers to LEED were identified in descending order of significance after the cost barrier was process, acceptance, knowledge and applicability. In many cases the barriers themselves were strongly interconnected with a number of barriers including process and knowledge having a costs component that further reinforced the existence of the barrier. The cost barrier also influenced the acceptance barrier as it ultimately affected the perceived value of seeking LEED certification on a given project. Building type and square meter construction costs were also shown to influence the perceived value of LEED certification.

In answering the second research question the interview data showed that although the interviewees across actor groups understood the reasoning behind why the public sector use LEED as a mandated tool they were ultimately unsure as to the potential issues such a mandate might cause. Interviewees cited concerns regarding complications with funding and project delivery models, as well as liability and litigation issues arising from the inclusion of LEED as a performance requirement in construction contracts. Informants were also apprehensive of LEED being viewed as a baseline for energy performance and water efficiency in the industry. The mandating of LEED, many interviewees believed, has turned the voluntary system into a "stick" used by the government to drag up performance standards in buildings rather than a "carrot" used by the private sector to reward building designers and constructors to push the top end of the industry in terms of building performance and technological innovation. It was also noted that in the absence of sufficient building codes, the use of standards that use code-like language such as ASHRAE 189.1 were suggested by informants as better tools to address issues of energy performance and sustainability in the built environment.

Table of Contents

List of Figures

List of Tables

Abbreviations

AIA	American Institute of Architects
AFP	Alternative Finance and Procurement
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BREEAM	BRE Environment Assessment Method
CAA	Credit Achievement Anticipated
CaGBC	Canada Green Building Council
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CCA	Canadian Construction Association
CI	Commercial Interior
CIR	Credit Interpretation Request
CMA	Census Metropolitan Areas
EB:OM	Existing Building: Operations and Maintenance
EEWH	Energy Saving, Waste Reduction and Health
EPBD	Energy Performance on Buildings Directive
EPC	Energy Performance Certificates
EU	European Union
GBCI	Green Building Certification Institute
GBI	Green Building Index
GHG	Greenhouse gas
GRIHA	Green Rating for Integrated Habitat Assessment
IDP	Integrated Design Process
IPD	Integrated Project Delivery
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LEED	Leadership in Energy and Environmental Design
LEED AP	LEED Accredited Professional
MNECB	Model National Energy Code for Buildings
MURBs	Multi-Unit Residential Buildings
NC	New Construction
NIST	National Institute of Standards and Technology
P3	Public Private Partnerships
SRI	Socially Responsible Investment
SRPI	Socially Responsible Property Investment
TRACI	Tools for the Reduction and Assessment of Chemicals and other Environmental Impacts
UNFCCC	Framework Convention on Climate Change
USGBC	U.S. Green Building Council

Exchange Rate as at 08/09/11	
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1 Introduction

1.1 Background

The construction, operation and demolition of buildings are associated with primary resource and energy consumption, waste generation, greenhouse gas (GHG) emissions and the release of toxic pollutants into the surrounding environment. At present, buildings consume 32% of the world's natural resources in their construction and use roughly 40% of global energy use in their operation (WGBC, 2010). As a result, the energy consumed in the heating and lighting of residential and commercial building generates approximately 25% of global green house gas emissions (GHG) (UN-HABITAT, 2008). These statistics reaffirm that buildings pose a significant threat to the environment and to the health and well being of the people that work, live and play in them on a daily basis.

Within climate change discourse buildings represent a large portion of end use energy demand and are often identified as a key intervention point. The UN Framework Convention on Climate Change (UNFCCC) Copenhagen Accord recognizes "the scientific view that the increase in global temperature should be below 2 degrees Celsius" in order to avoid "dangerous anthropogenic interference with the climate system" (UNFCCC, 2010). The role that the built environment will need to performance in limiting global temperature rise is well documented. According to the International Energy Agency (IEA) meeting such a goal requires a reduction in global CO_2 emissions of 50% by 2050 of which 52% would need to come from end use energy efficiency (IEA, 2009). To achieve the target of a 50% cut in CO_2 emissions buildings must deliver a large portion of the reduction in the short to medium term (IEA, 2010).

The Intergovernmental Panel on Climate Change (IPCC) stated that improving the energy efficiency of buildings, both new and existing, represents the most variegated and cost-effective opportunities for the reduction of GHGs globally (Levine, et al., 2007). In light of these facts, energy efficiency in buildings has been targeted by both governmental legislation and market-based instruments as a means to confront anthropogenic sources of GHG emission and to aid in the transition to low-carbon economies. Further, the IEA asserts that energy certification of buildings in particular are "a key policy instrument for reducing the energy consumption and improving the energy performance of new and existing buildings" (IEA, 2010, p.7).

Building related energy certification schemes address barriers to energy efficiency, including incomplete information and split incentives known as the principle-agent problem, by raising the awareness amongst both consumers and owners. A number of voluntary and mandatory energy and green building certification systems that address energy efficiency are in use globally. The method taken in different regions varies from a highly regulatory approach in Europe to a more market-based approach in other regions including North and South America, Asia, the Middle East and Africa.

In Europe, mandatory certification and labeling schemes that focus on reducing carbon emissions through assessing and showing the energy performance of buildings are widespread. The adoption of Directive 2002/91/EC, known as the Energy Performance on Buildings Directive (EPBD) in 2003, required that all European Union (EU) member states to legislate national programmes of

rating buildings through the issuance of Energy Performance Certificates (EPC) by 2006 (Directive 2002/91/EC, 2003). EPCs present owners, tenants and buyers with a certificate that indicates the energy performance of a building in its present state along with reference values and legal standards that allow for the building's energy performance to be assessed and benchmarked.

In countries where national regulation on energy certification for buildings is absent, market-driven third-party energy certification schemes are often relied upon as the primary arbiter of energy assessment and labeling. A number of voluntary energy and green building certification systems are available globally. Examples of such systems include: Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Japan; Green Rating for Integrated Habitat Assessment (GRIHA), India; Green Star, Australia; Green Building Index (GBI), Malaysia; Ecology, Energy Saving, Waste Reduction and Health (EEWH), Taiwan; BRE Environmental Assessment Method (BREEAM), United Kingdom; BCA Green Mark, Singapore; Green Globes, United States of America; ENERGY STAR, United States of America; Leadership in Energy and Environmental Design (LEED), United States of America.

Within North America LEED represents the most widely utilised certification scheme. The LEED green building rating system was developed by the U.S. Green Building Council (USGBC) as a voluntary market-based tool that acts as a framework to guide and facilitate in the implementation of green building techniques and technologies in a measurable proactive manner. LEED addresses the impact buildings exert on the environment and human health from a holistic lifecycle perspective that includes the design, construction, operation, and renovation of buildings. LEED certified buildings can be found in 91 countries and currently there are 35,000 participating projects worldwide that encompass roughly 418 million m^2 (USGBC, 2011). LEED as a certification scheme has been adopted by a number of green building councils globally as the de facto system to address issues of energy and water efficiency, as well as human and environmental health impacts attributed to buildings. Examples of countries where the LEED green building rating system has been adapted to specifically reflect the context of the country in which it is applied include Italy, India and Canada.

LEED was adapted to the Canadian market in 2004 by the Canada Green Building Council (CaGBC). Today, LEED is applied to every major sector of the building industry in Canada. However, despite LEED's increasing presence within the Canadian building market, the total area of certified space remains small as an overall percentage. A 2010 GreenMetrx report showed that in Canada LEED certified space encompassed roughly 0.0036% of total non-residential floor space (GreenMetrx, 2010).

It has been acknowledged that green buildings present unique and numerous challenges in design, construction and operation that are often not present with conventional building strategies (Bayraktar & Owens, 2010). Market wide barriers encountered at the individual, organisational and institutional levels present a real challenge to the adoption and widespread use of green building certification schemes such as LEED. Understanding the challenges and barriers faced by green building and building certification schemes is an important step in developing strategies that can be used in overcoming these barriers. Furthermore, exploring how voluntary certification scheme such as LEED are best utilised in confronting issues relating to energy efficient and environmental impacts of buildings can prove invaluable in developing strengthened policies to tackle anthropogenic sources of CO_2 and climate change.

1.2 Problem Definition and Justification

Since LEED's introduction to the Canada-wide market in 2004 the CaGBC has certified a total floor space area of 2,601,581m^2 encompassing 292 buildings under the LEED system[1] (CaGBC, 2011). Despite the rapid growth and market uptake of LEED, the number of certified buildings relative to the overall building stock remains small. This research was developed to investigate potential barriers that may exist in the Ontario market to LEED and its use as well as to gauge green building practitioners' opinions on how LEED is best utilised in the Ontario market.

One of the main justifications for this study is that research into LEED and its application in the Canadian market is limited. Da Silva & Ruwanpura state that Canadian practitioners and stakeholders most often rely on data derived from American LEED research as "there is so little information for Canadian circumstances" (Da Silva & Ruwanpura, 2009, p. 41). Da Silva & Ruwanpura (2009) point out that the circumstances that apply to American projects vary from those experienced by Canadian projects and warn that Canadian practitioners must be cautious in applying information from taken from studies conducted outside of Canada.

To the knowledge of the author, only one previous study in Canada has investigated barriers to LEED. Scammell & Waugh (2009) surveyed building industry professionals in the Atlantic Provinces on the barriers encountered in the application and certification process of LEED. As a part of their recommendations for future research, they concluded that more studies should be conducted on the topic to better understand the unique challenges Canadian practitioners face in their use of the LEED green building rating system.

Further to this, the author was unable to find research relating Canadian green building practitioners' opinions on how LEED is best utilised in the market to address the negative environmental and human health aspects of buildings. As LEED is increasingly being relied upon by governments at all levels in Canada as a tool to guide in the construction and procurement of public buildings, a number of unintended issues have begun to surface from the public mandating of a private sector administered voluntary green building rating system. Unknown and unanswered questions relating to how mandating LEED will affect public project delivery models, construction contracts and issues of liability are pervasive in the market. A part of this research was to survey various stakeholders and actor groups in Ontario and seek their opinions on how best to confront these issues and shed light on how best LEED is applied in the Ontario market.

It is hoped that this research can help to fill these identified gaps and provide valuable information to all stakeholders groups regarding LEED's application and role in the Ontario building market.

1.3 Research Objectives and Questions

This thesis was developed to address questions surrounding barriers experienced by market actors in the use and implementation of LEED. As a system of green building certification, LEED represents arguably the most well known brand currently active in the Canadian and Ontario

[1] Number of buildings certified up to June 30, 2011. Not included in this calculation are buildings certified by the USGBC,

markets. Yet despite its seemingly omnipresence in the environmental discourse surrounding current building design and construction in Canada and Ontario, LEED is still an under utilised tool and is applied to a relatively small percentage of total building and construction projects. With this in mind the intended outcome of this research was to: (a) investigate barriers to the use and implementation of the LEED green building rating system in the Ontario, Canada and (b) to investigate how actor groups view the use of LEED as a mandated tool to address sustainability in the built environment. The research questions therefore are:

1. What are the barriers to the use and implementation of LEED in Ontario, Canada? How are they perceived amongst the main LEED actors groups? These actor groups are:
    - a) owners/clients;
    - b) architects;
    - c) construction firms, and
    - d) project consultants.

2. How do actors perceive the use of LEED as a mandated tool to address the negative environmental effects related to the built environment in Ontario?

1.4 Methodology

Confronting the excessive energy and raw material demands of the building sector is an important part in combating climate change. Green building rating systems are one way that these important issues can be addressed. By designing, constructing and operating more efficient and less resource intensive building we can significantly reduce the demands and negative impacts we exert on the environment. In Ontario, Canada LEED represents the most well-know and utilised green building rating system and plays a central role in influencing the growth of the green building movement. However, the widespread use of LEED still remains minor when compared to the new building construction sector as a whole. To better understand the difficulties faced in the implementation and use of LEED and to understand how actor groups view the public sector's mandating of LEED as a policy tool to address the negative environmental effects buildings, it was necessary to design a study that would engauged professionals within the building industry.

To address the research questions posed by this study a qualitative research approach was taken. An initial literature review on the topic of LEED and green buildings showed that a number of barriers can be identified that play a significant role in limiting the wider adoption of sustainable design practices and green building certification schemes. From this initial review, a theoretical framework was identified that could used in the creation of an adapted framework for analysing barriers to LEED in the Ontario market. A literature review was then completed to update the identified framework to reflect the current state of barriers in 2011 and to isolate any barriers that may have emerged since the development of the framework. Interviews were conducted with industry professionals representing four identified actor groups familiar with the LEED rating system. The adapted framework was utilised in the analysis and categorisation of the interview data in order to answer the first research question. Barriers that were found to not fit within the framework were considered to be unique to the Ontario context.

The interview data was also used in answering the second research question. The semi-structured interview produce responses from the various actor groups that the researcher could synthesise and present in a structured way. These responses were supplemented with a literature review that was integrated into the analysis of the interview data on the topic. An overview of the data collection methods utilised in this study a present in the subsequent section.

1.4.1 Data collection methods

A literature review was first conducted to determine know barriers to LEED, green building and sustainable design. Academic writings including journal articles, theses and dissertations were use extensively in the literature review to delineate known barriers to green build and LEED implementation and in the development of the data analysis model and framework. *Grey* literature including non-profit organisation reports, industry based market reports, working papers and conference proceeding were also used in the literature analysis. Statistical databases were used in the calculation of some figures in the study and the source and method of calculation are footnoted where this is the case. Finally, a limited number of journalistic sources were used to supplement discussions relating to current issues within the field of study.

Interviews formed the backbone of data collection within this study. Interviews provided in-depth and insightful data as to the current state of barriers encountered in LEED adoption and implementation within Ontario. A number of previous LEED barrier studies conducted outside of Ontario have utilised electronic survey methods for data collection to varying degrees of success. Marchman & Clarke's (2011) investigation in to barriers encountered in the U.S. market noted that, "personal interviews would have allowed for more specific detail" and this was acknowledge in the design of this study. Interviews allowed for the researcher to target informants that were highly informed and knowledgeable on the subject area within each actor group. Interviews were also chosen over electronic surveys as they allow for the informants to speak freely about the subject at hand and to not be guided to discuss topics not relevant to their situation.

LEED Accredited Professionals (LEED AP) were the target population of this research and were chosen for their exposure to and knowledge of the LEED rating system and green buildings. The LEED AP credentialing system is designed and administered by the Green Building Certification Institute[2] (GBCI) in order to provide a designation for people with knowledge of the LEED rating system and who are versed in current green building technologies and best practices.

The first step in identifying potential informants was to generate a list of LEED APs in Ontario by searching the GBCI's publically available professional directory. This initial search returned a list of 1 486 potential informants. The list was then categorised based on the actor groups identified by the researcher as important to the study: owners/clients, architects and designers, construction professionals and consultants. From the categorised groups, the companies and organisations represented by individuals on the list were cross-referenced via Internet searches to find those that were most active in the use of LEED. From this pool, 50 potential informants were selected and sent an email describing the study and asking for their participation. In total, 17 of those contacted responded stating their willing to participate in the research study. Of the 17

[2] The GBCI provides third-party certification and professional accreditation services for the USGB's LEED green building rating system and LEED Accredited Professional programme.

respondents, due to circumstances outline in the limitations section of this paper, 12 interviews were conducted. These informants represented stakeholders from each of the four identified actor groups and were broken down as follows: four architectural and design professionals, three construction professionals, three consulting professionals and three actors from the owner/client group. Individual informants were then contacted again and arrangements were made to conduct the interviews at a location of their choosing.

The resulting interviews were conducted in a semi-structure process. A semi-structured process was used in the collection of data specifically because it "frees the interviewer to concentrate on the topic and the dynamics of the interview" (Brinkmann & Kvale, 2009, p. 130). Due to the unique characteristics of each actor it was deemed unbeneficial to limit the interview process to a strict set of predetermined questions. Instead, a number of general *talking points*, as well as some specific questions that were determined prior to the interview process, were used as common themes in each interview. Prior to starting the interviews the informants were briefed on the purpose and procedures of the research study and were informed on topics regarding confidentiality and their right to withdraw from the study at any point. A verbal affirmation of the informant's informed consent for the researcher to record the interview and to use parts of their interview for the purposes of the study was obtained from each interviewee before the interview began (the interview was then conducted and recorded for future analysis using a Sony ICD-AX412B Digital Voice Recorder). For the purposes of this paper, persons interviewed in the data collection process will be referred to interchangeably as *participants*, *interviewees* or *informants*.

It should be noted however, that since the researcher chose the individual informants within the target population, the sample population is therefore non-random. Due to the nonprobability purposive sampling method utilised in this study, it would be difficult to infer results to a wider population from the responses given and should only be viewed as representative within the context of this particular study. Although this method of sampling selection is the least precise method for choosing informants, it was decided by the researcher due to a number of limiting factors, that this sampling method was necessary to engauge key people within the industry.

1.5 Scope

At its core, this study investigates the implementation of LEED as a system encountered at the project level by actor groups involved in the LEED process. It utilises pre-existing literature to delineate known barriers to LEED and interviews with industry professional in Ontario in order to triangulate and illustrate barriers in the Ontario context. This research is not intended to be an evaluation on the merits of LEED nor is it intended to be a critique of sustainable design in general. As such, discussions and debates of this nature are outside the scope of this study.

This study focuses on the CaGBC's LEED Canada green building certification system as it applies to the construction and renovation of buildings. Experiences expressed on behave of study informants relating to LEED Canada for New Construction (LEED Canada NC 2009), LEED Canada for Core and Shell Development (LEED Canada CS 2009) and LEED Canada for Commercial Interiors (LEED Canada CI 2009) rating systems were all included in the scope of this research. Other LEED rating systems offered by the CaGBC including LEED Canada for Homes, LEED Canada Existing Buildings: Operations & Maintenance 2009 and LEED 2009 for

Neighbourhood Development with Canadian Alternative Compliance Paths were not including in the scope of this research. In addition, other green building assessment and rating tools present in the Canadian market such as BOMABESt/GreenGlobes and Living Buildings were also not investigated in the course of this study. Although the study did not explicitly focus on individual credits or groups of credits that make up the LEED rating systems, credits were investigated if they were identified or expressed as a barrier or potential barrier to LEED implementation and certification by the study's participants.

The geographic focus of this study was Ontario, Canada. In order to identify and understand unique issues related to LEED implementation in the context of Ontario other geographic locations outside of Ontario were not considered in the research of this paper. However, known barriers to LEED implementation derived from studies conducted outside of Ontario did serve as a proxy for the initial literature review and were used as talking points within the semi-structured interview process. As Hanby (2004) noted, due to the complexity of the barriers to LEED certification

1.6 Limitations

Throughout the preparation of this thesis a number of limiting factors were encountered. Limitations dealing with the selection, availability and location of interviewees were foremost amongst these. In addition, limitations were also encountered in the analysis of the collected data.

The interviewee selection process necessitated the need to find knowledgeable people within the industry and resulted in 100% of interviewees being LEED APs. It could be reasonably argued that LEED APs and organisations that employ LEED APs are generally more accepting of the value of LEED and have greater experience working with LEED rating systems. This potentially introduces bias to the study affecting how barriers to the implementation of LEED are expressed and characterised by the study's informants and may not necessarily reflect the reality faced by first-time, inexperienced or resistant practitioners of the system. In short, LEED APs as informants may not necessarily be representative of the population at large.

Informant availability, location and scheduling issues also played a role in limiting the number of primary data sources for this study. The interviewing process took place over a five-week period in the months of July and August, a time that is typically characterised as "summer vacation" in Canada. This aspect affected both the availability and number of potential informants for participation in this study. Reduced office hours and holidays made scheduling and coordination of interviews difficult. Early on a number of potential informants also expressed concerns of being directly quoted in this study if the interview was conducted over the telephone or via peer-to-peer voice services such as Skype. As a result, a decision was made on behalf of the researcher that all interviews would be conducted in person. As a result, for reasons presented in this section, this decision limited the number of participants in this study.

The geographic location of interviewees also necessitated that interviews be arranged and aligned with one another in order to reduce travel and travel related expenses on behalf of the study's author. Due to the physical size of the province of Ontario, study participants were all located in large metropolitan areas as it was deemed inefficient time wise and prohibitively expensive to

travel to many locations within the study area by the author. Having all participants located in urban areas within a small geographic area can been seen to introduce a regional bias and may be reflected in informants' responses on topic such as the availability of skilled professional, partnering organisations and the availability of regional material and supporting infrastructure for example.

The relative experience of the interviewees selected also played a role in exposing potential bias in this study. As previously stated informants were selected based on their knowledge and experience in working with the LEED green building rating system. Due to the informants' level of experience in working with LEED, the project portfolios of the companies and organisations interviewees either owned of worked for in most cases represented very large buildings, usually greater than $25 million CAD and in some cases in excess of $1 billion CAD. Projects of this size and nature may have different barriers to the implementation and use of LEED when compared to smaller building projects therefore the data presented in this paper may not be representative of the Ontario building market as a whole.

Finally, due to the qualitative research approach it was also difficult to generate quantifiable data. Difficulties were experienced in the ability of the interviewees to quantify many of the barriers identified. Barriers relating to time, paper work and premiums for incorporating LEED into a project are examples where interviewees struggled to provide concrete figures.

1.7 Intended Audience

First and foremost this thesis is intended for academic review and grading purposes and its evaluation forms the basis on which the completion of the Masters programme in Environmental Management and Policy at the International Institute for Industrial Environmental Economics at Lund University can be awarded. It also serves to add to the growing base of academic writing and knowledge in the field of sustainable building, specifically with respect to LEED and its implementation in the Canadian context. This study can be utilised in the wider context of academia as a starting point for future investigations into the topic.

Industry professionals along with green building and LEED practitioners should find the information and findings presented in this study a useful in understanding the unique challenges of applying the LEED green building rating system in Ontario. Public authorities and government policy makers looking to implement green building strategies can use the information presented in this paper to better understand the role green building certification systems can play in promoting sustainability in the built environment and the potential complications that can arise from mandating a private sector administered programme. Through understanding these challenges it could be possible to design green building policies that address issues of resource efficiency, pollution and human health impacts while avoiding the complication encountered in the current green building policy.

2 LEED

2.1 Drivers for Green Building Certification

It is estimated that between 2010 and 2020 the accumulative total of green building certified space worldwide for all market segments and will grow from roughly 560 million to 4.9 billion square meters (Figure 2-2) (Pike Research, 2010). LEED as a green building rating system will figure prominently in this expected growth. As of 2010 approximately 139 million square meters of commercial space has been certified under the LEED rating system and a further 650 million square meters of commercial space is registered with 28% registered outside the United States market (Watson, 2010; USGBC, 2011).

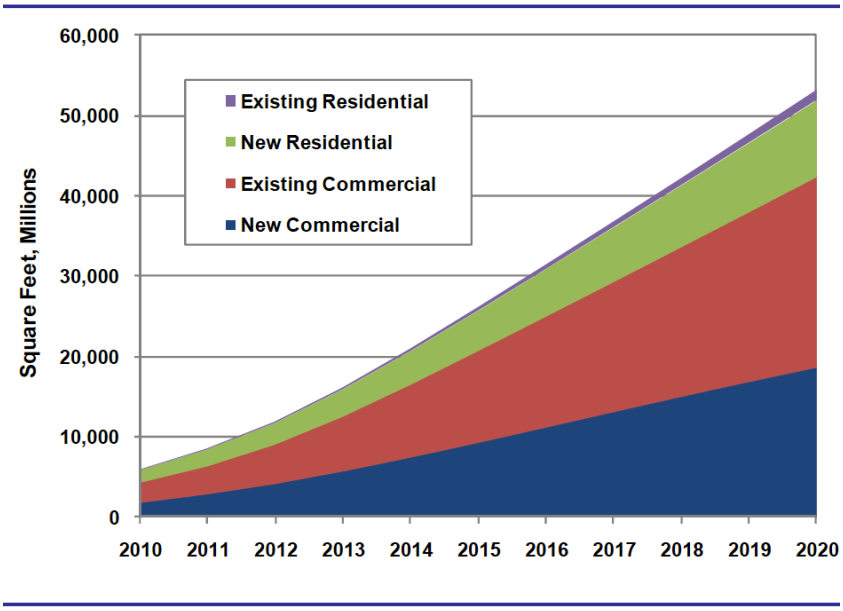

Figure 2-1 Certified Green Building, World Markets: 2010-2020

Source: (Pike Research, 2010)

A number of market drivers, both moral and economic, can be identified that contribute to the rapid expansion or green building rating and certification schemes. Corbett & Muthulingam (2007) explored whether green building certifcation were adopted intrinsic or for signalling reasons. They found that signalling was the overriding motivation for private and public corporations to adopt green building standard as a means to outwardly display the environmental aspirations of the organisation to the public at large and to meet commitments made in corporate social responsibility (CSR) plans.

Issa, Rankin, & Christian (2010) higlight the productivity and health benefits associated with green buildings but state that due to the intangible nature of measuring such parameters they are often not equally represented when compared to more tangible metrics of building performance. Kuba (2010) proposes tax and governmental incentives within the North American market and the reduction of implied risk associated with third-party verification as major drivers of the green building certification market. Kats et al. (2003) also pointed to decreased insurance premiums due

to perceive lesser risk resulting from third-party green certification of buildings as a major driver in the California market. Rapson, Shiers, Roberts, & Keeping (2007, p.347) believe that certification schemes allow for the public to identify "bad" build and that in turn this could result in, "increased letting voids and reduced asset values for these [bad] properties, while those with better sustainability profiles enjoy higher demand and increased returns." Kuba (2010) support this assertion and also points to the increased demand, higher occupancy rates and marketability of green buildings as an important driver.

2.2 Background on LEED

Leadership in Energy and Environmental Design known more commonly as LEED was developed by the USBG, a registered U.S. non-profit organisation, as a voluntary third-party building assessment and certification tool to aid in the design and construction of high-performance green building. LEED as a system was established to fill an acknowledged void in the sustainable building industry, namely the lack of a way to define and measure what was meant by the term "green building" (USGBC, 2011). Since its inception in 1998, LEED has provided a framework for building designers, constructors, owners and operators to identify and implement green strategies in building design, construction and operation that seek to address a building's environmental profile as well as the impact it has on occupant health and well-being from the life cycle perspective.

LEED can be applied to numerous building typologies in all market sectors including retail, commercial, manufacturing, institutional and mid- and high-rise multi-unit residential buildings (MURBs). LEED takes a holistic approach to building design and addresses sustainability through looking at five building performance metrics of human and environmental health including sustainable site development, water efficiency, energy efficiency, materials selection and indoor environmental quality (CaGBC, 2011). LEED as a system is continually evolving and changing through updates that are made to the rating systems in order to reflect contemporary practices in green building design and constructions and related technologies and best practices. LEED founding chairman Robert K. Watson explains the rationale behind the need to continually revise and update the LEED system:

> LEED is designed to fully reach the top 25 percent of the market in terms of the number of square feet — so a quarter of new buildings will be built to LEED specifications. The rest of the market will catch up eventually as green practices become more mainstream. So as we reach our target 25 percent, LEED will get more stringent so it will be a moving bar. Unless the engine is moving, the train following it won't move, either. So we want to keep raising the bar as the knowledge gets greater and the technology availability gets greater. We want to bring in ever greener and greener buildings (Law, 2008).

LEED's initial iteration as a singular rating system has evolve into a number of rating systems each designed to addressed specific building types or programmes underserved by the original LEED system. LEED rating systems have also been adapted to markets outside of the United States and will be further explained and their features outlined in the following sections.

2.3 LEED Rating Systems

The LEED green building rating system was adapted to the Canadian market in December of 2004 by the CaGBC. Utilising the USGBC's *LEED for New Construction and major Renovations* version 2.1 (2002) as its base, the CaGBC developed *LEED Canada New Construction and Major Renovations* version 1.0 (LEED Canada-NC 1.0) that was specifically tailored to Canadian climates, construction practices and regulations (CaGBC, 2011). Since introducing LEED Canada-NC 1.0 the CaGBC has revised the rating system twice with the current version, LEED Canada NC 2009 being released in June of 2010.

In addition to LEED Canada NC 2009 the CaGBC has further adapted and developed a suite of six rating systems necessary to meet the need of different building and project types. Current rating systems are designed to apply to new building construction and major renovations (LEED Canada NC), building core and shell (LEED Canada for Core and Shell Development), commercial building interiors (LEED Canada for Commercial Interiors), existing buildings (LEED Canada for Existing Buildings: Operations & Maintenance), residential homes (LEED Canada for Homes) and neighbourhoods design and development (LEED for Neighbourhood Development with Canadian Alternative Compliance Paths)[3]. In total the CaGBC offers a suite of six LEED rating system design to specifically address different development types and morphologies of the built environment.

For each rating system a scorecard is provided that is divided into a number of credit categories that depends on the certification system being used. In general, scorecards are based on the five performance metrics with additional credit categories either added or subtracted to tailor the system's application. The LEED New Construction rating system, the most commonly applied system in Canada, covers the design and construction of new buildings and major renovations of buildings that encompasses over 50% of total floor area to be certified. A description of what is addressed by each impact category within LEED Canada NC 2009 is provided in Table 2-1.

Table 2-1 LEED Canada NC 2009 Credit Category Descriptions

Credit Category	Description
Sustainable Sites (Credit SS)	Deals with environmental considerations given to site location and brown field redevelopment, building orientation, light pollution, regionally appropriate landscaping, site erosion and run-off control, heat island mitigation and site and construction related pollution and waste generation.
Water Efficiency (Credit WE)	Addresses issues related to the use of potable water within buildings and building sites by rewarding the use of low flow and waterless fixtures and appliances, grey water collection and low water landscaping.
Energy and Atmosphere (Credit EA)	Encourages energy efficiency and reduced GHG emissions through the use of monitoring and sensor

[3] For a further description of CaGBC LEED rating systems see http://www.cagbc.org/Content/NavigationMenu/Programs/LEED/RatingSystems/default.htm

	systems, energy efficient appliances, equipment and fixtures, energy efficient building design and construction, individual user-controlled lighting and HVAC, use of clean renewable energy and on-site generation.
Materials and Resources (Credit MR)	Promotes the use of sustainable building materials that takes into consideration the production and transportation methods used in their creation, reuse and recycling of building materials and the reduction and proper recycling of waste generated in the construction and operation of the building.
Indoor Environmental Quality (Credit IEQ)	Supports design features and materials usage that foster improved indoor air quality by avoiding products that contain VOCs, reduce noise and improve access to natural daylight and outdoor air.
Innovation in Design (Credit ID)	Rewards projects the employ innovative design and construction techniques, building systems and materials that deliver performance above and beyond the requirements prescribed within the LEED framework.
Regional Priority (Credit RP)	Addresses areas of most concern at a regional scale and are prioritised by the regional Green Build chapter. Regional priority credits vary depending on the location the building.

Source: Adapted from (CaGBC, 2011).

Within each LEED credit category points are awarded based on a project's ability to meet the intent of the credit. Point allocation between the credits, also known as weighting[4], is based on impact categories that assess the potential environmental impacts and human health benefits of design, construction operation and maintenance of the building (CaGBC, 2011). Credits that address the most significant impact categories, for LEED Canada 2009 these include energy consumption reduction and GHG emissions of building systems, transportation, water and the embodied energy of materials, are allocated a higher number of points achievable for those credits (CaGBC, 2011).

In each credit category a number of prerequisite or compulsory credits known as Minimum Program Requirements (MPRs) exist and are required to be fulfilled in order for certification to be awarded. These credits represent the minimum standards of energy efficiency, water consumption and waste generation prescribed under the LEED. Further elective credits, chosen and pursued individually at the discretion of the design team and project commissioners, can be achieve through fulfilling prescribed requirements within the specific LEED framework. The number of credits and in which impact categories the project team decides to pursue directly relates to the level of certification sought by the project. See Appendix I for an example of the LEED Canada NC 2009 credit categories and point distributions.

All CaGBC LEED rating systems have 100 base points with the further availability of up to 10 bonus points based on the Innovation in Design and Regional Priority credit categories. Building

[4] Weighting of credits is based on the U.S. Environmental Protection Agency's Tools for the Reduction and Assessment of Chemicals and other Environmental Impacts (TRACI) with the National Institute of Standards and Technology (NIST) weightings also taken into consideration.

certifications are awarded in four certification levels *Certified*, *Silver*, *Gold* and *Platinum* and depend on the number of points achieved by the project. At minimum a project must satisfy all MPRs and achieve at minimum 40 points in other credit categories for certification to be awarded. These two criteria must also be satisfied if points in the Regional Priority category are to be awarded. Certification thresholds for each level, expected energy savings, payback periods and incremental construction costs are presented in Table 2-2 below.

Table 2-2 LEED Certification Threshold Chart

LEED Rating	**Certified**	**Silver**	**Gold**	**Platinum**
LEED Points Required for Performance Ratings	40 – 49	50 – 59	60 – 79	80+
Energy Savings	25 to 35%	35 to 50%	50 to 60%	>60%
Typical Payback	Under 3 yrs.	3-5 yrs.	5-10 yrs.	10+
Incremental Construction Cost				
Small Building	3%	7%	10%	15%
Large Building	1%	3%	5%	8%

Source: Adapted from (Enermodal Engineering, 2011)

2.4 LEED Certification Process

Projects seeking LEED certification must first register with the CaGBC under one of the LEED rating systems offered that is most suitable to the project particulars. The registration of the project signals to the CaGBC that the project team is making a declared intent to certify the building to the LEED system that it registered under (see Appendix II for the CaGBC costs related to the registration and certification process). Upon registration, the project is placed in a database of LEED registered projects that are open and viewable to the public. At this point the entity responsible for registering the project is given the right to use the term "LEED® Candidate" or "LEED® Certification Candidate" in public materials referencing the project (CaGBC, 2011). The project team then begins the process of collecting the documentation, calculations necessary to satisfy performance criteria and submittal information requirements of the CaGBC to prove that the intent of the MPRs and credits have been achieved. Once this has been completed the certification submission process can begin.

LEED certification follows a two-step review process conducted by the CaGBC. Figure 2-2 below presents an overview of the LEED Canada 2009 certification process. The certification process entails an initial submission in which a project team submits the documentation and calculations necessary to satisfy MPRs and credits to the CaGBC who review the information

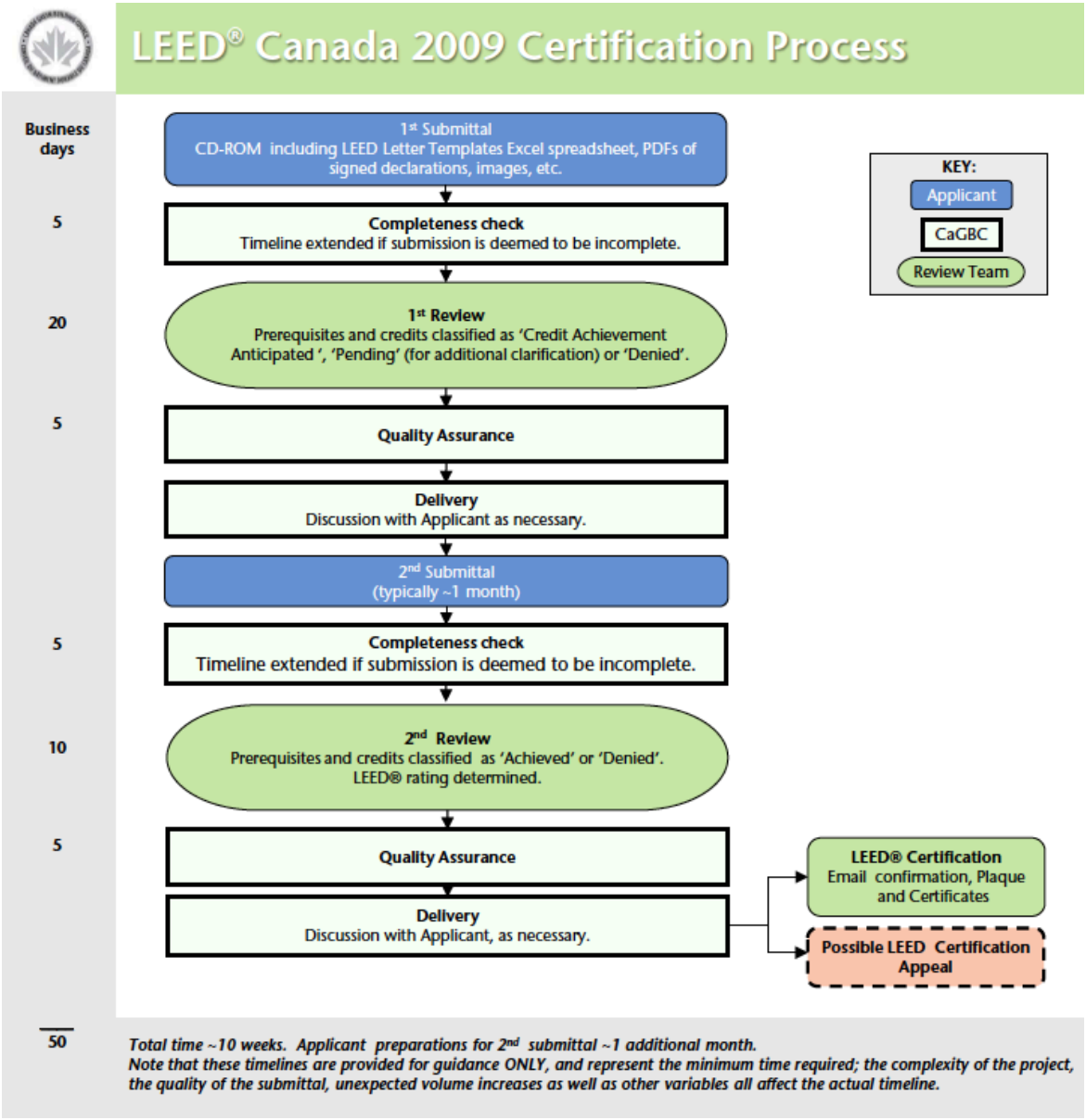

Figure 2-2 LEED Canada 2009 Certification Process

Source: (CaGBC, 2011)

provided and determine the credits to be either "Credit Achievement Anticipated (CAA)," Pending," or "Denied" (CaGBC, 2011). Project teams then take the necessary corrective actions and collect the data and documentation required to substantiate these in response to the first review. Upon the final submission the CaGBC conducts a completeness check of the submitted information and reviews the project assessing whether credits are either "achieved" or "denied"

and a LEED rating is determined relative to the number of credits achieved on the project. Certification for the project is then awarded.

2.5 LEED in Ontario

Ontario is Canada's most populous province. With a population of approximately 13.2 million, Ontario is home to roughly 39% of Canada's total population and claims nine of Canada's twenty most populous cities (StatsCan, 2010). Due to the large percentage of the Canadian population that choose to live and work in Ontario, a great demand is placed on the construction sector within the province to deliver buildings in order to keep pace with the needs of the growing population. In 2010 the value of non-residential building permits within the province were approximately $28.14 billion CAD, representing close to 39% of the total value of Canadian non-residential building permits (StatsCan, 2010). As apart of its effort to combat climate change and transition toward a lower carbon society, the government of Ontario identified energy-reduction opportunities within its existing and future building stock as fundamental to addressing these issues.

Since it's introduction in 2004, LEED has increasingly been utilised as a policy tool by all levels of government within Canada. Thomas Mueller, executive director of the Canada Green Building Council states in Yudelson (2008) that federal and provincial policies to address GHG emissions will be the major driver for green buildings in Canada for the foreseeable future. In this regard, LEED offers governments an industry-recognised system to provide third-party verification of efforts made to address the environmental profiles of buildings. LEED has been mandated at both the Federal (2005) and Provincial (2007) levels for new government facilities built within Canada and Ontario. The 2007 provincial government's commitment to green building that stated, "Leadership in Energy and Environmental Design (LEED) will be the design standard for new government-owned construction, major renovations and alternative financing and procurement projects, where appropriate," was renewed as a part of Ontario's 2009 *Green Energy and Green Economy Act* (ORC, 2009).

The mandating of LEED at both the federal and provincial levels has seen a rapid increase in the number of projects registering and certifying under the system. Prior to the announcement of the provincial mandate on June 1st 2007, there were 88 registered and 16 LEED certified projects in Ontario. In the years subsequent to the mandate, registrations and certifications have accelerated substantially with an additional 958 project registrations and 139 certified buildings up to June 30th 2011.

In terms project registrations and certifications Ontario can be viewed as assuming a leading role amongst the Canadian provinces. Figure 2-2 depicts total LEED registered and certified projects up to June 30th 2011. Two provinces, Ontario and British Columbia, account for roughly 58% of all LEED registered projects and nearly 68% of all LEED certified projects in Canada. Ontario's share of this is 39% and 46% respectively and can be seen to be in line with Ontario's share of total Canadian population and non-residential building permits.

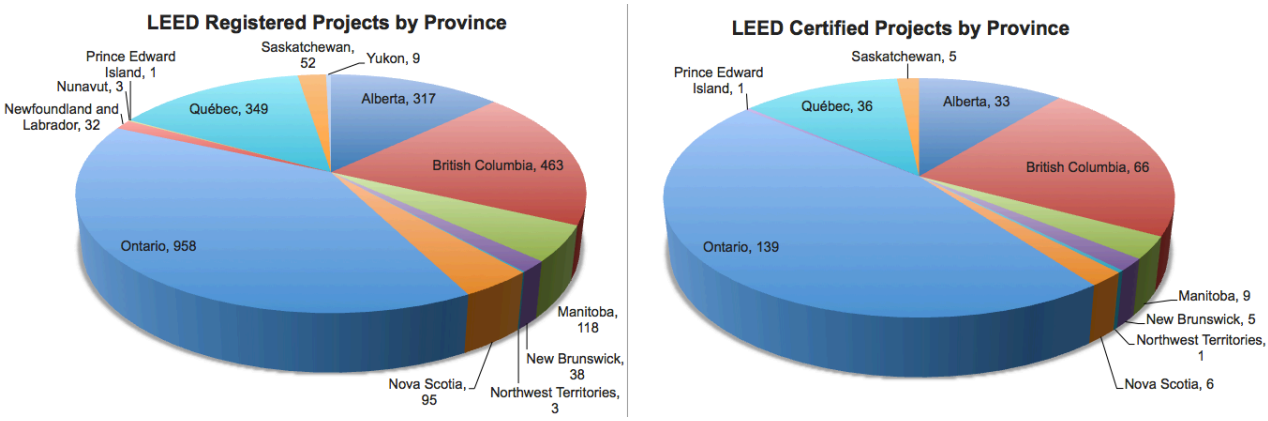

Figure 2-3 LEED Registered and Certified Projects by Province

Source: Adapted from (CaGBC, 2011)

Municipal levels of government in Ontario have also played a large role in the promotion of LEED as a tool to address sustainability in the built environment. A number of municipalities in Ontario have developed green building policies for the construction and renovation of municipal facilities that incorporate LEED certification as a prerequisite for all new projects of a certain size[5]. Examples of Ontario municipalities with stated green building policies that incorporate LEED include the town of East Gwillimbury, the Region of Waterloo, York Region, city of Kingston, city of Ottawa and the city of Burlington (ECO3, 2009).

[5] In most instances the threshold for incorporating the use of LEED on municipal projects is <500m².

3 The conceptual framework of barriers to LEED

There are a variety of factors that can affect the implementation of LEED in the design or certification of building projects. Johnson (2005) in a survey of 43 industry professions to assess the motivations for and barriers to LEED certification, found that the most significant barriers to LEED certification were problems relating to the documentation process, insufficient knowledge and education on the LEED system, costs associated with both LEED certification and green buildings, and communication barriers with the certifying authority. Scammell & Waugh (2009) study of building industry members in the Atlantic Provinces of Canada identified that the biggest barriers to increased use of LEED in the region were extra time and costs associated with LEED certification, a general lack of knowledge and support from industry and applicability issues with credits that limit the viability for higher certification levels. Marchman and Clarke's (2011) study to understand barriers to sustainable construction in the United States, used a nation-wide study of LEED APs in the construction industry and showed that increased documentation, the learning curve associated with materials and methods, as well as costs accrued in pre-project planning posed the largest barriers. Turner Construction (2005) found in a market survey of 665 business executives that perceived higher costs and an overall lack of understanding and awareness as to the benefits of building green were the primary reasons cited for not pursuing green construction. The survey further found that other obstacles included the perceived complexity and added costs related to the documentation process, perceived extended return on investment periods, inability to quantify the co-benefits of green buildings, and increased complexity of building construction (Turner Construction, 2005). Hanby (2004) assessed barriers to LEED's implementation in the state of Oregon through interviewing LEED practitioners and found that barriers both real and perceived existed in terms of cost, complications experienced in the LEED design and certification process, LEED programme applicability, availability of knowledge, as well as acceptance barriers to LEED as the benchmark for validating a project's green credentials.

3.1 The development of a conceptual framework

Figure 3-1 Barriers to LEED Framework

Source: Hanby (2004)

Within this study the conceptual framework for barriers to LEED developed by Hanby (2004) was used as a departure point for identifying and analysis barriers to LEED within Ontario. The framework was selected through an initial investigation into recent barrier studies on LEED that determined the barrier categories defined by Hanby were still relevant in contemporary discourse on the subject and further it represented the only study in which barrier categories were defined. One of the stated aims of Hanby's study was to, "develop a system of inquiry that may be used for on-going investigation into overcoming barriers to certification," (Hanby, 2004, p. 5) and therefore the framework was adaptable to Ontario. Hanby's investigation into the barriers affecting LEED implementation in Oregon as stated previously, concluded that the barriers encountered could be divided and classified into five categories; applicability,

acceptance, knowledge, process and financial (see Figure 3-1).

3.2 The conceptual frame work applied to the study

Using Hanby's barriers as a starting point, barriers relating to the use of LEED and its implementation were investigated in the context of Ontario, Canada (see Figure 3-2). Due to the duration of time that has passed and the number of revisions and developments that have been made to LEED rating systems, not in the least the adaption of LEED to the Canadian market since the publication of Hanby's study, a literature review was necessary to determine the nature of barriers to LEED at present. Once the barriers to LEED's use and implementation in the current context were assessed, adjustments were made to the framework developed by Hanby (2004).

The resulting framework of barriers was then tested specifically in the Ontario context through semi-structured interviews with stakeholders representing the four stakeholder groups identified in the research objectives.

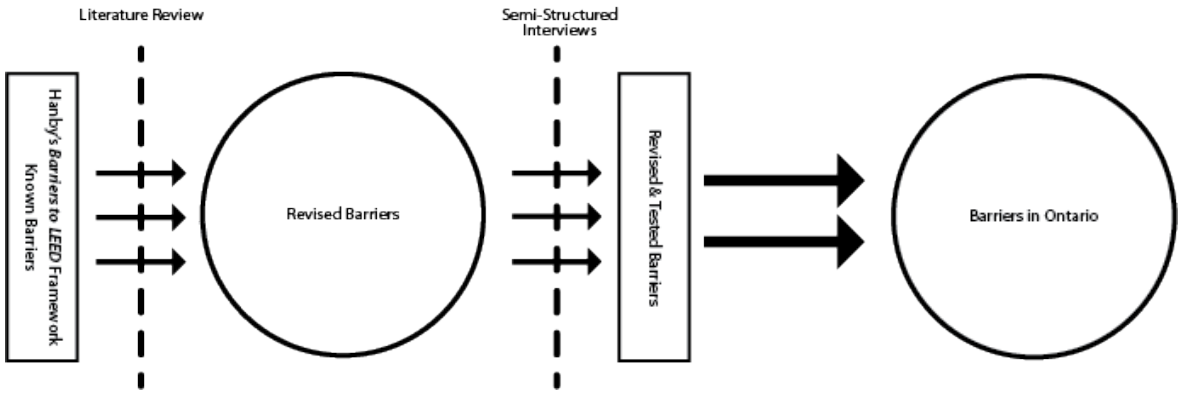

Figure 3-2 Process for the development of a conceptual framework using Hanby (2004) as a starting point

3.2.1 Interview process and analysis method

These interviews would either confirm or reject the existence of each specific barrier to LEED and its use in Ontario and would highlight any barrier not previously identified by Hanby and the literature review. The identification of these barriers would then be used to update the barriers to LEED framework with specific regard to Ontario.

The semi-structured interview process also provided a qualitative assessment of how actors groups within Ontario view the use of LEED as a policy tool to address the negative effects of buildings on the environment. Through this assessment it was possible to identify the barriers to using LEED as a policy instrument and to make recommendation on how LEED would be best utilised within Ontario.

Interview data was analysed and organised through the use of research coding keywords (see Table 3-1). The keywords applied are adapted from Hanby (2004). The coding key words were expanded to include terms encountered during the literature review process in order to represent

terminology and colloquialisms present in current discourse within academia and industry relating to green building and LEED barriers. The terms that have been added are italicised in Table 3-1.

Table 3-1 Research Coding Keywords

Barrier	Keyword
Applicability	Apply, codes, edict, governmental policy, mandate, non-traditional, programme requirements
Acceptance	Accept, achievement, advocate, attitude, belief, benefits, *business as usual*, *buy-in*, care, convince, *corporate culture,* enlighten, green wash, interest, *LEED Champion*, mentality, mandate, perception, *push back*, reputation, spirit, support, understand, *uncomfortable*, value, willing
Knowledge	Background, communication, confusing, decision, definition, educate, experience, familiar, feedback, ignorance, information, know, learn, study, training, understand
Process	Communication, consultant, contract documents, continuity, coordination, design development, documentation, eco-charrette, integrated, learning curve, LEED AP, linear, ownership, paperwork, priorities, process, project delivery, programming, revise, schedule, schematic design, surprise, team, timing, racking, verify, *workload*
Costs	Area bonus, bid benefit, bottom line, budget, *capital*, cost (hard cost, soft cost), energy savings, expense, expensive, fees, financial, funding, grant, incentive, investment, money, operating cost, pay, pay back period, premium, price, resources, *return*, savings, tax credit, tunnelling, *up front*, value added

Source: Adapted from (Hanby, 2004).

The interview recordings were then played back and listened to using the table of coding key words as a reference guide and partial transcription were taken in relation to the key words spoken on behalf of the interviewees. Recorded interviews were not fully transcribed during the analysis process. Due to the number and length of interviews and the resources required[6] to perform full transcriptions, a system of partial transcriptions was utilised. It was also the view of the study's author that the topic under study did not demand the extremely high levels of detail and exactitude full transcriptions provide.

A time coding system was used in the transcriptions to allow the research to revisit the interview recordings for context and further analysis at a later date. The transcribed portions of each interview were then assigned a grouping according to their alignment with the known barriers to green building and LEED implementation.

[6] The average one hour interview requires roughly five hours to transcribed when completed by a professional transcriptionist and results in approximately 20 to 25 single-space A4 pages (Brinkmann & Kvale, 2009).

4 Literature Review on Barriers to LEED

A literature review was conducted in order to determine whether or not new barriers to green buildings and the implementation and use of the LEED rating system have appeared in the time proceeding Hanby's 2004 study. In most cases the literature was limited to information published subsequent to 2004, except in cases where the inclusion of the source would help the reader better understand the nature of the barrier at hand. The literature was also utilised to update the research coding keywords use for the later analysis of the interview data. Barriers found to be new or unique would be used to update the framework used in this study.

4.1.1 Applicability

The adaptability and *applicability* of rating systems including LEED is difficult as they are often developed within a specific region and contain local biases in relation to assumptions made in the relative importance of rating criteria (Larsson, 2010). Larsson (2010, p.115) identified the following issues regarding applicability that can vary greatly from region to region and can diminish the relevance of rating systems when applied outside their region of origin:

- Units of measure
- Standards
- Local climate
- Solar hours
- Water resources
- Cultural aspects of design
- Availability of some materials and equipment

Although LEED has been adapted to the Canadian market and the introduction of Regional Priority credits within the LEED rating systems will significantly help ameliorate some of the issues identified by Larsson, due to the geographic and cultural vastness of Canada some issues may still be applicable in the Canadian and Ontario contexts. In this sense, the applicability of LEED relating to issues of region, climate, building programme and site can still be viewed as potential significant hindrances to the implementation of LEED on any given project. Therefore, applicability can be a determinant factor in what credits will be pursued and whether or not LEED and/or certain certification levels of LEED will be sought in many projects.

Da Silva & Ruwanpura (2009) compared LEED points achieved by Canadian projects with their American counterparts and noted that the regional materials requirement favoured American projects due to the greater number of cities encompassed by the 800km (2 400km if shipped by sea or rail from the final manufacturing site) project product radius. Finding resources that can be sourced locally can pose a challenge for geographically remote building projects such as those situated in Northern Canada. A 2006 credit interpretation request (CIR) submitted to the CaGBC on behalf of a remote project highlights this challenge.

> We are seeking a credit interpretation on the following; % of materials extracted and manufactured regionally. Yellowknife is a remote location, beyond 800 km from centres where the majority of materials or products are extracted, processed

> and manufactured. Commercial transportation is by air and road. Yellowknife is not located on a rail line. The site is not accessible via water routes for delivery of materials and products. The City of Edmonton, located 937 km away is the closest marketing and manufacturing centre to Yellowknife. Within reason we are bringing in materials from the nearest possible supply points. Thus, we feel we are achieving the intent of the requirement, though not the exact distance requirements. We are interested in knowing how the CAGBC will look at this (CaGBC, 2011).

In this case the CaGBC ruled against the CIR for making an exception for projects that fall outside the prescribed radius thereby establishing precedence for future projects regarding this issue. Scammell & Waugh (2009) view the applicability of certain credits in the LEED system due to geographical considerations as a potential barrier to obtaining higher levels of certification and believe that if levels of certification are to remain the focus of LEED then more credits need to be applicable to more projects regardless of location.

Climate considerations can also play a role in determining the applicability of rating systems such LEED in the design and construction of buildings. Ali & Al Nsairat (2009) surveyed various green building certification schemes and their potential use in Jordan and determined that a number of them were insufficient in addressing local conditions relating to water and energy efficiency, natural resources that Jordan is lacking in. In Canada, and in Ontario to a lesser degree, local climatic conditions vary greatly and could potentially serve as a barrier to LEED implementation. Again with the introduction of Regional Priority Credits in LEED Canada NC 2009 however, geographically specific environmental priorities can be addressed as a result of increased weighting of credits with regional importance.

The applicability of LEED to building programmes can also be viewed as a potential barrier. Currently, organisations in Canada wanting to incorporate LEED into a portfolio of standardised construction and building types can only do so through the USGBC's LEED Volume Program. The CaGBC states that the LEED Volume Program "requires an entirely distinct certification process" and that due to the small number of organisations in Canada that would meet the requirement of certifying at minimum 25 buildings in a three-year period, the CaGBC is not making this programme available to the Canadian market (CaGBC, 2011). Organisations wishing to utilise the LEED Volume Program can apply for certification through the USGBC and would be subject to following USGBC LEED guidelines. As noted earlier the adaption of LEED to the Canadian market was done to reflect the uniqueness of Canadian climates, construction practices and regulations, therefore certifying projects under a USGBC system could pose as a potential barrier.

Building type and conflicts with building codes, zoning bylaws and government regulations is another potential barrier to the implementation of LEED. New building techniques, technologies, and construction processes that are not covered by or that run contrary to established norms and regulations need to be addressed by architects and engineers during the design phase (Doyle, Brown, de Leon, & Ludwig, 2009), failure to do so can add lengthy delays to the construction approval and permitting process and can lead to cost and scheduling overruns. Yuldelson (2008) noted that certain building types including can and do run into applicability issues with LEED. Hospitals, due to their focus on disease prevention are "highly regulated and risk averse" and

therefore the restrictive nature of health care design often does not allow for elements such as natural ventilation and under floor air distribution systems, features that are preferred in the LEED rating system (Yudelson, 2008, p. 149).

4.1.2 Acceptance

Acceptance, often characterized as *buy-in*, must be present at all levels of the project team including architects and designers, owners and constructors. The acceptance barrier can be view as the most difficult barrier to overcome as it deals with individual and organisational views and experiences. How an individual person, group of persons or a whole organisation perceives issues of sustainability, the environment, and the ultimate value in green building certification schemes directly relates to their openness for embracing the intent of green buildings and systems such as LEED. Green building and LEED are often met with scepticism or resistance, as they are perceived to upset or challenge the status quo.

Hoffman & Henn (2008) state that social and psychological barriers to green building exist at three levels - the individual, the organisational and the institutional. At the individual level they identified: *over discounting the future* – a failure to make decision based on calculations regarding payback periods; *egocentrism* – in putting one's own wants and desires before that of the collective, say for instance at the expense of the environment; *positive illusions* – the tendency to view the future in a better condition than the reality might be; *presumed associations* – the linking of uncorrelated subjects such as relating products with environmental benefits to inferior quality; and *mythical fixed pie* – viewing things as mutually exclusive entities, such as the environment and economic competitiveness; as psychological barriers.

From the institutional perspective Hoffman & Henn (2008) found: *structure* – that determines information and decision flows and can lead to competing interests, communication breakdowns and suboptimal decision-making affecting environmental decisions relating to organisations and projects; *language and terminology* – green building creates new terminology that requires new knowledge and may be resisted in favour of the status quo; *rewards* – capital budgets departments pay for energy efficiency measures' up front costs but the physical plant reaps the resulting savings; *organisational inertia* – resistance to change established patterns of behaviour; *habitual routines* – much like organisational inertia, habitual routines can be seen as adhering to the status quo such as taken for granted design or construction practices; *fear of the unknown* – can act as a driver for both organisational inertia and habitual routines and lead to increased transaction costs to cover future uncertainties; *resource limitations* – in both money and time can inhibit an organisations ability to recover sunk costs in buildings, equipment and personnel.

Lastly, Hoffman & Henn (2008) described three institutional archetypes that can act as a barrier to green design: *regulative institutions* – can occur when standard setting draws attention away from the purpose behind the law to the law itself such as prescriptive building codes that may inhibit solutions found outside the letter of law; *normative institutions* – where standards become the established way of conducting business constraining the ability to adapt and change in a proactive manner; and *cognitive institutions* – where common perceptions and behaviours are ingrained at the institutional level and can act to control decision-making process of individuals and organisations even without their knowledge.

In addition to social and psychological barriers to green buildings and LEED, a lack of or perceived poor quality of empirical data relating green buildings and LEED and their benefits can often lead to resistance. Issa, Rankin and Christian (2010) in a study of 276 LEED APs practicing in Canada demonstrated that even amongst LEED practitioners' acceptance of the outcomes of LEED pose as a potential barrier. They found that many practitioners view academic research into the costs and benefits of LEED as being too simplistic in design, lacking in empirical evidence and not reflective of the realities encountered in real-world practice (Issa, Rankin, & Christian, 2010). Conflicting reports and studies on the performance of LEED certified buildings including (Newsham, Mancini, & Birt, 2009) and (Scofield, 2009) also creates confusion in the market and can seriously diminish the acceptance of the principles, limitations and outcomes of LEED certification amongst building professionals.

4.1.3 Knowledge

Barriers associated with *knowledge* can be linked to lack of exposure to, or familiarity with, green buildings and LEED as they relate to all areas of the building design and construction process. Knowledge and experience can vary greatly between the different actor groups making the sharing and communicating this knowledge between actor groups essential in successfully implementing sustainable design strategies including LEED. Kuba (2010, p.127) emphasises the necessity for knowledge sharing amongst green building stakeholders throughout the lifecycle of the building from design through to construction and operation.

> In the absence of an interactive approach to the design process it would be extremely difficult to achieve a successful high-performance building. The successful design of buildings requires the integration of many kinds of information into a syncretic whole. The process draws its strength from the knowledge pool of all the stakeholders (including the owner) across the life cycle of the project. They are collaborative involved from defining the need for a building through planning, design, construction, operation, maintenance of the facility, and building occupancy. The best buildings result from active, consistent, organized collaboration among all players, which is why the stakeholders need to fully understand the issues and concerns of all the parties and be able to interact closely throughout the various phases of the project. (Kubba, 2010, p. 127)

Häkkinen & Belloni (2011) identified the sharing of strategic knowledge between actor groups as a potential barrier to sustainable building in general and site that although technological solutions maybe available their limited use can be viewed as symptomatic of this. At the institutional level, organisations such as universities often fail to effectively communicate and share knowledge resources between researchers and faculty employed on campus and administration when considering pursuing sustainable design strategies on campuses. A lack of synergy between institutional 'silos' can pose as a barrier to the implementation of sustainable design strategies and LEED on campuses. Richardson & Lynes (2007) suggested that a stronger commitment on behalf of university administrators and increase dialogue amongst faculty, staff and administration regarding sustainable design was needed to overcome barriers to its implementation on university campuses.

Experience of team members and their familiarity with LEED is considered by Bayraktar & Owens (2010) as the most important element of pre-project planning but concede that identifying

experienced people is difficult. Bayraktar & Owens (2010, p.87) are also wary of implicitly linking LEED AP designation with experience and state "although these professional have LEED accreditation, it should never be assumed that they have LEED experience," further stating that the only knowledge require to become a LEED AP is the ability to pass an exam and therefore does not indicate practical experience working with the system. Marchman & Clarke (2011) also found that experience with sustainable building projects and extensive pre-project planning were the two most effective barrier-breakers to sustainable projects in their survey of over 2,200 LEED APs. However, Yudelson (2008) believes that a disparity in professional education related to green buildings is also a factor, stating that architects often know more about mechanical and electrical engineering than engineers know about architecture that can lead to difficulties in the integrated design process and pre-project planning.

4.1.4 Process

Process barriers deal with issues relating to time invested in the administrating the LEED process, documentation collection and handling, and decisions concerned with when to incorporate LEED criteria on a project. In construction there is general acknowledgement that time and costs are intrinsically linked (Lam, Chan, Chau, Poon, & Chun, 2009). In this regard many of the matters categorised as *process* barriers can in some ways be viewed a barriers due to the added costs to construction budgets they ultimately represent.

Process barriers to green building and LEED can occur in all project delivery models. However, when green building methods are applied to the traditional normative approach to building design and construction, process barriers can become amplified (Mogge, 2004). Mogge (2004) believes that process barriers and the resulting higher first costs can occur due to dropped and miscommunication between project stakeholders, inefficiencies in the process and professional disagreement. Miscommunication often occurs in the normative project delivery model due to the limited interaction of the designers, engineers and constructors in the early stages of project development. Hansen (2005) assert that the main issue in standard construction models is finding a common language amongst project team members and advocates for an integrated design process (IDP) in which all actors are engauge from the earliest stages of project development to help overcome this issue. Further, Harvey (2009) states that through the use of an integrated design process, buildings in all climates can achieve energy use reductions of between 50-75% compared to standard buildings built to local codes.

The American Institute of Architects (AIA) also advocates for project teams to take an integrated project delivery (IPD) approach when using sustainable building rating systems like LEED (AIA, 2007). The AIA explains that taking an IPD approach helps to transcend the "silos of responsibility" that traditional exist in normative and linear approaches to project design and delivery and further that "aggressive goals for energy and carbon reduction are best achieved through collaborative processes" (AIA, 2007, pp. 7,3).

> At the core of an integrated project are collaborative, integrated and productive teams composed of key project participants. Building upon early contributions of individual expertise, these teams are guided by principles of trust, transparent processes, effective collaboration, open information sharing, team success tied to project success, shared risk and reward, value-based decision making, and utilization of full technological capabilities and support. The outcome is the

> opportunity to design, build, and operate as efficiently as possible (AIA, 2007, p. 2).

Utilising IPD in the design and construction of high-performance buildings can allow owners to recoup additional first costs faster than if traditional linear approaches to project delivery were used (Qualk & McCown, 2009). Cappuzi (2010) also advocates for early incorporation of LEED in to the projects in order to avoid potential cost increases and schedule delays. However, Mary Ann Lazarus director of sustainable design for HOK, America's largest architectural firm[7], stresses that IDP and IPD runs into a number of barriers in the current building market.

> Integrated design is not something that naturally happens—because of the way that contracts work, because of traditional relationships between contractors, engineering consultants, design teams, and the architects. We need to be willing to work at making integration happen and adjust contract, schedule, and fees appropriately (Yudelson, 2008, p. 170).

It would appear that systems such as LEED require an IPD delivery process to overcome many of the process barriers encountered in constructing sustainable buildings however, IPD and IDP itself encountered barriers within the market due to the normative institution of traditional design, build and operate paradigms.

Pise (2006) in her study of the barriers encountered in the LEED documentation process in educational institution building projects ultimately found the eight following barriers some of which can be linked to the linear approach to construction and a number unique to the LEED rating system itself.

- Contractors are unaware of LEED documentation requirements and hesitant to carry out documentation
- Design teams have no experience and are not used to the amount of paperwork required in LEED
- LEED documentation requires expertise for services like commissioning and daylighting
- The LEED documentation is a time consuming process with certain credits consuming most of the time (for example: Brownfield, Daylighting, Commissioning, and IAQ management plan)
- LEED documentation process is expensive and not ideal for tight budget projects such as schools
- Some of the requirements for preparing LEED submittals are ambiguous and not self-explanatory
- The level of difficulty in the LEED documentation process is influenced by the type of products or systems used in the project
- The review process during auditing of the document submittal is inconsistent (Pise, 2006, p. 90)

[7] http://www.bdcnetwork.com/sites/default/files/Architecture:Engineering%20Firms%20Giants%20300%202011_0.pdf

4.1.5 Costs

The *financial* barrier, relating green buildings and LEED, is most often cited as the principal barrier to certification. Building owners and practitioners often point to high initial costs and extended return on investment and payback periods related to sustainable design elements as justification for not pursuing green. The costs, commonly characterised as a *premium*, can be divide into two categories: (1) soft costs, encompass items such as fees related intellectual energy invested in the design, evaluating and documenting of the process, and (2) hard costs, related with physical elements of the building's components, structure and site. While there is evidence to suggest that premiums for green and LEED buildings do in fact exist, there is often a disconnect between the real and perceived costs of green building and LEED. Misperceptions as to the cost of green buildings coupled with a general lack of awareness of the associated benefits relating to green buildings highlights the need for education amongst building owners (Turner Construction, 2005). Despite early studies, including Kats et al. (2003) that found that the cost premium associated with LEED certified buildings were slightly less than 2% while the associated financial benefits of building green can be up to ten times the initial cost increase over the life-cycle of the building, confusion surrounding the financial aspects of green buildings and LEED persist.

Premiums related to green buildings and LEED can be attributed to a number of factors. Syphers et al. (2003, p.2) found that the additional costs incurred as a result of the decision to pursue LEED certification on a given project depended on a number of assumptions and factors that included:

- 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.

As Syphers et al. (2003) showed, many of the financial premiums associated with green buildings and LEED are a result of, or in part relatable to, soft costs encountered in the process of constructing green buildings.

The additional costs associated with green buildings and LEED can also present themselves as a barrier to the wider adoption of sustainable design. An industry survey of 631 architects, engineers, construction professionals and building owners conducted by the magazine Building Design + Construction, illustrated that the perceptions of added costs associated with green buildings and LEED varied greatly from anywhere between 0-2% to more than 15% with the majority of respondent placing the extra costs in the 6-10% more category (see Figure 3-1) (BD+C, 2007).

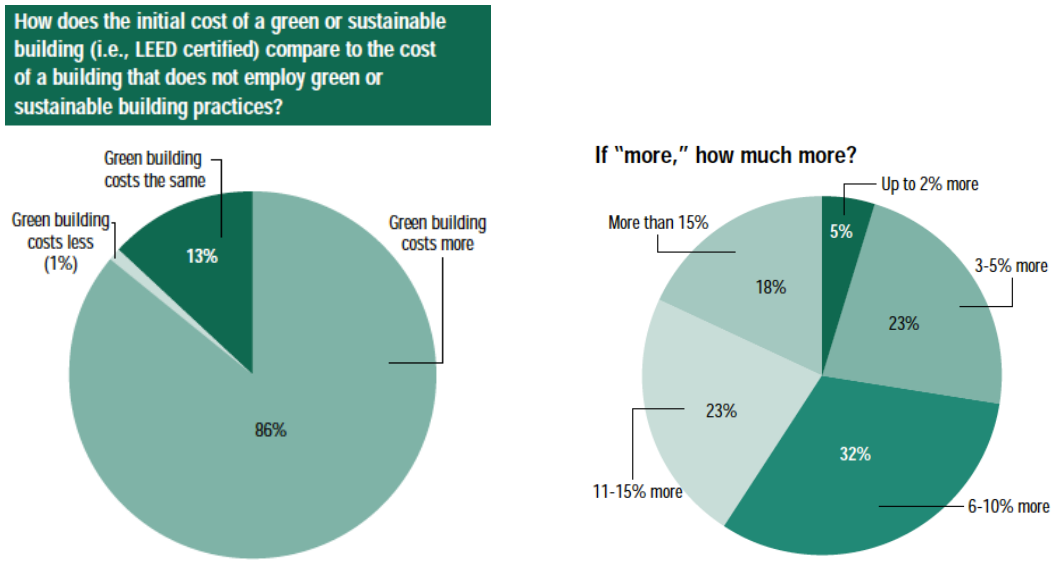

Figure 4-1 Market Perception of Green Building Costs and Premiums

Source: (BD+C, 2007)

Recently, as the pool of green buildings available for analysing has grown, a number of academic and industry-based studies have attempted to quantify the costs associated with green buildings when compared to their traditional non-green counterparts. These studies have attempted to arrive at a percentage that could be viewed as a *green premium.*

The global construction-consulting firm Davis Langdon conducted one of the most comprehensive studies on the topic of green building costs. Their study of 221 buildings[8] within the U.S., consisting of 83 buildings that were designed with the intent to meet some level of LEED certification and 138 projects were not, showed that there was no significant differences in cost related to green buildings when compared to their non-green contemporaries (Matthiessen & Morris, 2007). Ultimately, Davis Langdon found that aside from there being no significant cost differences by building type in both categories, for green and non-green buildings alike, there were examples of both high cost and low cost buildings (Matthiessen & Morris, 2007). A more recent study by Kats (2010) did show some additional premium associated with greed and LEED buildings. Kats' study surveyed 170 U.S. and 10 non-U.S. LEED certified buildings, found that cost premiums connected to the buildings ranged from between 0% to 18%, with a median of 1.5%. In addition, over three-quarters of the buildings contained in the study had green premiums between 0% and 4% (Kats G. , 2010). One of the final conclusions of the report was that as a general rule of thumb "the greener the building, the greater the cost premium," but that for most buildings LEED is achievable with minimal additional costs (Kats G. , 2010, p. 8).

The costs premiums of LEED have also been quantified by comparing prototype buildings with the same building containing the necessary changes needed to achieve LEED certification. Consulting firm Steven Winters Associates (2004) found that when comparing base buildings

[8] The buildings in the study were normalised for time and location and then grouped and compared by building type (Matthiessen & Morris, 2007).

modified to achieve various levels of LEED certification, premiums associated with the changes ranged from -0.4% to 8.1%. In another study on the costs attributed to different level of LEED certification, Turner Construction (2005) found average cost premiums of 0.8% for LEED certified, 3.1% for silver, 4.5% for gold, and 11.5% for platinum buildings.

In light of these studies, it is interest to see how practitioners within the green building industry view these statistics. Issa, Rankin & Christian (2010) showed that Canadian practitioners of LEED disagreed with Matthiessen & Morris' (2007) assertion that there was no significant difference in the costs between green and non-green buildings. Further, of all the cost studies tested, practitioners agreed most with Kats' (2003) acknowledgement of a cost premium and his assessment that the higher the LEED rating achieved the higher the higher the associated premium (Issa, Rankin, & Christian, 2010). Practitioners in the study were also undecided regarding studies estimating the size of premiums associated with green buildings and LEED (Issa, Rankin, & Christian, 2010). Issa, Rankin & Christian (2010) concluded that Canadian practitioners of LEED tend to adopt a myopic perspective on LEED and green building by focusing on the minimization of short-term capital costs and not fully assessing the long-term benefits attributable to many sustainable design strategies.

4.1.6 Summary of findings in the literature review

Barriers to both real and perceived to sustainable design and LEED are still very much present within the market today. The literature review did not expose any new barriers that can be viewed as falling outside of the categories presented in Hanby's (2004) framework. Although a number of developments within specific barrier categories were highlighted in recent research conducted in the field, they did not necessitate altering the framework to accommodate them. It should also be noted that many of the barriers identified by Hanby have been "mitigated by time and experience" (Kovac, 2009, p. 20). This is to be expected, as there has been a significant maturation period for LEED since 2004 in which practitioners have been able to develop strategies to address barriers encountered in the use of the system. Further to this, the development of update versions of LEED, completely new LEED rating systems, academic research, political mandating, and general market transformations, has led to a much more widespread use and understanding of LEED and the certification process.

In addition, the literature review highlighted an overall lack of information and data relating specifically to the Canadian market. As Da Silva & Ruwanpura (2009, p. 41) noted "decision makers for Canadian projects must often rely on American data, since there is so little information available for Canadian circumstances." This lack of data made it difficult to determine to what extent the barriers discussed in academic literature are present within the Canadian and Ontario markets.

A number of new terms and colloquialisms relating to LEED, green building and sustainable design were also identified and were used to update the research coding keywords used in the analysis of the interview data.

5 Perception of Barriers to LEED in Ontario

The analysis and findings of the interview process are presented in the following chapter. The significance of the previously identified barriers will be assessed in the context of Ontario in order to address the first research question of this study.

RQ1. (What are the barriers to the use and implementation of LEED in Ontario, Canada?) How are they perceived amongst the main LEED actors groups? These actor groups are:

- a) owners/clients/governments;
- b) architects;
- c) construction firms, and
- d) project consultants.

5.1 Applicability barrier to LEED certification

Three of twelve informants within this study expressed applicability barriers relating to LEED implementation, while one other expressed applicability as a barrier to certain credits but not overall certification.

In this study, applicability issues of LEED dealing with project location and project type were foremost amongst reason stated. An interviewee from the Owner/Client group noted that reasons for failing to meet desired levels of LEED certification are traditionally either programmed based or geography-based.

> Obviously, it is significantly more costly to develop LEED Silver buildings in northern North Ontario. When you get up there you don't have the easy credits, the densification, the commuting etc. and you are not left with as much to play with and it is not as mature of the delivery group up their, so you do pay a lot of premiums. Sometimes you're flying in different groups from Toronto or major urban centres to help deliver those projects. That's often a challenge (up) there (Owner/Client 3).

In addition, the specifying of materials to satisfy regional content requirements of specific credits[9] within the LEED rating system can become an issue given a project's location. Owner/Client 3 further explains that the "specing of different materials and resources can be a big challenge … it is that regional issue, that geographic issue. So materials and resources can be quite costly." Informant CONSULTING PROFESSIONAL 1 presents a similar scenario when dealing with projects away from major urban centres and indicates that some project locations "don't actually have infrastructure in place to support things like recycling of construction waste or getting regional content materials, they just don't have it." Although, CONSULTING PROFESSIONAL 1 believes that while being a challenge to implementing certain desirable aspects of LEED, project

[9] Materials and Resources Credit 5 (MR Credit 5) – 'Regional Materials' in LEED® CANADA FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS 2009

location and the market conditions and supporting infrastructure around a project should not be viewed as a barrier although concedes that it "changes the approach you take to get your points."

The geographic location of building projects can and does pose a challenge to constructors that are often delegated the responsibility "to divert construction and demolition debris from disposal in landfills and incineration facilities[10]" in order to achieve the intent of certain credits under the LEED system (CaGBC, 2010). One interviewee from the CONSTRUCTION PROFESSIONAL group expressed the difficulties encountered by constructors when faced with a lack of appropriate supporting infrastructure needed to satisfy specific LEED credits.

> They (LEED firm of record) seem to want to target the 75% (construction waste diversion) on every project that we go into and I think to them it's an easy credit to get 75% diversion … which necessarily isn't really all that easy to get because it depends on your end user. So if you're sending brick rubble … if nobody wants it at the end of the day it has to go somewhere and usually it ends up going to landfill. You are limited by the number of outlets that you have (CONSTRUCTION PROFESSIONAL 3).

CONSTRUCTION PROFESSIONAL 2 as a potential barrier also cited the applicability of certain credits within the LEED rating schemes. CONSTRUCTION PROFESSIONAL 2 stated that, "mandatory credits are being dictated in contract documents that are not necessarily achievable for given projects." The stipulating of a particular credit(s) within LEED within contract documents, could pose as an applicability barrier if the project's location, site conditions, building programme or building type do not lend itself to accommodate the intent of the credit.

Along with project location, project type was also identified as a possible barrier to the applicability of LEED. Specifically, "trying to implement or transplant existing technologies from one industry segment to another," was identified by participant CSLT 3 as a barrier to applying LEED to certain market segments. CSLT 3 believes that it is "very difficult to get efficiency measures in the retail-type big-box store market segment. All the vendors and everything else are not geared toward sustainable design features. But schools and product for schools it is easy to get high efficiency products." This is in part due to the applicability of LEED to other market segments where there is an acknowledgement on behalf of manufacturers of products and technologies that "a healthy indoor environment is a critical decision factor" in those market segments, whereas "switch to the retail market that is not the case" (CSLT 3).

CONSULTING PROFESSIONAL 2 also stated that for some private developers, the inability to reap the financial benefits of energy efficiency in their buildings can "limit what green decisions are made." Although there are examples of private developers in Ontario that are committed to certification of their buildings,[11] the split-incentive between operational efficiency and the capital costs of many technologies commonly utilised in achieving LEED certification do not fit within the building programmes and financial models of many small and medium-sized private developers.

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[10] Materials and Resources Credit 2 (MR Credit 2) – 'Construction Waste Management' in LEED® CANADA FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS 2009

[11] For an example see Minto Group Incorporated http://www.minto.com/minto-green/index.html

5.2 Acceptance barrier to LEED certification

Seven of the twelve informants in this study had encountered acceptance barriers, both internal and external, and stated that they posed a challenge when implementing LEED in a project.

One interviewee from the BUILDING DESIGN PROFESSIONAL group found that acceptance barriers tended to be issues related favouring the status quo over incorporating the new, "usually it ends up revolving around business-as-usual. I find that most issues that are difficult are results of people thinking a certain way and that something has to be a certain way" (BUILDING DESIGN PROFESSIONAL 3). BUILDING DESIGN PROFESSIONAL 1 believes that although "there's a lot of hesitancy on our projects about the implications of LEED certification," he does see the "influence of LEED spreading right through the industry. So even those organisations and clients where it is not a big priority to make their building green, it's building is greener than it even was five years ago." In this sense the maturation and wider use of the LEED system by early adopters in the period between its introduction to the Canadian market in 2004 and 2011, has resulted in an overall trend toward more sustainable building practices despite the existence of acceptance barriers in the market.

When dealing with issues of acceptance of LEED amongst clients, CONSULTING PROFESSIONAL 1 believes that there are three types of owners that specify LEED for their building projects.

> There are the motivated types who agree and think it's the cat's pyjamas, so 'we are going to do this.' There is the, call it the encouraged type, where the architect says 'you should really consider doing this' and the client says 'we'll take a look at this and if it makes sense we'll plug it in.' Then there is the mandated type. Those are the ones where the city has said 'thou shalt get LEED.

CONSULTING PROFESSIONAL 1 furthers that when working with those different types of owners, "the mandated group is often the most resistant" and that "the other two are often more accepting." Interviewee Owner/Client 1, a city employees where a municipal mandate states that all public projects over 500 m^2 are to meet LEED Silver certification, said that initially projects falling under the mandate were met with "internal judgements of asking as to whether this is really green? Are we wasting money? Is this just for a plaque?" Owner/Client 1 did indicated however that this early trepidation and resistance toward LEED and the challenge it posed was, more often than not, one of education and getting stakeholders both internally and externally to understand the value in building to LEED Silver standards. Accepting the value of softer intangibles was, early on in Infrastructure Ontario's LEED mandated building programme, a difficult barrier according to Owner/Client 3.

> It is not so much now, but there was certainly the understanding of the energy driver and what we were talking about with the energy efficiency credits. But, there is certainly a lot of inexperience around the softer more intangible elements. Why we are specing certain products, carpet tile and furniture, and what the benefits of that? Criticisms against the programme for having shower facilities. Not understanding that this is part of a more holistic programme to try to encapsulate sustainability within the building system. A lot of pushback and challenge from that standpoint.

Informants in this study, from all actor groups, were keen to stress the importance of buy-in from all levels of personnel within organisations. CONSTRUCTION PROFESSIONAL 1 noted that at times the "older crowd" at the on-site level in the construction industry, tended to offer more resistance to change and their inclination to favour the business-as-usual approach stating, "that's your site super intendant and if he's not buying into this whole process…that makes it very difficult (to implement LEED)." COP 1 furthers that this is in part due to the fact that for younger people in the construction industry, LEED "will be a huge part of their careers going forward so it won't be a choice. Whereas with the other guys, they will fight it out for another couple of years and retire."

Buy-in and acceptance of LEED on the behalf of those in positions of authority and decision-making power was also noted to be extremely important. BUILDING DESIGN PROFESSIONAL 2 expressed concern at whether or not in many instances "the LEED champion, the LEED guy or women, is necessarily high enough up the ladder," to be able to influence acceptance and buy-in from the top within many organisations. BUILDING DESIGN PROFESSIONAL 2 further stressed that "one needs to understand the whole big idea of LEED or environmental design…to say why we are doing this…at a certain level (however) there are a group of people who are *all about the capital costs* [italics added]. Period." This comment alludes to the existence of 'silos' or groups of like-minded individual within organisations who's attitude toward a given idea can become a roadblock for embracing the new and making it pervasive within their organisations. A disconnect in assigning value to LEED between silos, say capital planners and the physical plant or operations, may arise as a result of the principal-agent problem in which increased spending by the capital planners may benefit operations but not their own department. The principal-agent problem can lead to different values being assigned to decisions such as the pursuit of LEED amongst the different silos within an organisation further underlining the need for decision making to be driven in a top down process and for the existence of a LEED champion within organisations.

The acceptance barrier to LEED can often be attributed to lack of clearly defined goals. This is especially the case when environmental and sustainability goals are discussed and incorporated at the organisational level. Not having agreement on clearly defined goals is "a major barrier at most large institutions," observed informant Owner/Client 2. Owner/Client 2 believes that having agreement on clearly defined goals not only facilitates buy-in amongst individual members of institutions but is also a key prerequisite for implementing a system such as LEED and for "doing this stuff and doing it well." CONSULTING PROFESSIONAL 1 further reinforces this sentiment by stating "getting strong owner buy-in at the beginning is key. It's a challenge…at times it can be a challenge but as soon as you have that you have that you everything you need to get the project together." For public and private institutions and corporations considering applying LEED, having well-defined sustainability and environmental goals particular to the organisation's aspirations and vision can greatly simplify the implementation process (CONSULTING PROFESSIONAL 1)

5.3 Knowledge barrier to LEED certification

Knowledge barriers were identified by half of the twelve informants in this study as either being a barrier to the process of LEED certification itself or as a wider barrier to the implementation of LEED.

Knowledge barriers can often be attributed to the perceptions various actors have about LEED in the absence of sufficient exposure to the system. Informant BUILDING DESIGN PROFESSIONAL 2 believes that, "perceived complication" and "perceived unknown as to the process" is as a major barrier encountered amongst client groups. BUILDING DESIGN PROFESSIONAL 1 also indicated that, "uncertainty and lack of information is a big one (barrier). More and more people have heard about LEED but they don't have a lot of practical understanding of its meaning and how it works". For organisations looking to implement LEED on a building project, failure to "understand the nuances of LEED" often necessitates the hiring of a LEED consultant (CONSULTING PROFESSIONAL 2).

The hiring of people from outside the project to make up for knowledge deficiencies within the project team can represent a real and sometimes large added costs to the LEED process. BUILDING DESIGN PROFESSIONAL 3 indicated that soft costs associate with consulting fees can add anywhere between $60,000 CAD - $100,000 CAD per project and that those fees do not include the costs associated with other LEED related consulting services including commissioning, thermal comfort studies and measurement and verification. CONSTRUCTION PROFESSIONAL 2 also pointed to a Credit Interpretation Request/Response process that requires specialised LEED consultants to navigate as most users of the system are "not privy to it" and that this can "add cost and confusion to certification."

The addition of LEED consultants, although noted by almost all in the study as beneficial, can sometimes add a layer between the owner and the design team and can lead to owners being disengauged from the LEED process. CONSTRUCTION PROFESSIONAL 2 believes that this can results in owners viewing the value of LEED as only the "marketing value of a LEED plaque." This can manifest itself into a barrier if the owner perceives the costs of LEED to be prohibitive without a real knowledge and understanding of the purposes and intents of the LEED process itself. BUILDING DESIGN PROFESSIONAL 1 stated, "again, at the outset before they (owner) really understands how it all works, they perceiving it to be the cost of getting the LEED plaque. I have to explain to them that if that's all that there was to it, somebody filling out a form so that you can get you plaque, it would be hard to justify the kind of money involved" (BUILDING DESIGN PROFESSIONAL 1).

The learning curve connected utilising a system like LEED for the first time was also mentioned by informants as a barrier for practioners new to the standard. An interviewee from the CONSTRUCTION PROFESSIONAL group stated the importance of sharing knowledge with partnering organisations and project team during their first LEED project, "basically to voice the whole LEED concept we use that (project) as our pilot programme for LEED and educated a whole number of firms and organisations around Southwestern Ontario about LEED from that project (CONSTRUCTION PROFESSIONAL 1). Along with first time user, veterans of the LEED process still view knowledge and "keeping abreast of the volume of information" relating to the system can pose as a challenge and barrier for some (BUILDING DESIGN PROFESSIONAL 1). As LEED ratings systems become renewed with greater frequency the need for continuing education for all actor groups becomes a challenge to the industry.

A lack of skilled and knowledgeable people was also cited as a barrier to LEED. CONSULTING PROFESSIONAL 3 believes that a barrier to LEED, sustainable design and the building industry in general is need to increase the competency level of the people attracted to the industry.

> All around I think there is a need for education and to attract the right people into our industry and part of it is systemic. If you take a look at the educational system, if you are achieving 80s and 90s (percent) in school 'you need to go to university. We are going to send you here and if you are a delinquent and you've had some trouble with the law and dropped out of school, well, we are going to get you back into school and send you off to be a trade,' and that's the mentality. So the industry is getting burdened, and always has been, with a negative connotation and that has to change. It really does.

The lack of skilled professionals in the design and construction industries was not the only area where informants cited a deficiency. CONSTRUCTION PROFESSIONAL 2 believes that there is also a "serious lack of skilled and knowledgeable people to administer the (LEED) process." CONSULTING PROFESSIONAL 2 also sees a shortage of competentcy in consultancy services in the exisisting building market stating, "we're finding more service providers are required. We've notice a gap in the ability for the market to provide acceptable service." Designers also aknowledge that the knowledge of LEED consultants and LEED consultancy firms varies greatly and this can be a challenge when seeking professional services relating to LEED facilitation as noted by BUILDING DESIGN PROFESSIONAL 3.

> The people that are the LEED consultants aren't always aware of what is going on in the project. They're kind of very active for a period and then they are kind of back, then back in. They don't always know a lot about building buildings. Depending on their training and their level of interest. Sometimes they never ever go to site for instance and to me I have always had a fundamental blockage around being able to understand that because I am also an architect.

Misinformation including information that falsifies or overstates environmental benefits of products and conflicting reports on the performance of LEED buildings were also cited by some informants as a knowledge barrier to LEED and within the industry in gerneral. Owner/Client 2 stated, "there is some chinks in the cofidence as to wherther LEED is delivering on what it promised…I think that those are the issues that may undermind it."

5.4 Process barrier to LEED certification

Process barriers were referred to by eight out of twelve of this study's informants. Informants indicated process barriers relating project timing issues, documentation and certification processing as either barriers or perceived barriers to the implementation of LEED and in the LEED certification process.

A number of informants identified timing issues in the way that development is done and the difficulties encountered when pursuing LEED in the typical project delivery scenario as a barrier. One informant form the CONSULTING PROFESSIONAL group illustrated this point by stating, "truth be told it is a challenge. A barrier to the industry, saying if we want to do really good design and think about it *but* [italics added] we don't have the time. It is a Catch-22" (CONSULTING PROFESSIONAL 1). BUILDING DESIGN PROFESSIONAL 3 believes that architects are often committed to the form and configuration of a building much earlier than they would like as a result of common development practices and this can pose an issues as

LEED "takes longer and costs more in the beginning." A number of informants in the study reflected on the hesitancy of some clients to engauge in the practice of integrated design.

> There are benefits to the full-blown integrated design process but, and this is a tangent, I cannot think of many clients we have that would buy into additional consulting fees to talk about all the lovely features that are in the building. Most building owners and developers say, 'I want it by this date and I want it for this much money, and if costs me more or takes me longer, you're all fired (CONSULTING PROFESSIONAL 1).

> Time is a factor here and it's funny because in a four year construction process we're talking about adding a couple of weeks on to a project and all of a sudden it's this *massive* [italics added] deal and it can save you money and give you a better product at the end of the day and the list goes on for all the benefits (CONSULTING PROFESSIONAL 3).

A participant from the Owner/Client group also notes that although LEED certified building can be constructed under different project delivery models including design-build, which typically does not lend itself to the integrated design process, in order to avoid timing issues from becoming a barrier to the process "things should move a bit slower or there should be time to properly design" (Owner/Client 2). Not allowing for proper planning in the front end of projects or trying to integrated LEED into a project at a late stage was identified as a factor that can lead to increased costs due to design decisions being handled by the change order process. The added premiums as a result of timing decisions made throughout the project can become a barrier to certification.

Issues dealing with documentation attributed to the LEED certification process were also suggested by study informants as a potential barrier. CONSTRUCTION PROFESSIONAL 2 noted that, "many people who are involved with the collection of LEED documentation get burned out quickly." This statements alludes to the fact that LEED projects carry an added burden in terms of paperwork for those involved. CONSTRUCTION PROFESSIONAL 1 stated that for the person assigned to collect documentation on the construction side the process "becomes an eight-hour workday" (CONSTRUCTION PROFESSIONAL 1). An interviewee in the CONSTRUCTION PROFESSIONAL group discussed the learnin curve in administering the documentation process of LEED.

> When you are doing your first project and you're largely kind of left on your own and these credits are your responsibility…there's no standard forms that say 'this is how you should collect the data for this' or whatever. So you have got to kind of create all that stuff the first time through and end up going overboard. So you end up collecting a tonne of data that really may never be required or used or anything. You spend a lot of money doing that, you've got additional people on site because collecting so much data, creating all the forms and doing all that stuff, so you're not efficient of the start…it's a learning curve and something that we have to get as efficient at as possible on, it's another point where if we're more efficient than the competitor on this this then we can out price them (CONSTRUCTION PROFESSIONAL 3).

CONSTRUCTION PROFESSIONAL 3 further concedes that "at the end of the day is paperwork, it's a better design, but there's paperwork to back it up."

Collecting the required documentation from subtrades was also expressed as a challenge due to the nature of the information required.

> The biggest barrier is collecting the information from the subtrades. You're dealing with in some cases mom-and-pop (small business), very small operations…a lot of people have trouble sending in the cost of their materials for instance you. It's almost like they're laying everything on the table, 'here's my whole estimate' (CONSTRUCTION PROFESSIONAL 1).

The mishandling of documentation was also stated to be the reason for the failure of some projects to achieve certification as stated by Owner/Client 3.

> Mishandled documentation by just inexperienced project leads who were doing this for the first time and our projects sort of became a bit of a feeling out process for them and then again in those cases the opportunity is missed when you have mishandled you documentation.

The time lag experienced between project completion and LEED certification was also noted to be a potential barrier to LEED by some of the study's informants. CONSTRUCTION PROFESSIONAL 2 stated that, "both green building councils (CaGBC and USGBC) have an incredible backlog and are not certifying projects fast enough." The inability of the authority in charge of certification to certify projects in an expedited fashion can pose a challenge if too much time is allowed to pass between building completion and certification as expressed by Owner/Client 3.

> Some of our intial projects that came out of the gate are still not certified, there is still some haggling going back and forth. You know, it's certainly always is a challenge when somebody has completed their scope of work outside of some deliverable like that (certification). The walls are up the building's functioning and it's occupied, if they're fully paid as well, good luck trying to get them to come back and complete the work.

A quick certification review and approval process allows time for necessary corrections to be made on the project should the project fail intially to meet the expected level of certification.

5.5 Cost barrier to LEED certification

Actors in each of the four actor groups identified costs, both soft and hard, as barriers to either LEED certification or the pursuit of LEED certification on a given project. Ten out of the twelve informants in this study made statements that would characterise financial aspect related to LEED and its implementation as a barrier.

A number of study participants acknowledged that LEED certification could be delivered to the client for little premium if the proper amount of time is allocated to an integrated design process before the building project enters the construction phase but that in practice that is often not the

case. CONSTRUCTION PROFESSIONAL 1 stated that the costs to deliver a LEED project "can be fairly minimal, maybe within a percent (of total construction costs). Does that happen? Very rarely. You know there is always a crunch to design the building…so coordination suffers a little bit," he furthers, "in reality…(added costs for a LEED Gold building) I'd say in the three, three to five percent ratio." An informant in the CONSTRUCTION PROFESSIONAL group stated that the costs of pursuing LEED are often scrutinised by owners and clients throughout the construction process.

> They (owner) always want to determine what the cost of LEED is at some point throughout the project. So there always seems to be some idea, or some concern that we're spending too much money on LEED. (Owner asks) 'What's it giving us? How much will it cost if we drop from LEED Silver to LEED certified? How much will we save if we abandoned it all together? What are the costs associated with that?' There is always a thought that you can save a tonne of money if you drop it (CONSTRUCTION PROFESSIONAL 3).

CONSTRUCTION PROFESSIONAL 2 explains their rationale as to why they believe owners and clients often ask these questions once the decision has been made to pursue LEED certification.

> The very fact that people seek a premium amongst certification levels is an indicator that they may not be entirely engaged in the environmental initiatives they are undertaking in the first place. They are more interested in the plaque and the minimum capital investment they can get away with to attain that plaque.

BUILDING DESIGN PROFESSIONAL 1 argues the case however that owner groups including institutions and public authorities have a vested interest in building buildings that are efficient and that will provide long-term operational savings. Therefore the addition of LEED does represent a premium to the building project and questions related to the costs of servicing LEED are valid and not necessarily reflective of a disengauged owner.

> Probably still the foremost one (barrier) is cost. There is a premium. I do have to respectfully disagree with my colleagues that there is no cost premium for LEED…our clients are pretty knowledgeable about the impact of operating cost savings over the life span of the building and they are already making wise decisions about building envelope and mechanical systems. So the baseline of comparison with that building and a LEED certified building does introduce a premium of some kind. What it is? It's getting to be a smaller number, it's very hard to get a specific percentage but obviously the larger the building the lower the percentage premium is and conversely the smaller the building it can add up to be a much larger premium (BUILDING DESIGN PROFESSIONAL 1).

BUILDING DESIGN PROFESSIONAL 1 also believes that the cost premiums attributed to LEED certification also directly impacts the amount of building given budget constraints that a building designer is able to deliver to the client that "is probably the biggest thing that prevents clients from say 'yes, let's get going'."

BUILDING DESIGN PROFESSIONAL 2 presents a similar concern expressed on behalf of client groups that view the soft costs associated with the LEED process as an added cost on their projects.

> I think the one (cost) that garners the greatest attention is the certification process *itself* [italics added]. Not an expensive point (LEED credit), not an expensive change in practice such as site issues or a particular way of doing the building, detailing the building, doing the landscaping, doing the envelope, doing whatever. The one that gets the biggest acknowledgment is the fact that there is the cost to go through the process…that's the perception we see fairly constantly.

The soft costs associated with consulting fees although linked to a service that was viewed by many informants as necessary, "in my opinion it is key to have a LEED consultant" (CONSTRUCTION PROFESSIONAL 1), was paradoxically also viewed as a potential barrier to LEED certification. Owner/Client 1 stated that "yes, I would definitely say that if they (consulting fees) got too high and the perception was that we would be building to LEED standard anyway naturally without the whole process then it (certification) would be abandoned at that time." BUILDING DESIGN PROFESSIONAL 3 further stated that the need to hire outside consulting services to handle the process was also related to the fact that many design firms simply did not have enough "inexpensive people power" to handle the large amount of documentation coordination. Informant Owner/Client 3 also reflected on the substantial costs linked consulting services in the LEED process in his company's project delivery model.

> I'd say our biggest cost is a softer intangible and it's really about consulting costs. It's partly because of how our project delivery process is set up. We have so many layers. We as agency don't really get too deep in the weeds. We manage contracts. So if you're talking from our project delivery, a major capital project delivery, we have a service provider who is responsible for coordinating that business. So, we have a project manager in-house who'd be responsible for managing the service provider project manager. The service provider project manager would tender the documents, which we oversee to make sure that they meet our needs but then they would hire the architect or design lead who then hires the team all the various subs flow from that degree. So you can see the sort of consultancy costs that come on at every layer. So at any stage during that drop-down you can get someone that comes on board says 'LEED, ah… okay that's going to be an extra, you know, whatever here's my number.' But then also just the fact you've got to bring on some specialty house (consultant) like an Enermodal or a Halsall to coordinate all the documentation side of things. Obviously, there is a lot of work involved in that.

BUILDING DESIGN PROFESSIONAL 1 in addition to their earlier comment on the price premium of LEED stated, "in fact, that's probably becoming the biggest barrier to LEED certification is the cost of consulting fees themselves even beyond the cost of the components of the building." BUILDING DESIGN PROFESSIONAL 1 dampens this assertion however by reflecting on the value a good consultant brings to the LEED process.

> For people that have not been through this before there is a sticker shock…but once they've been through it they realise how much is involved and the value that a good consultant brings to the project, especially if you are achieving a very high level of performance with the building.

Additionally, the costs associated with purchasing the educational and reference materials, as well as the fees paid in the professional credentialing and credential maintenance of LEED APs were on a number of occasions referred to by interviewees as a "money grab." CONSTRUCTION PROFESSIONAL 2 further states that these costs represent, "a massive barrier to education to the user and implementation of the system." Therefore in the absence of knowledge related to LEED and its implementation the need to purchase knowledge either through hiring in outside help or through the education of the members that are a part of the project team can add to the costs associated with pursuing LEED. For project teams that are defficient in LEED process knowledge the perceived and actual cost of pursuing LEED can vary greatly from teams that have previous project experience with LEED.

5.6 Discussion on Barriers in the Ontario Context

The analysis of the interviews showed that actors in all groups made statements that would indicate the existence of barriers relating to acceptance, applicability, knowledge, process and costs in the use and implementation of LEED in the Ontario context. However, it should be noted that a number of interviewees made statements that also indicated that barriers to LEED were either diminishing or had been overcome. For example, CSLPT 2 stated, "we're not finding many barriers to certification. There are some issues that pose challenges, but I haven't seen a project wishing to achieve certification unable to achieve it," and informant OC2 asserted, "apparently we have overcome any barriers that there were" in reference to their organisation's successful green building programme. Although that may be true for organisations and project teams where the level of experience is high, for uninitiated actor groups the barriers identified in the literature review and interview process may still pose a challenge in overcoming. Early adopters and those well versed in the system in combination with revision made to LEED by the CaGBC however have helped to establish procedures and protocols aimed at reducing the barriers encountered by many first time users. Integrated design process or integrated project delivery are an example of procedures that have been identified by many as the most significant aspect in addressing many of the barriers to LEED's use.

Table 5-1 shows a summary of the interview data and the confirmation of the existence of the barrier either internally within the interviewee's organisation or externally in other actor groups and in the market in general. Although the interview analysis did not discover any

Table 5-1 Summary of Interview Data – Confirmation of Barriers

	CONSULTING PROFESSIONAL 1	CONSULTING PROFESSIONAL 2	CONSULTING PROFESSIONAL 3	BUILDING DESIGN PROFESSIONAL 1	BUILDING DESIGN PROFESSIONAL 2	BUILDING DESIGN PROFESSIONAL 3	CONSTRUCTION PROFESSIONAL 1	CONSTRUCTION PROFESSIONAL 2	CONSTRUCTION PROFESSIONAL 3	Owner/Client 1	Owner/Client 2	Owner/Client 3
Acceptance	X			X		X	X			X	X	X
Applicability			X				X					X
Knowledge			X	X	X	X		X				X
Process	X		X		X	X	X		X		X	X
Cost	X	X		X	X	X	X	X	X		X	X

previously unknown barriers that would be considered unique to the Ontario context, a number of interesting observations can be made. The cost barrier and financial aspects entailed in LEED certification proved to be the largest barrier to the use of LEED on a building project and confirmed what had been previously uncovered in the literature review. Of note, a number of interviewees stated the phenomena of *LEED-like* or *LEED shadowing*. LEED-like and LEED shadowing are terms that describe incorporating aspects of LEED into building projects but not going through the administrative and documentation process of certifying. Larsson (2010, p.116) states that, "the potentially high total costs of a complete rating and certification service may help to explain why many developers and designers use rating systems as a checklist, without getting certification." In this sense the LEED-like and LEED shadowing may be considered a barrier to the wider application of LEED in the industry.

It was also suggested by a number of informants in this study that building type played a role in determining the perceived and actual costs associated with pursuing LEED certification. For different market segments, the industry norms in terms of square footage construction costs can be seen to influence the premium or perceived premium associated with LEED certification. In the retail sector where construction costs average $700 CAD per square meter the decision to pursue LEED will cost more than in an institutional project where construction budgets are typically between $3,225-4,300 CAD a square meter. Building elements in institutional projects including mechanical systems, building envelope and building components are often more energy efficient than similar systems in the retail sector and the added costs associated with these systems can be justified in financial models where the owner is able to see a return on investment due to operational saving over long-term occupancy. With these elements already in place, the decision to certify a building to LEED standards is less costly than in the retail sector where the efficiency gains needed to bring the baseline building up to the energy perquisites of LEED is much more expensive. A number of interviewees believed that the added costs to build to higher performance criteria should not be viewed as a premium over status quo and one interviewees encapsulated this by asking, "is that the cost of LEED or is that just the cost of good design?"

(CONSULTING PROFESSIONAL 1). Again, although not a barrier per se in the the use of LEED, building type may play a role in determining an owners willingness to pursue LEED and the value they assign to the certification process.

Amongst actor groups it was also noted that there was also little monetising of the co-benefits, higher productivity, lower absenteeism, increased worker retention amongst others (Athens, 2010), related to the LEED system and green buildings in general. Instead the informants were heavily focused on the capital costs related to construction and operational energy and water costs of the new building. The "soft intangible" benefits as identified by one interviewee, were often considered difficult to put a value on and therefore did not factor into most budget forecasts and models. Better cost-benefit analysis and monetisation of the co-benefits and externalities related to the LEED systems could reduce many of the perceived cost barriers to LEED.

The process barrier was found to represent the next highest barrier category followed by the acceptance barrier for the Ontario market. The process barrier was, as the literature review found, often a result of incongruences between traditional linear project design and delivery models and the integrated approach to whole building design preferred in green and sustainable construction. The disconnect between the two models of design and construction resulted in timing issues, potential project delays and break downs in communication between actor groups. The time lag between project completion and certification was also identified as a potential barrier to certification as it prevented remedial action from being taken on deficiency identified in the certification review process.

Documentation was also identified as a process barrier to LEED. Increased documentation of the design and construction process that required additional work hours, mishandled documentation, and the reluctance of sub trades to disclose pricing information all led to difficulties in the documentation of the LEED certification process. Many of the process barriers are intrinsically linked to added soft costs and therefore the cost barrier. Servicing LEED certification through documenting the procedure is a barrier both in process of collecting the documentation and in the associated costs of doing so.

The acceptance barrier for many of the participants interviewed was as result of business-as-usual mind-set, ownership buy-in, lack of clearly defined organisation goals, and in valuing the benefits of green buildings outside of energy and water performance. Ultimately much of the acceptance of LEED, like the process barriers, was associated with the value individuals and organisation assign to the LEED certification process. The difficulty is that the term "value" is an extremely subjective term and may be different between silos within organisation. The need for the decision to pursue LEED to be driven in a top down manner through an organisational LEED champion was highlighted by interviewees.

Interviewees identified lack of organisational knowledge of LEED and the certification process, the learning curve associated with implementing LEED, a shortage of knowledgeable people to administer the LEED process, and a general deficiency in the skills required in constructing green building within the construction industry as all contributing to knowledge barriers to LEED. Often a lack of knowledge within organisations necessitated hiring in knowledgeable people in the form of consultants from outside to supplement knowledge deficiencies. The hiring of consultants added costs to the process and as discussed in section 5.5 this presented itself as one

of the largest barriers to LEED identified. Informants also noted the experience and quality of companies hired as consultants varied greatly within the industry and could lead to a disconnect between actor groups.

Applicability was identified through the interview analysis as the barrier that presented the least challenge to the use of LEED. Applicability issues dealing with lack of supporting infrastructure to support the intent of some credits, transfer of technology between market segments and the uptake of LEED amongst small and medium-sized developers were all identified as barriers. Surprisingly, no interviewee identified conflict of LEED with local codes and standards that may be encountered when new building techniques and technologies are used in projects. This may be a reflection that many levels of LEED certification can be achieved with using standard techniques and technologies as acknowledged by Harvey (2009).

6 LEED as a Mandated System in Ontario

Informants in this study were also engauged to understand their opinions on the use of LEED as a public policy tool in addressing the negative environmental aspects of buildings. The following section presents the results from the interview process and is supplemented with a literature review to substantiate the opinions expressed on behalf of the informants. This section will serve to answer the second research question.

RQ2. How do actors perceive the use of LEED as a mandated tool to address the negative environmental effects related to the built environment in Ontario?

6.1 Perception of LEED as a mandated system in Ontario

Since LEED's adaption to the Canadian market in 2004 its use has undertaken a transformation from being a purely voluntary system, designed for marketing green buildings through addressing greenwashing and providing rigour toward sustainability claims, toward a mandated system that is increasingly being utilised by both the private and public sector in order to promote sustainability in the built environment. As noted previously in section 2.5, both the Federal government of Canada and the Ontario Provincial government have mandated that all new government owned and operated buildings are require to achieve some level of LEED certification. New Federal government buildings have been required to meet a minimum of LEED Gold certification since April of 2005 and as of June 2007 all new Provincial government building are required to achieve a minimum of LEED Silver. While the mandating of LEED can occur both in the public and private sectors the motivations to do so varies between the two.

Within the private sector, both globally and in Ontario, the mandating of LEED for the construction of corporate owned buildings has been embraced by a number of organisations looking to capitalise not only on the cost savings associated with the long-term operation and use of certified buildings but also for the signalling effect (Corbett & Muthulingam, 2007) certified buildings can bring. Companies including Starbucks, CitiGroup and FedEx amongst others have mandated LEED for all new corporate construction in an attempt to capture the added goodwill and reduced exposure to reputational risk participating in green building programmes offers (Starbucks Corporation, 2011; CitiGroup, 2011; FedEx, 2011). LEED and other green building certification schemes can also be used as an instrument that helps corporations to attract socially responsible investments (SRI) from pension and equity funds in. A 2007 study showed that half of the market leaders in equities SRI products and services surveyed included socially responsible property investment (SRPI) considerations in their investment decisions (Rapson, Shiers, Roberts, & Keeping, 2007). In response, a growing number of companies are including green building consideration along with other environmental targets in their corporate social responsibility (CSR) reporting initiatives.

The motivation on behalf of governments and public authorities to mandate green building rating systems including LEED tends to vary from the motivations of the corporate world. Economic considerations such as attracting outside investment generally do not apply to the realities of the public sector and therefore system such as LEED present themselves as a policy tool that offers a "faster approach than mandatory regulation" to confront environmental issues associated with buildings (Levine, et al., 2007, p. 425). The different rationale for mandating LEED in both the public and private sectors was expressed by interviewees within the study. One informant from

the Owner/Client group saw the value of a policy that mandates LEED in that it permits those who mandate the system to bypass the regulative institutional archetype identified by Hoffmen & Henn (2008).

> Mandating LEED allow for organisations, corporations and municipalities to specify greener buildings without having to wait for building codes to catch up…this is done for a number of motivating factors and has caused momentum in the industry. Where one may see LEED is a nuisance, another may see it as an opportunity (Owner/Client 2).

Interviewee CONSULTING PROFESSIONAL 2 conceded that although LEED was not designed as a regulatory tool, LEED "provides governments a widely accepted, already developed, third party system on which to rely" and could be viewed as an indication as to one motivating factor why governments look to LEED. As a policy tool, the mandating of LEED can shorten the time necessary to influence building design and construction practices when compared to the alternative route of updating building codes. This could be viewed as a plus by governments and political parties that are often accused of responding slowly to addressing issues concerning the environment. LEED offers governments the ability to address the negative externalities associated with the built environment through using a tool that is widely accepted and known in the private sector and that can be mandated with less resistance than altering building codes. An interviewee from the Owner/Client group summed up from their point of view the reason why LEED is increasingly mandated, "building codes are traditionally far lacking and they're not renewed with as much regularity as perhaps they should be, so this provides a third-party opportunity to really challenge the marketplace and really push the boundaries" (Owner/Client 3).

Although all informants understood the reasoning behind governments mandating LEED, many were wary of the implications such a policy approach in the public sector may bring about. They raised questions concerning issues of financing, construction contracts, liability and litigation. An interviewee from the BUILDING DESIGN PROFESSIONAL group approached the idea of mandated LEED certification for projects with trepidation.

> That is an unanswered problem in the industry because these requirements have only recently come to the fore and the one thing that clients don't understand about LEED is that you don't know what your certification is until probably a year after your building is completed. That is going to introduce some interesting issues for funding, you know, when the funding is tied to meet certification and you don't know whether you have got your LEED certification yet. Yeah, that's going to be interesting problem (BUILDING DESIGN PROFESSIONAL 1).

Examples of instances where project funding and payments have been withheld as a result of unknown or pending certification status have begun to be reported within the Ontario media and have to some extent substantiated these concerns. Two recent cases from August 2011 in Brantford Ontario show that this represents a real concern for developers, contractors and practitioners of LEED in general who's financing models are linked to achieving certification. In the Brantford cases, two developers that had recently completed affordable housing projects required to meet LEED certification under the Canada – Ontario Affordable Housing Program

grant requirements, were going to be withheld payments pending certification. However, city officials intervened and approve a negotiated one-time compromised that saw a much smaller portion of the monies withheld (Marion, 2011). Uneasiness related to LEED being used as a performance criterion in construction contracts has prompted the Canadian Construction Association (CCA) to draft a pending bulletin to their members concerning the practice. John Bockstael, chair of the CCA's general contractors council stated about the forthcoming announcement "what this bulletin attempts to achieve is to get information out that the LEED third-party certification is not an obligation to achieve substantial performance of the work although it is often specified in construction contracts by owners as the expected end result" (Versace, Canadian Construction Association warns about potential liability on projects, 2011).

Interviewees also expressed a certain level of ambivalence as to the potential liability issues surrounding mandated LEED certification. One informant from the BUILDING DESIGN PROFESSIONAL group stated,

> The CaGBC put this tool out there and now the government is making it mandatory. What happens if someone doesn't achieve it on an Infrastructure Ontario project and all of a sudden this gigantic penalty is slapped on the contractor? How many lawsuits will come out of this?" (BUILDING DESIGN PROFESSIONAL 3).

Another participant in this study from the CONSTRUCTION PROFESSIONAL group discussed LEED certification as a performance criterion and the resulting penalties, up to $2 million CAD (Kenter, 2010), for failing to meet the Provincial government mandated LEED requirement saying,

> If a client wants a LEED certified building and it has to be Silver and that is what we are providing them. If we fail, as far as providing a LEED Silver building there is a penalty that you have to pay and it is *hefty* [italics added]. But that penalty is you know [pause] that never happens (CONSTRUCTION PROFESSIONAL 1).

A further interviewee was ambiguous on the potential fallout from failing to meet a mandated LEED target stating, "that would just look really bad on our department probably…I don't know what would happen? That can't happen" (Owner/Client 1).

These concerns and uncertainties expressed by the study's informants raise interesting and important questions as to liability and enforcement issues that mandating LEED can create. Herazo-Cueto & Lizarralde (2010) point to organisational *fragmentation* within the construction sector and increasing *project complexity* as two reasons potential reasons why building projects often fail to actualise their strategic planning tactically during the construction phase. LEED as a point-based system requires that all parties in the project team work together to achieve points and credits require for final certification. In this sense, responsibility for delivering on LEED certification is diffused amongst all members of the project team. A risk analysis of the alternative finance and procurement (AFP)[12] project deliver model – the project delivery model used by the

[12] "Alternative Financing and Procurement is an innovative way for the government to deliver on its commitment to maintaining and expanding public infrastructure. Infrastructure Ontario's AFP model uses private financing to strategically rebuild vital

Ontario government for most LEED mandated new construction - prepared for Infrastructure Ontario, highlights the increased possibility of failing to meet contract requirements under this type of arrangement.

> The likelihood of one of the entities or joint-venture partners of the proponent becoming unable to fulfill its contractual obligations are greater under the DBFM[13] model, due to the number of parties involved and the complexity of such a financial arrangement (Altus Helyar Cost Consulting, 2007, p. 12).

In addition the report stated that they AFP project delivery method also entails "risk associated with the contractor's obligation to meet the LEED requirements stated in the contract documents" (Altus Helyar Cost Consulting, 2007, p. 15). Questions relating to the liability assumed by project team members as a result of LEED being introduce as a performance clause in construction contract documents still remain largely unanswered. John Bockstael of the CCA wonders whether liability, in the case of failing to meet LEED certification, would be passed on to sub-contractors or even manufacturers and suppliers of products if it was shown that their contributions "led to the failure of getting LEED points" (Versace, 2011).

Financial penalties and lingering concerns about liability linked to achieving LEED certification has led a number of industry observers to speculate on a potential surge in litigation related to LEED non-performance clauses in contract documents and have begun to use the colloquialism *LEEDigation* to describe this possible development (Del Percio, 2010). However, the Canadian Federal and Ontario Provincial governments as well as the private sector in Canada have, to this point, avoided any major litigation cases related to LEED and LEED certification. One interviewee from the Owner/Client group in this study explains how they have seen the potential litigation issues as a result of mandating LEED play out in the Ontario market so far.

> The construction community has had enough of an appetite for green buildings, because the public has an appetite for green buildings and because their market has an appetite for green buildings, that they have said 'you know what, we're not going to figure out all the litigation issues up front, we're just going to do it. Let's just do it.' And in some ways how could you figure out all of the litigation issues before hand. You cannot predict a lot of this stuff…I think that when it comes down to the mandatory (LEED) litigation, what could be the crux in it is whether or not you start seeing some suing happening. To my knowledge it hasn't happened yet…I don't know if anybody would bother going after anyone really, other than reputation-wise. There would be a lot of yelling and a lot of angry phone calls but I think generally what has happened across the industry is that people haven't went out and actually sued people. Now, just like we mentioned before with a lot of registered projects that never got LEED there should be people getting sued left and right but they're not…when you have these larger contractors who have been sued on projects inevitably because of the scale of the business, they have lawyers on staff. The lawyers probably look at all this green

infrastructure, on time and on budget, while ensuring appropriate public control and ownership" (Infrastructure Ontario, 2009).

[13] Design Build Finance Maintain

> stuff and say 'oh my god, we're leaving ourselves open to all this liability,' but they're doing it (LEED) anyway…right now they (construction community) are raising the issues because they see it as something that needs to be fixed and eventually somebody is going to get sued but it hasn't seemed to have held back the market that much (Owner/Client 2)

Although the new construction market in Ontario has appeared to avoid LEED related litigation to this point, as the number of mandated LEED registered projects grow however it remains to been seen whether or not *LEEDigation* will become a significant issue in Ontario.

Study informants were also concerned that government at all levels increasingly used LEED as a baseline for energy efficiency in buildings thereby displacing the role that building codes had traditionally played in the building sector. The effect this has on increasing energy efficiency within the building industry can be limiting as one interviewee from the CONSULTING PROFESSIONAL group stated.

> The real challenge for mandated LEED is that it becomes the status quo and the building code exists so that people don't do worse than it. If you build worse than the building code you will go to jail. If you then go out and put LEED in as the thing that is dragging the building industry ahead, if it goes into the baseline, then to some extent you have eliminated the ability for movement in the industry forward (CONSULTING PROFESSIONAL 1).

An informant from the CONSTRUCTION PROFESSIONAL group explained a common rationale for deciding the credits to pursue in LEED used by owners who are mandated to achieve LEED, "when it is more of a mandated system, where you have to achieve LEED Silver, you're going to get the cheap ones (credits). You're going to look at the price for each one, how many credits can I get for this dollar value" (CONSTRUCTION PROFESSIONAL 3). In many instances the expensive credits that provide dramatically increased reductions in a buildings environmental impacts are forgone in favour of meeting only the minimum requirements in those categories. In terms of decreasing energy use and increasing energy efficiency in buildings under the LEED system, specifying to the minimum requirements necessary to meet the mandated certification level by owners can prove problematic.

A LEED credit distribution published by the CaGBC (see Appendix III) of all the LEED certified buildings in Canada up to March 2011 showed that for LEED Silver certified buildings, the current minimum requirement for government buildings in Ontario, only 39% of projects achieved credits in the Optimized Energy and Performance category (see Appendix III) (CaGBC, 2011). The Optimized Energy and Performance credit, under the Energy and Atmosphere category, is intended to reward projects for achieving higher levels of energy efficiency than the MPR of LEED. Under the LEED Canada NC 1.0 rating system in order to achieve points in the Optimized Energy and Performance category project teams had to demonstrate, through whole building energy simulation, that their building design exceed at minimum 24% energy efficiency cost relative to the Model National Energy Code for Buildings (MNECB) of Canada (CaGBC, 2004). A recent study in Canada concluded that for commercial buildings a 25% reduction in energy use when compared to the MNECB is easily achievable by most designer and further that 50% reductions were possible by more skilled designer even without the use of "unconventional

systems" (Harvey D. L., 2009, p. 160). However despite the apparent ease with which high levels of energy efficiency can be achieved according to Harvey (2009), the number of Canadian LEED certified projects achieving points in the Optimized Energy and Performance category remains low. Harvey also believes that although LEED Platinum buildings have the potential to deliver up to 50% energy savings over traditional buildings reductions of 65%+ are need to combat climate change (Harvey I. , 2010). It should be noted that the energy requirements have changed with the introduction of the LEED NC Canada 2009 rating system to reflect a greater focus and weighting on energy performance in buildings that will help to push the market to achieve higher levels of energy efficiency.

Informants in this study also recognised the role mandating LEED played in helping to transform the market in it acceptance of green buildings but ultimately questioned whether this was in fact the right way to induce change. One interviewee from the Owner/Client group acknowledged that the growth of LEED within Ontario has been as a large result of the public sector's policy of mandating LEED.

> They are going after 25% of the market. That's a huge percentage of the market, so to be able to get there inevitably you are going to have to have municipalities and governments mandating it. Realistically, you are not just going to have ever fourth project saying 'hey, oh yeah, let's just go for it (LEED)' right?" (Owner/Client 2).

Interviewee CONSULTING PROFESSIONAL 3 reaffirmed this by saying that LEED registrations and certification would "plummet precipitately" without a governmental mandate. In addition a number of this study's informants expressed similar views to Hart's (2009, p. 3) assertions that although LEED has done much to push the market forward, "it is inevitably bumping up against its limits in the current policy environment." Interviewees discussed the role of LEED is currently playing in the market and worry that mandating LEED forces the system into becoming a stick rather than a carrot and ultimately diminishes it's ability to promote higher levels of energy efficiency in buildings. As one informant indicated "I like to see it mandated but not necessarily as the baseline" and furthered that "if you are pushing from behind then put it into the building codes" (BUILDING DESIGN PROFESSIONAL 3). One interviewee from the CONSULTING PROFESSIONAL group stated that other standards exist that would better serve the intents of a mandate than LEED.

> If municipalities and groups want to implement LEED-style requirements they should take ASHRAE 189[14] and use the language that is in that standard, it's very much like LEED but it is in code-like language, standard type language, and say 'thou shall design your sustainable features to ASHRAE 189.' Then encourage people through vehicles like tax breaks, lower development charges and faster building permit reviews to go to the next level (CONSULTING PROFESSIONAL 1)

CONSULTING PROFESSIONAL 3 also viewed the wider adoption of ASHRAE 189.1 as a positive development for LEED.

[14] An overview of the ASHRAE 189.1 green building standard is available at http://www.ashrae.org/publications/page/927

> I do see that as being part of where the industry is going to go and that will help to address some of the barriers and it would then allow the LEED to become what it was intended to be again. Which is a voluntary system that is aimed at helping users of the system to promote their buildings and to promote their accomplishments that are above and beyond what everybody else is doing.

Using building code and stadards with code-type language would help to overcome many of the complications of mandating a voluntary system. Ontario cities such as Toronto that has the authority to mandate more stringent municipal building codes that take precedent over the Ontario Building Code have already begun to do so with the development of the Toronto Green Development Standard. However, for cities that do not have the legislative authority to require higher building performance standards for new development, they must rely on using policy tools including mandating LEED to influence the market through their own procurment policies. An interviewee from the CONSTRUCTION PROFESSIONAL group acknowledged that despite the complications mandating LEED may cause, they do recognise the need to do so as a reflection of the time it takes for governments to update building codes.

> It does make sense. However I do see a lot of these aspects of LEED being written into the code, eventually. What we will be looking at ten to fifteen years down the road might be a new Ontario Building Code with a lot of this stuff (LEED) written into it (CONSTRUCTION PROFESSIONAL 1).

6.2 Discussion on LEED as a Mandated System in Ontario

In analysing the comments made by informants in the study it would appear that although many understand the rationale for a public sector mandate of LEED ultimately the majority do perceive many complications and are for the most part ambivalent on the consequences such policy measures will have in the market.

Interviewees identified issues with the financing of projects as one potential consequence of a LEED mandate as well as liability issues associated with failing to meet LEED certification as a performance requirement in construction contracts. Although, as explained by the study's informants, LEED-related litigation is not a common occurrence in the Ontario market, is this one thing that has the potential to become a more substantial issue? The AFP project delivery process utilised on large infrastructure projects undertaken by the province of Ontario could possibly play a role in amplifying the issue of litigation. The public private partnerships (P3) required in DBFM place large financial pressure on the private sector consortiums to delivery public infrastructure projects on time and within budget. If LEED is included as performance criteria in contract documents could this lead to the hold back of money on large government infrastructure projects? Further, will this result in the likelihood of litigation between individual members of the private sector consortiums and between the consortium and the government of Ontario? One could speculate that as stated earlier the achievement of LEED should not be a measure of substantial performance of the work completed and therefore from a legal standpoint it may be difficult to defend. There is also the public relations aspect that might check any potential litigation procedures. Governments use LEED not only as a means to address environmental issues associated with building that code is their current state fail to address but also because the represent a marketable brand recognized by the public at large. Litigation that may put the LEED brand in an unfavourable light amongst constituents may be

counterproductive to the government's agenda. In any case, whether the concerns are realistic or not they do raise interesting question regarding the use and jurisdiction of a private third party voluntary standard as a policy tool.

Informants were also concerned that mandating LEED turns the rating system from a tool that promotes and rewards those that go above and beyond in the industry, a carrot, into a system to force or pull up the quality of buildings within the market, a stick. A number of interviewees cited examples where those forced to meet LEED requirements through a mandate are more likely to building to the minimum criteria need to meet the required certification level and are not encouraged to go beyond. In this sense informants were concerned that LEED was increasingly being viewed as a baseline requirement a spot traditionally reserved for the building code. In doing so, many believed that the value of LEED to push the market and to induce change in the market as a whole was being diminished as a result of policy mandates. In addition interviewees expressed concern that viewing LEED certification as a baseline requirement could also have potential ramifications as the LEED system is updated and performance criteria are increased. When the Ontario provincial mandate was established, along with a number of municipal mandates, LEED Canada version 1.0 was used as the rating system to set the minimum achievement of certification levels. With the introduction of LEED Canada 2009 in 2010, all new projects must register under the new rating system making the requirements to achieve a certain level of certification more stringent. As on informant from the BUILDING DESIGN PROFESSIONAL group stated, "people don't always understand, including the CaGBC, necessarily what the implications of those rule changes are going to be…cities and governments that mandate will they be able to keep up with it?" (BUILDING DESIGN PROFESSIONAL 3).

Informant's concerns about the use of LEED as a baseline does raise a number of interesting points related to the role private sector certification systems play in public policy. Although there is a recognised need to increase building standards, interviewees did understand why governments turn to mandating systems such as LEED to bridge the gap between what is needed in terms of energy efficiency in buildings and what is required by law but ultimately questioned whether or not LEED was the right tool. A number of interviewees suggested standards such as ASHRAE 189.1 that used code-like terminology are better suited as a public policy tool. Mandating a standard like ASHRAE 189.1 would allow for LEED to fulfill its original intent of bringing recognition for those building designers, constructors and owners that go above and beyond what is required by law and rewarding them for pushing the top end of the building design and construction field. Informant Owner/Client 2 stated in regards to the use of LEED as a public policy tool that, "the real question should be, as it becomes mandated is, is LEED a system that can and should it evolve to meet those needs or not?"

7 Concluding Remarks

Buildings have been shown to exert negative effects on the environment and human health both directly and indirectly. In Canada it is estimated that buildings are responsible for approximately 33% of Canada's energy consumption, use 50% of its extracted natural resources, are directly accountable for 25% of all landfill waste and produce 35% of all domestic greenhouse gas emissions (OCGBDD, 2011). As a market sector, commercial and residential buildings are directly responsible for roughly a quarter of total GHGs globally. In light of these facts, buildings have been identified by a number of non-governmental organisations, including the IPCC and IEA, as a key intervention point in the fight against climate change. Energy and green building certification schemes are tools that can be utilised to address energy efficiency issues in the construction of new buildings and the retrofitting of existing buildings.

The CaGBC's LEED green building rating system represents the most widely used certification framework in Canada and in Ontario. However, despite increased use of the LEED rating system in Ontario the total number of buildings designed, constructed and certified using the system remains small given the overall building market. This statement leads to the first research question posed in this study:

RQ1. (What are the barriers to the use and implementation of LEED in Ontario, Canada?) How are they perceived amongst the main LEED actors groups? These actor groups are:

- a) owners/clients;
- b) architects;
- c) construction firms, and
- d) project consultants.

The interview process and resulting analysis showed that all the barriers identified through a literature review were present within the Ontario market. It should be noted that no distinctions were made between real and perceived barrier in this study expressed by the informants and were treated as one in the same. The barriers were found to by in line with the framework used in the study and were delineated into five categories including acceptance, applicability, knowledge, process and costs. The costs barrier was found to represent the largest barrier to the wider use and implementation of LEED in Ontario. Interestingly the cost barrier for the most part was not related to increased costs due to construction methods or technologies used but rather as a direct reflection of the LEED certification process itself. The practice of LEED-like and LEED shadowing whereby the LEED system is followed as a checklist in the design and construction of buildings but certification is not pursued, can be viewed as a consequence of the cost barrier in the Ontario market.

Barriers to LEED identified in descending order of significance after the cost barrier was process, acceptance, knowledge and applicability. In many cases the barriers themselves were strongly interconnected with a number of barriers including process and knowledge having a costs component that further reinforced the existence of the barrier. The cost barrier also influenced the acceptance barrier as it ultimately affected the perceived value of seeking LEED certification

on a given project. Building type and square meter construction costs were also shown to influence the perceived value of LEED certification.

The use of mandating of LEED as a public sector policy tool to address the negative impacts of buildings was the departure point for the second research question:

RQ2. How do actors perceive the use of LEED as a mandated tool to address the negative environmental effects related to the built environment in Ontario?

Analysing the interview data showed that although the informants across actor groups understood the reasoning behind why the Ontario government uses LEED as a mandated tool to address the negative environmental effects of building and to influence the market through procurement policies, they were ultimately unsure as to the potential issues such a mandate may cause. Interviewees cited concerns regarding complications with funding and project delivery models as well as liability and litigation issues arising from the inclusion of LEED as a performance requirement in construction contracts. Informants were also apprehensive of LEED being viewed as a baseline for energy performance and water efficiency in the industry. The mandating of LEED, many interviewees believed, has turned the voluntary system into a "stick" used by government to drag up performance standards in buildings rather than a "carrot" used by the private sector to reward building designers and constructors to push the top end of the industry in terms of building performance and technological innovation. It was also noted that in the absence of sufficient building codes, the use of standards that use code-like language such as ASHRAE 189.1 were suggested by informants as better tools to address issues of energy performance and sustainability in the built environment.

7.1 Recommendations for Future Research

A number of potential areas for future research were identified in the completing of this thesis. Perhaps most interesting is the practice of LEED-like and LEED shadowing in the building industry. It would be valuable to investigate this further to better identify to what extent it is done in the building industry and to study if there is any performance variation between projects that certify and projects that follow the LEED framework but do not certify. Also, due to the relative recent introduction of LEED as a mandated policy tool, it would be valuable to further investigate the impact mandates have on large infrastructure projects and how liability issues are address on a contractual level amongst consortium members in DBFM project delivery models.

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Appendix I – LEED Canada 2009 NC Points

SUSTAINABLE SITES		26 POSSIBLE POINTS
❒ Prereq 1	Construction Activity Pollution Prevention	Required
❒ Credit 1	Site Selection	1
❒ Credit 2	Development Density and Community Connectivity	3, 5
❒ Credit 3	Brownfield Redevelopment	1
❒ Credit 4.1	Alternative Transportation: Public Transportation Access	3, 6
❒ Credit 4.2	Alternative Transportation: Bicycle Storage and Changing Rooms	1
❒ Credit 4.3	Alternative Transportation: Low-Emitting and Fuel-Efficient Vehicles	3
❒ Credit 4.4	Alternative Transportation: Parking Capacity	2
❒ Credit 5.1	Site Development: Protect and Restore Habitat	1
❒ Credit 5.2	Site Development: Maximize Open Space	1
❒ Credit 6.1	Stormwater Design: Quantity Control	1
❒ Credit 6.2	Stormwater Design: Quality Control	1
❒ Credit 7.1	Heat Island Effect: Non-Roof	1
❒ Credit 7.2	Heat Island Effect: Roof	1
❒ Credit 8	Light Pollution Reduction	1

WATER EFFICIENCY		10 POSSIBLE POINTS
❒ Prereq 1	Water Use Reduction	Required
❒ Credit 1	Water Efficient Landscaping	2, 4
❒ Credit 2	Innovative Wastewater Technologies	2
❒ Credit 3	Water Use Reduction	2-4

ENERGY AND ATMOSPHERE		35 POSSIBLE POINTS
❒ Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
❒ Prereq 2	Minimum Energy Performance	Required
❒ Prereq 3	Fundamental Refrigerant Management	Required
❒ Credit 1	Optimize Energy Performance	1-19
❒ Credit 2	On-Site Renewable Energy	1-7
❒ Credit 3	Enhanced Commissioning	2
❒ Credit 4	Enhanced Refrigerant Management	2
❒ Credit 5	Measurement and Verification	3
❒ Credit 6	Green Power	2

MATERIALS AND RESOURCES		14 POSSIBLE POINTS
❒ Prereq 1	Storage and Collection of Recyclables	Required
❒ Credit 1.1	Building Reuse: Maintain Existing Walls, Floors, and Roof	1-3
❒ Credit 1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
❒ Credit 2	Construction Waste Management	1-2
❒ Credit 3	Materials Reuse	1-2
❒ Credit 4	Recycled Content	1-2
❒ Credit 5	Regional Materials	1-2
❒ Credit 6	Rapidly Renewable Materials	1
❒ Credit 7	Certified Wood	1

INDOOR ENVIRONMENTAL QUALITY		15 POSSIBLE POINTS
❒ Prereq 1	Minimum Indoor Air Quality Performance	Required
❒ Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
❒ Credit 1	Outdoor Air Delivery Monitoring	1
❒ Credit 2	Increased Ventilation	1
❒ Credit 3.1	Construction Indoor Air Quality Management Plan: During Construction	1
❒ Credit 3.2	Construction Indoor Air Quality Management Plan: Before Occupancy	1
❒ Credit 4.1	Low-Emitting Materials: Adhesives and Sealants	1
❒ Credit 4.2	Low-Emitting Materials: Paints and Coatings	1
❒ Credit 4.3	Low-Emitting Materials: Flooring Systems	1
❒ Credit 4.4	Low-Emitting Materials: Composite Wood and Agrifibre Products	1
❒ Credit 5	Indoor Chemical and Pollutant Source Control	1
❒ Credit 6.1	Controllability of System: Lighting	1
❒ Credit 6.2	Controllability of System: Thermal Comfort	1
❒ Credit 7.1	Thermal Comfort: Design	1
❒ Credit 7.2	Thermal Comfort: Verification	1
❒ Credit 8.1	Daylight and Views: Daylight	1
❒ Credit 8.2	Daylight and Views: Views	1

INNOVATION IN DESIGN		6 POSSIBLE POINTS
❒ Credit 1	Innovation in Design	1-5
❒ Credit 2	LEED® Accredited Professional	1

REGIONAL PRIORITY		4 POSSIBLE POINTS
❒ Credit 1	Durable Building	1
❒ Credit 2	Regional Priority Credit	1-3

Source: (CaGBC, 2011)

Appendix II – CaGBC Related Registration and Certification Costs

	Registration		Certification	
	Member	Non-member	Member	Non-member
LEED Canada NC and CS				
< 2,500 m^2	$500	$750	$3,700	$5,550
2,500-24,999 m^2 (per additional m^2)	$0.11	$0.183	$0.67	$0.99
> 25,000 m^2	$3,000	$4,800	$18,500	$27,400
LEED Canada CI				
< 500 m^2	$500	$750	$2,650	$4,010
500-11,999 m^2 (per additional m^2)	$0.226	$0.368	$1.384	$2.045
> 12,000 m^2	$3,000	$4,800	$18,500	$27,400
LEED Canada EB:O&M				
< 2500 m^2	$500	$750	$3,000	$4,500
2,500-21,999 m^2	$750	$1,125	$0.6 / additional m^2	$0.9 / additional m^2
> 22,000 m^2	$1,000	$1,500	$15,000	$22,500

Appendix III – Average Scorecard for LEED Canada-NC 1.0

LEED Canada for New Construction (NC) Credit Distribution as of Mar 2011

			% of Total	% of Certified	% of Silver	% of Gold	% of Platinum
Sustainable Sites	Possible Points 14						
Prereq 1	Erosion & Sedimentation Control	Required					
Credit 1	Site Selection	1	92	89	93	92	100
Credit 2	Development Density	1	24	11	23	26	50
Credit 3	Redevelopment of Contaminated Site	1	26	14	25	28	50
Credit 4.1	Alternative Transportation, Public Transportation Access	1	60	57	62	55	86
Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1	88	80	93	87	93
Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles	1	17	3	13	20	50
Credit 4.4	Alternative Transportation, Parking Capacity	1	49	34	46	53	71
Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space	1	33	9	21	45	71
Credit 5.2	Reduced Site Disturbance, Development Footprint	1	59	46	54	68	64
Credit 6.1	Stormwater Management, Rate and Quantity	1	51	20	38	66	93
Credit 6.2	Stormwater Management, Treatment	1	48	37	37	57	71
Credit 7.1	Heat Island Effect, Non-Roof	1	50	26	46	54	100
Credit 7.2	Heat Island Effect, Roof	1	55	43	45	65	71
Credit 8	Light Pollution Reduction	1	63	43	62	70	71
			51	**37**	**47**	**56**	**74**
Water Efficiency	Possible Points 5						
Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1	90	74	87	97	100
Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1	81	69	73	88	100
Credit 2	Innovative Wastewater Technologies	1	43	9	23	64	93
Credit 3.1	Water Use Reduction, 20% Reduction	1	97	89	97	100	100
Credit 3.2	Water Use Reduction, 30% Reduction	1	92	80	89	99	93
			81	**64**	**74**	**90**	**97**
Energy & Atmosphere	Possible Points 17						
Prereq 1	Fundamental Building Systems Commissioning	Required					
Prereq 2	Minimum Energy Performance	Required					
Prereq 3	CFC Reduction in HVAC&R Equipment	Required					
Credit 1	Optimize Energy Performance	1 to 10	49	32	39	59	86
Credit 2.1	Renewable Energy, 5%	1	10	0	6	8	71
Credit 2.2	Renewable Energy, 10%	1	7	0	3	5	50
Credit 2.3	Renewable Energy, 20%	1	3	0	1	2	21
Credit 3	Best Practice Commissioning	1	58	34	52	66	86
Credit 4	Ozone Protection	1	82	69	82	85	100
Credit 5	Measurement & Verification	1	26	9	15	36	64
Credit 6	Green Power	1	38	20	39	35	93
			34	**20**	**30**	**37**	**71**
Materials & Resources	Possible Points 14						
Prereq 1	Storage & Collection of Recyclables	Required					
Credit 1.1	Building Reuse: Maintain 75% of Existing Walls, Floors, & Roof	1	6	6	13	2	0
Credit 1.2	Building Reuse: Maintain 95% of Existing Walls, Floors, & Roof	1	4	6	6	2	0
Credit 1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements	1	1	3	1	1	0
Credit 2.1	Construction Waste Management: Divert 50% from Landfill	1	88	83	89	88	100
Credit 2.2	Construction Waste Management: Divert 75% from Landfill	1	72	51	77	73	86
Credit 3.1	Resource Reuse: 5%	1	4	3	4	5	0
Credit 3.2	Resource Reuse: 10%	1	2	3	1	2	0
Credit 4.1	Recycled Content: 7.5% (post-consumer + ½ post-industrial)	1	99	100	99	99	100
Credit 4.2	Recycled Content: 15% (post-consumer + ½ post-industrial)	1	77	63	77	79	93
Credit 5.1	Regional Materials: 10% Extracted & Manufactured Regionally	1	97	94	97	97	100
Credit 5.2	Regional Materials: 20% Extracted & Manufactured Regionally	1	83	69	82	87	93
Credit 6	Rapidly Renewable Materials	1	2	0	3	1	7
Credit 7	Certified Wood	1	25	14	14	32	57
Credit 8	Durable Building	1	26	6	23	30	71
			42	**36**	**42**	**43**	**51**
Indoor Environmental Quality	Possible Points 15						
Prereq 1	Minimum IAQ Performance	Required					
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required					
Credit 1	Carbon Dioxide (CO_2) Monitoring	1	58	51	45	64	100
Credit 2	Ventilation Effectiveness	1	24	6	13	30	79
Credit 3.1	Construction IAQ Management Plan: During Construction	1	90	71	89	96	100
Credit 3.2	Construction IAQ Management Plan: Testing Before Occupancy	1	65	49	54	75	93
Credit 4.1	Low-Emitting Materials: Adhesives & Sealants	1	86	91	85	83	100
Credit 4.2	Low-Emitting Materials: Paints and Coating	1	83	71	83	84	100
Credit 4.3	Low-Emitting Materials: Carpet	1	89	80	92	88	100
Credit 4.4	Low-Emitting Materials: Composite Wood & Laminate Adhesives	1	52	34	49	59	64
Credit 5	Indoor Chemical & Pollutant Source Control	1	57	49	59	54	86
Credit 6.1	Controllability of Systems: Perimeter Spaces	1	42	20	28	53	86
Credit 6.2	Controllability of Systems: Non-Perimeter Spaces	1	24	20	11	25	93
Credit 7.1	Thermal Comfort: Compliance	1	86	74	89	88	93
Credit 7.2	Thermal Comfort: Monitoring	1	69	51	66	75	93
Credit 8.1	Daylight & Views: Daylight 75% of Spaces	1	44	17	32	60	64
Credit 8.2	Daylight & Views: Views 90% of Spaces	1	50	29	39	62	79
			61	**48**	**56**	**66**	**89**
Innovation & Design Process	Possible Points 5						
Credit 1.1	Innovation in Design	1	97	86	97	100	100
Credit 1.2	Innovation in Design	1	95	80	96	100	100
Credit 1.3	Innovation in Design	1	87	54	89	97	100
Credit 1.4	Innovation in Design	1	66	23	61	80	100
Credit 2	LEED® Accredited Professional	1	100	97	100	100	100
			89	**68**	**88**	**95**	**100**

Rating Level	No.
Certified	35
Silver	71
Gold	92
Platinum	14
# of LEED Canada projects	212

Note: LEED-BC projects are not included due to a slight difference in requirements and EAc1 scoring

Note that the percentage achieve represents the average of how many projects achieved that score in the appropriate rating level. For EAc1, the percent can also be used to generate average score for this credit; i.e., 50% of 10 EAc1 points would be an average score of 5 points.

Source: (CaGBC, 2011)