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Green vs. sustainable: analyzing and expanding LEED (leadership in energy and environmental design)

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ABSTRACT

GREEN vs. SUSTAINABLE: ANALYZING AND EXPANDING LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN)

by
Sonay Aykan

This dissertation investigates the possibility of including new socio-economic indicators in green building rating systems in order to promote innovative practices in the building planning, design, construction and operations by introducing a broader definition of sustainability in the building industry. It provides a comparative analysis of the frameworks, indicators and measurement methods of Leadership in Energy and Environmental Design (LEED), which is a voluntary green building rating system, and the reporting guidelines of Global Reporting Initiative (GRI) by examining several selected socio-economic indicators from GRI and questioning the possibility of introducing similar indicators (credits) in LEED. By doing so, it assesses the comprehensiveness of LEED against another widely-accepted list of metrics developed for sustainability benchmarking. The theoretical framework is based on a critique of contingencies inherent to various definitions of sustainability and an analysis of the new politics that is emerging through the discourse of sustainability. The research relies on the data collected from USBGC LEED Project Directory, documents submitted during the LEED certification process for four projects that pursue LEED certification and interviews with the participants of these projects, USGBC members and people who were actively involved in the preparation and implementation of the GRI guidelines. By depicting the intertwined relationship among the building industry, labor markets, financial and legal forces, the findings of this research show that development of socio-

economic indicators for the building industry is not impossible, but is bounded to the methods of asset value calculations, regulations on labor markets, workflow structure of the building industry and the political structure behind the rating systems.

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APPROVAL PAGE

GREEN vs. SUSTAINABLE: ANALYZING AND EXPANDING LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN)

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To live! Like a tree alone and free
Like a forest in brotherhood

Nâzım Hikmet Ran

to my wife,	who taught me love
to my mom,	who taught me patience
to my dad,	who taught me courage
and to the giraffe in africa,	whom I don’t know but I still love

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LIST OF DEFINITIONS

Building Project	Combination of all the activities that occur throughout the design and construction of a building.
Credit	A measurable and optional standard in LEED that helps building projects obtain certification.
Discourse	Combination of elements through which the society creates and reshapes the knowledge.
Ecology	(In this study) the interactions among organisms and their environment.
Economy	The social system of production, consumption and distribution of limited goods and services.
Environment	The surrounding physical system of an object. In this study "environment" is sometimes used interchangeably with "ecology".
Framework	Conceptual grounds defining on what basis indicators will be brought together and calculations will occur.
Green	A system, good or service that has significantly minimum negative impact on Earth's ecology.
GRI	Global Reporting Initiative, a non-government organization that develops sustainable reporting guidelines.
Impact Category	A category that defines the potential environmental impacts and human benefits of each LEED credit
Indicator Category	A distinct class under which similar indicators are classified.
LEED	Leadership in Energy and Environmental Design is a volunteer rating system intended to provide certification for green building systems.
Lexis	Speech, one of the two components of Aristotle's definition of politics. The combination of meaningful words that make a language.
Lifecycle	All of the stages of a product or a service from cradle to grave.

LIST OF DEFINITIONS (Continued)

Lifecycle Assessment	An assessment technique that measures impacts of goods and services in all different stages of their lifecycle.
Measure	A plan or action aiming at achieving a goal.
Natural Resource	Resources that can be extracted from nature. (This phrase is sometimes criticized for its interpretation of the nature as a resource that can be extracted for the benefits of human).
Natural Wealth	Naturally occurring substances, without human intervention, including minerals, vegetation and biodiversity. There are studies that try to interpret natural wealth in monetary terms; however natural wealth does not necessarily have to be measured through money.
Performative mode of expression	Form of a social relationship through which politics takes place. According to Judith Butler, performative mode of expression can occur either in the form of speech act or as the reproduction of social norms.
Politics	The practice and theory that enable human beings to change and operate through the physical space that surrounds them.
Praxis	Practice, one of the two components of Aristotle definition of politics. The combination of activities through which people change their physical surroundings.
Prerequisite	A measurable and mandatory standard in LEED that is required for building projects to obtain certification.
Rating system	A system designed for ranking certain goods or services based on their performance on specific issues, i.e. their performance on environmental protection.
Set of Indicator	Group of indicators brought together based on a framework for the purpose of sustainability assessment.
Sustainability	Meeting the needs of present without compromising the ability of future generations to meet their own needs (general definition); or actualization of a human action or provision of a good or service without damaging the capability of ecological, economic or social systems to endure (in this study).

LIST OF DEFINITIONS
(Continued)

Sustainability Assessment	The act of measuring the negative and positive impacts of a good or service on ecology, economy or society, or the balance among them.
Sustainability Indicator	A tool that translates the data collected from the complex systems of economy, society and ecology, or from human activities that affect these systems, into pieces of information that describe the ability of these systems to sustain current and future generations, or the effects of human activities on this ability
USGBC	United States Green Building Council, mother organization of LEED.

CHAPTER 1

INTRODUCTION

1.1 Reasons Behind the Research

The researcher's interest in sustainability assessment dates back to his internal audit experience in Akbank, one of the biggest national banks of Turkey and a strategic partner of Citigroup. As an internal auditor, he realized that our routine assessment activities were focusing on the financial performance of the bank while skipping many other variables that affect the efficiency of banking operations. Among these variables are the use of resources such as electricity, water and paper; and other factors that affect the working conditions such as indoor environmental quality of the offices and the working hours of the employees. On many occasions, he witnessed that the lights and the air conditioning units for unoccupied rooms and offices were not tuned off and significant amounts of paper were sent to landfills instead of being recycled. Throughout his trips to various branches of the bank, he also noticed how the working environment changes the efficiency of employees by affecting their psychological wellbeing. People, who worked for the Operations Department, those who deal with the physical money and therefore mostly stay behind the closed doors for security purposes often complained about being deprived of daylight, while those who worked for the Marketing Department and therefore stayed in open, semi-public spaces showed more signs of enthusiasm and concentration.

These details directed his attention towards seeking solutions to improve both the environmental footprint of the bank and also the working conditions in the offices, hence helping to increase efficiency in both material and human resources. The bank had remarkable resources and the capability to monitor and manage the use of these resources by introducing no or low cost audit mechanisms similar to what had already been used for financial audits. However, there were two hurdles in front of actualizing this. First was the lack of an external incentive that would force large corporations to take the necessary measures. In many cases, energy agreements with utility companies were signed on a fixed rate of usage on an annual basis. Therefore, the amount of energy usage was not changing energy costs, thereby eliminating any motivation to reduce energy use. The second hurdle was the unfamiliarity of the banking industry with the importance of the concept of sustainability or environmental protection. For this reason, no significant measures were taken to mitigate the negative impacts of the daily banking operations on the environment. In the absence of necessary guidelines, certifications or other benchmarking tools, any efforts to increase corporate social responsibility would be invisible in the big forest of profit driven corporations.

The courses that he has taken at the New Jersey Institute of Technology helped him reinterpret these experiences through a theoretical framework and gave him the chance to learn more about the concept of sustainability. Becoming familiar with the green building rating systems and other sustainability assessment tools made him realize that the missing piece, the incentive mechanism was now in the market and corporations now the chance to be recognized not only for increasing their profit margins, but also for reducing the negative impact they may have on the environment and society. For these reasons, he decided to delve into the field of sustainability assessment and focus his research on finding new ways to encourage corporations to increase the sustainability of their operations.

1.2 Importance of the Research

The building industry is one the engines of the global economy and it is also one of the sectors which can have significant effects on population. By changing the physical spaces in which we live and work, the building industry has the power to shape our daily activities and educate our bodies to act in certain ways. Building industry can contribute to the formation and transformation of the socioeconomic structure in several ways. Together with zoning regulations it can affect population densities by creating buildings for different number of occupants. By determining the amount of open space and daylight, location and number of shared spaces, entry and exit rules, occupational practices and the amount of green space buildings can affect the shape of social structures, how people live, how they transport and work. Simultaneously, can affect where and how significant amounts of financial and human capital will be mobilized, which industries will be supported and what type of labor skills will be rewarded.

These features make the building industry a significant nexus that connects financial processes with social ones. Buildings are also major actors in environmental change. Accounting for 40 percent of energy use in the US (in 2012), buildings are the number one producers of CO2 in the US. The materials that are used during construction and their transportation carry these effects to a global scale by creating a domino effect in a building's supply chain. Locations of buildings can also be vital for preservation, or destruction, of natural wealth such as underground water resources and biodiversity. Thanks to their power over the daily practices of social life, they can also create indirect effects on the environment through shaping transportation habits, infrastructural expansion and individual resource consumption.

The building industry has long been the focus of sustainability discussions. Starting with BREEAM and LEED, many green building rating systems have emerged in the last two decades, aiming to mitigate the negative impacts of buildings on the environment, while also providing better and healthier living spaces. However, the majority of these rating systems miss the chance to focus on the social and economic impacts of the buildings in addition to the environmental ones. Being the leading sector in the sustainability movement, the building industry has the power to determine the next item to be included in the agenda of sustainability discussions. Therefore, it is important to introduce new measures to the building industry which will focus on the socioeconomic aspects of sustainability, hence attracting global attention to these aspects, as well as to the environmental ones.

Based on this reasoning, the aim of this research was to identify which aspects of sustainability are being addressed and measured currently by the building sector and to explore possibilities for developing new tools that will address and measure sustainability more fully and in a more comprehensive way by including socioeconomic aspects, as well as environmental ones. In order to achieve this, the researcher compared the leading green building rating system in the US, Leadership in Energy and Environmental Design (LEED) with the reporting guidelines of Global Reporting Initiative (GRI) which is one of the most comprehensive sustainability reporting guidelines in the market. By doing so, it is hoped that new research opportunities will emerge that can trigger the creation of a new assessment approach to connect all three aspects of sustainability (economy, ecology, society) into one rating system for the building industry in the world.

To achieve this goal, this study starts with a critique of the sustainability concept (Chapter 2 and 3) and role of this concept to construct a new discourse. Accordingly, it examines how this new discourse on sustainability can change the urban environment through changing the way we build buildings. For this purpose, it presents a comparative analysis of the existing literature on sustainability with addressing possible problems that may occur due to the catch-all character of the concept.

Chapter 5 and 6 try to identify how sustainability concept is applied to the building industry and which aspects of sustainability are addressed or omitted by LEED or other green building rating systems. These chapters also compare the sustainability approach of green building industry with the sustainability assessment tools developed for other sectors and identify 10 sustainability indicators that could be included in LEED. Chapter 7 discusses the possibilities to include each of these 10 indicators in LEED, by examining the data collected from actual building projects, interviews with LEED and sustainability specialists and several other written documents. The details regarding the methods of analysis and sources of data are presented in Chapter 4. Conclusions and implications for future research are presented in Chapter 8.

CHAPTER 2

DEFINING SUSTAINABILITY

2.1 Rise of Sustainability as a Concept

Thanks to the emergence of a global exchange market for words, “sustainability” has entered our lives as a side dish with our entrees, an ornament in our houses and a badge on top of our hearts. While influencing discussions on a wide range of topics ranging from urban design to agriculture, it has also a new conceptual field through the introduction of labels such as “green,” “natural” and “organic”. This new conceptual field also heralded a discursive shift from “development” to “sustainable development.” As “development” and “growth” have slowly resigned from being the leading terms of the socio-economic field of the 20th century, their position has been taken over by a “more advanced” version of the developmentalist paradigm, which is “sustainable development,” This transition has also changed the commonsense view that assigns positive values to concepts like economic growth, investment, employment and profitability, while making them questionable with respect to the needs of the future generations.

The rise of sustainability as a candidate for leading concepts of the 21st Century is evident in the number of times the term “sustainability” appears in online searches. Similarly to how trends in a stock market can help predict the future of financial capital in a particular sector, trends in online searches can provide clues about the future of a particular topic, a thought, an industrial sector or even the values that shape entire socio-economic systems. The frequency of particular words in online searches can represent changes in the cultural capital of society. These changes can reveal elements of the discourse through which society operates, not discourse as mere language or text, but as the way that society creates and reshapes knowledge. These elements build a new network of information and create new ways of collecting, analyzing and rephrasing this information, hence opening up possibilities for new social practices.

Google Trends is an application developed by Google to track the frequency of topics or words since 2004. It also shows how often a particular topic appears in Google News stories. Although Google is not the only tool for identifying changes in the interests of the world, Google's 70 percent share in the worldwide online search volume (Yarow, 2010) makes Google data an important sample representing changes in worldwide interest in a particular topic.

According to Google, Google Trends application analyzes a portion of Google web searches to compute how many searches have been conducted for a particular term, relative to the total number of searches conducted on Google over time, in order to find the likelihood that a random user has searched for that term. The results are then normalized and represented by a number between 0 and 100 to show the change in searching over time. If multiple terms are being compared, then numbers between 0 and 100 also indicate the frequency of searches for each term.

Statistical data provided by Google shows that since 2004 users hit the keyboard at an increasing rate to search the word "sustainability" (Figure 2.1). Evident in the trendline drawn between 2004 and 2013, the word "sustainability" is also expected to receive increasing attention from online users in the future. The rate of increase in the appearance of the word "sustainability" in Google News searches is even higher (Figure

2.2), showing that its significance is also increasing in the daily agenda and more incidents are being interpreted and reported with respect to the concept of sustainability every day.

Figure 2.3 shows that “environmental sustainability,” “definition of sustainability” and “sustainability report” are among the terms that appear most frequently during these online searches. The same data also shows that definitions of sustainability, jobs related to sustainability and sustainability businesses are the search items that have received more attention from online users recently, indicating the increasing importance of the sustainability concept in the business environment.

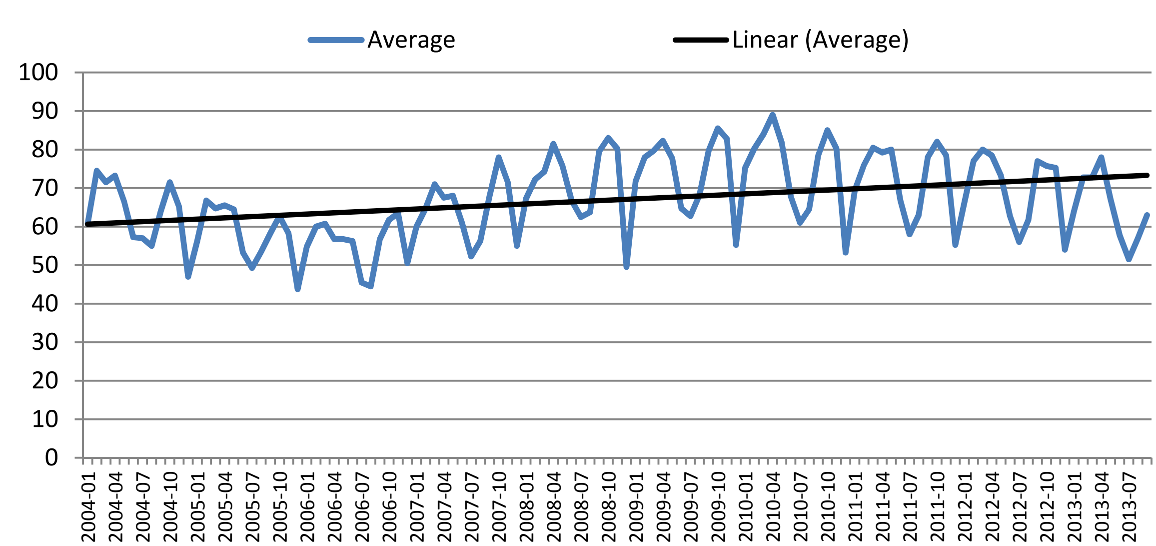

Figure 2.1: Change in the appearance of word “sustainability” in Google searches.
Source: *Google Trends, http://www.google.com/trends/, accessed on September 2013.*

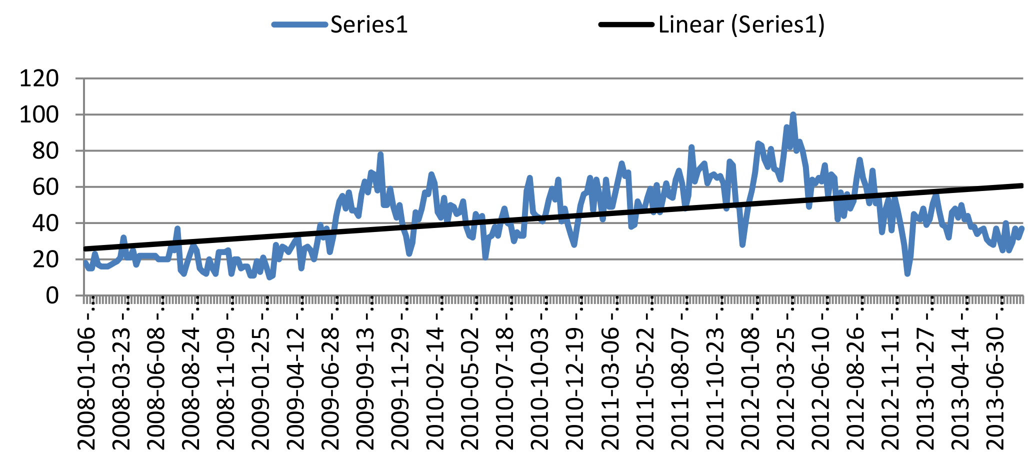

Figure 2.2: Change in the appearance of word "sustainability" in Google News searches.
Source: *Google Trends, http://www.google.com/trends/, accessed on September 2013.*

Top related terms appear in online searches	
sustainable	100
environmental sustainability	85
definition sustainability	50
sustainability report	50
sustainability development	45
what is sustainabilty	40
energy sustainability	35
business sustainability	35
sustainability management	30
social sustainability	30

Rising related terms appear on online searches	
define sustainability	+200%
sustainability jobs	+140%
sustainability in business	+100%
what is sustainability	+90%
food sustainability	+70%
definition sustainability	+60%
sustainability report	+60%
energy sustainability	+50%
definition of sustainability	+40%
sustainability conference	+40%

Figure 2.3: Other terms that appear in online Google searches related with the word "sustainability".
Source: *Google Trends, http://www.google.com/trends/, accessed on September 2013.*

Sustainability is not only an ethical label with multiple values attached to it representing ultimate goodwill towards the environment and society, but it is now also an intangible asset such as goodwill and brand that has value in the financial markets. In 1999 the Dow Jones Sustainability Index (DJSI) was launched to monitor the portfolios of professional investors regarding sustainability criteria developed by DJSI (Knoepfel, 2001). Since then, stocks of the 2500 largest companies selected from different sectors have been traded under DJSI. Many other indexes have been established to manage financial markets with respect to principles of sustainability, such as the Calvert Social Index, Ethibel Sustainability Index, FTSE4Good, Domini 400 Social Index and Vigeo ASPI. These indexes offer different indicators to asses a company's performance with respect to climate change, environment, human rights and discrimation prevention, as well as its relationship with problematic sectors such as nuclear technolgy, gambling, weaponry, alcohol and tobacco (Fowler & Hope, 2007). It is these assessments that are used to determine which companies will be included in or excluded from sustainability indexes.

Changes in financial markets also affect investment strategies as compliance with sustainability standards becomes an important criterion for making investment decisions. On its website, the World Bank (WB) promotes its bonds by stating that it provides about 20 billion US dollars (USD) worth of loans annually to "help each developing country onto a path of stable, sustainable, and equitable growth" (WB, 2009). More than 358 different funds in Europe provide financial support to "sustainability" projects, with magnitudes ranging from 40 thousand USD to 2 billion USD (Flotow, 2011). Energy is among the leading sectors where business strategies are restructured with regard to issues that are gathered under the umbrella of sustainability, such as clean energy, renewable technologies and low carbon emissions. According to a 2008 report from the International Energy Agency (IEA), between 2004 and 2008, world clean energy investments jumped from 55 billion USD to 155 billion USD (IEA, 2008). As of July 2011, 21 different US federal incentive programs offer tax reductions, allowances for modified accelerated cost-recovery system, tax credits and grants to those who install renewal energy systems (Dsire, 2011).

In many industries such as building, textile, banking, coffee trade, forestry, food, retail and tourism there are regulations that aim at reorganizing different phases of the lifecycle of economic activities based on sustainability criteria. For example, Leadership in Energy & Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Green Globes (GG), International Green Building Code (IGBC) and Whole Building Design Guide (WBDG) are only a few of the tools that have been developed to regulate the building industry with respect to sustainability. Similarly, many other other tools have been developed for other economic sectors in accordance with sustainability principles, such as the Fair Trade Organization, which focuses on the global trade of goods, Global Organic Textile Standard for textile products, Forestry Stewardship Council for foresty, ISO 14000 series, which focuses on complicance of trade organizations with environmental laws, and the principles of Global Rerporting Initiative, which aim at guiding organizations for sustainability reporting.

According to the 2012 report issued by the Forum for Sustainable and Responsible Investment (US SIF) in 2011 $3.7 trillion worth of investment in the US was made in consideration with environmental social and corporate governance (ESCG) principles. This is equal to 11.2% of all the funds that were managed by financial investment corporations in the US, in 2011 (USSIF, 2012). But it is too early to claim that one tenth of investments in the US are being managed in accordance with sustainability criteria because the same report also shows that the leading ESCG criteria that determine the investment decisions in the US does not represent the basic tenets of sustainability debates but instead address national security related issues, such as compliance with the international trade restrictions towards Iran and Sudan, trade relations with the "terrorist and repressive regimes" and compliance with the MacBride principles in trade relations with North Ireland. Climate change and carbon emissions, which are primary concerns of sustainability debates, are however placed at the end of the list, showing that tools that claim to assess sustainability might not always be designed to address the problems important for sustainability.

Data collected through online searches and the increasing attention given to sustainability in different markets represent more than just a shift in public interest or a linguistic innovation. These changes are also signs of a shift in the discursive field in which the entire society operates. Appearance of "sustainability in public domain signifies the beginning of a significant transformation in production and consumption habits as well as decision-making processes. But simultaneously the increasing frequency in the occurrence of sustainability in literature, news and other channels of public communication can accelerate this transformation by creating a new public understanding where the "good" and the "bad" ways of doing things have changed. It can create a new paradigm in which the production, transportation, marketing and consumption of goods and services are not evaluated based on only their profitability but also on their effects on the environment and the society. This change does not occur due to a simple linguistic shift in the naming of these processes but results from an alteration in these processes. Changing the way people produce and consume also requires redefining their relationship with the environment and the society, in other words redefining what we call environment and society, from a perspective where these components were interpreted as mere resources to be exploited for economic development to a view where economy, society and environment are equals, each having their individual role in the human existence.

The research conducted by US SIF shows that the increasing power of the sustainability concept within the real economy and its enlarging borders in the conceptual world can also be threats to the usability of the term sustainability turning it into a catch-all term. In other words, with the lack of a clear definition, the term “sustainability” has the danger of becoming an “empty-signifier”, which Laclau defines as a concept that refers to many things but cannot describe anything (Laclau, 2006). Therefore, for sustainability be able to operate outside the conceptual world and lead to solid changes in human interaction with the society, economy and the environment, a clear definition of the term is needed along with the development of assessment tools, which can determine the borders of concept, while introducing the ways to operate within these borders.

Sustainability is not a predefined set of rules that can be imposed through a top-down social structure, nor is it simply reflection of a profit crisis among the forces of production projected on the socioeconomic superstructure, as Marx would put it. Although the foreseen ecologic crises and its possible destructive effects on the whole socioeconomic structure, starting with the productive capital, is the main cause of the rise of sustainability as a popular concept, the relationship between the concept and the elements of the social structure is too complex to be explained by a deterministic approach. The worldwide acceptance of the concept includes various processes of negotiation among the different agents of society, including productive capital, finance capital, local interest groups, NGOs, environmental activists and the academia. In many cases, sustainability is not enforced only by those who are affected negatively by the economic activities of the so-called "capitalists", (with a more sound definition- those who manage creation and distribution of the economic capital; i.e. transnational corporations [TNCs], local manufacturing companies, financial corporations, brokers, small businesses, etc.) but it is also promoted by the "capitalists" as well. Especially big companies such as Nike, CocaCola, HSBC and BP are among the flagships of their industries, who apply the tools of sustainability assessment first by using reporting tools such as Global Reporting Initiative guidelines or rating systems such as LEED. Therefore, as sustainability cannot be defined as rescue project of the forces of production to save the economy from the approaching ecologic crisis, it cannot not be defined as an environmentalist/ecologist movement of resistance rising against those forces of production either.

2.2 Sustainability Discourse

In his work on Schopenhauer and Nietzsche, Georg Simmel (1991) distinguishes “man” from the “animal” by man’s manifold character, which allows him to grasp multiple images of the same object, each reflecting different perceptions of the same reality. For animals, he says, “images of objects are expressions of a uniform nature, of typical needs and apperceptions and therefore of a typical relation to the given things” (p.15). The relationship between the animal and nature is “unilateral” as opposed to the comprehensiveness of man’s perception of an object beyond being a mere desired thing but also being a means of theoretical understanding, aesthetic evaluation or religious meaning.

Although the validity of Simmel’s arguments about the level of simplicity of animal perceptions is questionable today, more than 100 years after his studies, especially given the existence of numerous counter-findings from neuroscience and psychology, his statement about the relationship between humans and their surrounding is still valid. Human interactions with the so-called outer reality, which can also be called the “environment”, occur in a multi-dimensional universe of concepts and emblems. This conceptual space constitutes a gate between the subject, or the post-enlightenment individual of the modern world, and the object of his or her perceptions or simply the “surrounding environment.” Not only are the many perceptions and meanings of the human mind formed in this conceptual space, but a person’s will toward the surrounding environment also operates through that conceptual space. Additionally, human interaction with their surroundings is not bi-directional but a multi-directional collective communication that includes other human subjects, and it is this communication that forms and actualizes a person's wills towards the surrounding environment.

Understanding what sustainability is and how adopting principles of sustainability can positively change the physical world relies on answering the following question: "What are the elements of the new discursive field defined by the concept of sustainability?" Both institutions and individuals who seek to establish of sustainable life-styles operate in this new discursive field. It is in physical space that meanings are created that make up the discourse. As Foucault reminds us (1986) many of the meanings that form the daily discourse are produced through spatial characteristics. For example, what we call sacred derives its power from spatial practices of reiterations, silence, positioning in architecture, lighting or preservation. Space sets the rules of our environment, as well as our world vision; the discourse and the politics revolve around these rules, either to apply or to change them. On the one hand politics reconstructs the space we live in; on the other hand politics also reconstructs the discursive field through which humans define their identity, by changing the spatial elements of this identity. By setting the rules of physical space, politics determine the possibilities of the urban design including shapes and types of buildings, the ways people use these buildings or the limits of this use; eventually creating a means politics of the human body or "biopolitics" as Foucault names it.

Emergence of the discourse of sustainability has both provided new tools for politics and allowed for new subject positions by creating a new discourse. On the one hand it has introduced new criteria to manage the physical space we live, such as those for sustainable urban design, green building, energy efficiency, fair trade, reduced environmental footprint, etc. These criteria have been translated into the language of laws and regulations through the creation of assessment tools, guidelines, rating systems or other instructive written documents; and new agencies have been established to implement these rules either in the form of state authorities or as private enterprises, none-government organizations (NGOs), etc.

Following the adoption of sustainability as a value new products have appeared in the market that promote a "green" way of living by adding new labels to their packages that say "green," "organic", "humanely raised," "natural," "ENERGYSTAR," "FAIRTRADE". Even brand names have been transformed to employ these signs of being sustainable with names such as "Ecolicious"[1] or "Gustrorganics[2]". Green and light brown have become the leading colors of what is meant to be socially responsible and environmentally friendly, occupying a vast visual space ranging from product packages to logos and the visual elements of web design. All of these signs and emblems make up a playground in which individuals can express themselves and form new identities through the new practices of "being sustainable", such as buying green products, measuring their environmental footprint, reducing their energy use, recycling, reusing etc. It is this playground which opens up new subject positions and makes it possible for individuals to say "I am green", "I am sustainable".

The discourse of sustainability "recruits" subjects by using the same mechanism that Althusser (1971) describes in his discussions of ideology. In his famous example about a man being hailed by a policeman on the street, Althusser says that the ordinary individual becomes a subject the moment he reacts to this call and turns back to the

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[1] A store in Charlotte, N.C., selling organic food and organic cleaning products.
[2] A restaurant in downtown Manhattan, serving organic food.

policeman. In other words, by turning back he recognizes both the “ideology” that is calling him and his identity as the subject of this call. What Althusser calls as ideology in this example is the relationship one believes to be established between him and the material reality, which determines how an individual perceive the reality and allow him operate within the society through the identity he employs.

The significance of the emerging discourse of sustainability in transforming the social space and urban politics can be reread with reference to Althusser’s description of ideology and the formation of subjects. The increasing number of measures on resource efficiency, environmental footprint, social responsibility and many other issues constantly create new benchmarks of being sustainable or unsustainable, simultaneously requiring the individuals to (re)position themselves according to these benchmarks. Each new threshold introduced by the sustainability assessment tools, each new green brand or a new suggested way of sustainable living brings a new ethical line through which the individual has to reassess his relation with the material world outside him. This call from the sustainability discourse is not much different from Althusser’s policeman calling a man on the street and asking “Hey you! Are you sustainable?”

All of these practices, including the creation of new measures and regulations, establishment of regulatory agencies, the introduction of new products and private enterprises, promotion of new lifestyles and transformation of the symbolic space through new words, colors codes, brands and labels make up what we call as the sustainability discourse. The recent rise of “sustainability” as a “catchall” term in socio-environmental and socio-economic fields (Gunder, 2006) encompasses a discursive shift from “environmentalism” to “sustainability.” The power of the term resides in its reconciliatory character. Detaching itself from the ideologically loaded oppositional character of the environmentalist discourse (O'Riordian, 1999), the new discursive field introduced by the sustainability concept brought diverse disciplines --- economy, ecology and social sciences-- together and started to create new institutions, tools of planning and new nodes for social identification. With the formation of sustainability as a new discursive field, the conflicting character of the environment-economy relationship was transformed into one of reconciliatory interaction. The earlier environmentalist fight against economic development was replaced by the institution of a concept of development that would sustain the next generations. In other words, for the first time advocates of economic development and advocates of environmental protection shared the same ground and begun to cooperate.

2.3 From Environmentalism to Sustainability

O'Rordian (1999) describes environmentalism as an "endless negotiation between the consumer self and the Gaian citizen" (151), where citizenship is defined as a universal and passive political position. For him, environmentalisms is a moral brake driven by the fear of the future destruction of the planet by people's actions and its simplest form is the constant "reinterpretation of our human-ness in a Gaian world". Several environmental organizations such as Greenpeace and the World Wildlife Fund include traces of this vision and which have then employed aggressive tactics against the environmentally "irresponsible" economic development. They have criticized the lack of sound data about the environment and they emphasized the need for a distinguished branch of science dedicated to environmental research (O'Riordian, 1999). These attempts paved the way for the development of an environmentalist discourse, which has changed the shape of planning processes in different fields ranging from the use of pesticides to urban design. The tone of planning shifted from interventionism that fights against nature, to nurturism, which redefines nature as something to be cared for.

The shift from the environmentalist discourse to sustainability is a recent phenomenon. Even ten years after the term “sustainability” was first coined by the World Commission on Environment and Development’s (WCED) report in 1987, the concept of sustainability (concept as a functioning term, an effective signifier that has roots in real life and politics, which can influence the daily life through tools of assessment and decision making) did not appear during planning processes. Gunder (2006) states that during the early 1990s, sustainability was not a topic or a term considered in Western planning schools. But today, sustainability is used frequently in urban planning, architectural design, food production, transportation, textile production and many other branches of goods and service industry. The Global reporting Initiative (GRI) recently announced that between 2006 and 2010 a 50 percent increase has been recorded in the proportion of companies that use software to monitor their sustainability performance (GRI, 2011a). According to a survey conducted by KPMG, an international business consulting firm, 62 percent of companies worldwide had a formal sustainability strategy in 2011? (Anonymous, 2011). In 2013 sustainability is a widely used term through governmental institutions in many countries, states or cities. The Australian Government of Department of Sustainability Environment Water Population and Communities (2010), the U.S. government's Sustainable Development Partnerships (2002), the Sustainable

Development Commission of UK (2000), Newark's Office of Sustainability (2008), Seattle's Office of Sustainability & Environment (2000) are some examples.

The success of sustainability in shaping decision making processes in different fields of the economy and society is a consequence of its flexible structure, which can include concerns from multiple disciplines grouped under the same concept. Solidified by Elkington's (Elkington, 1994) "triple bottom line" approach, sustainability has gained the position of a mediator or a peacemaker whose task is to reconcile relationships between economy, ecology and society. This position has lifted the concept of sustainability above one sided, short-term interests, generating calls for multidisciplinary, long-term solutions. For decision-makers sustainability has become a higher authority an ethical consciousness, something that whose truth cannot be rejected even if not being executed.

Simultaneously creating new tools of politics, through both *praxis* and *lexis*, and also transforming the daily life of individuals by defining new practices, the discourse of sustainability promises significant transformations in the way that people in the 21st Century will see and react to their physical environment. This promise, of course, is not independent from the material forces which have imposed a drastic change in the production and consumption habits of the 20th Century, which were highly unsustainable in terms of preservation of natural wealth, survival of the ecology and achieving social justice.

Nevertheless, the rising power of the sustainability concept in the political and discursive fields is not a guarantee for better management of world's natural and human resources. The "catch-all" and "floating" (Laclau & Mouffe, 2001) structure of the term resulting from its flexibility enables it to incorporate every single aspect of daily life, while hollowing out its content and blurring its boundaries. As is evident in the US SIF's report (USSIF, 2012), even with the existence of tools and mechanisms that require implementation of sustainability criteria in financial investments decisions, which are the engines of the economic structure, these requirements can still prioritize national security ahead of environment protection or social justice. With the absence of constructive practices that will define and assess sustainability in a way that addresses environmental protection and social justice, the diffusion and consequent dilution of the term reduces the power of the term "sustainability" that it has gained in the political and discursive fields.

This problem of confusion about what sustainability exactly means result from the vast conceptual space created by the absence of any precise definition of sustainability supported with a regulating body of clearly defined indicators. If ideology "is precisely the confusion of linguistic with natural reality" (Man, 1986, p. 11) then contemporary uses of the word "sustainability" open a gateway to new forms of ideological aberration by detaching the term from its origins. In many examples of its use, sustainability becomes a limited form of expression of environmental consciousness or an introduction of technological fixes to environmental issues. In these ways one misses the chance to actualize its power to reshape urban politics and manage contemporary lifestyles in ways that will reconcile economy, ecology and society, and promote significant changes in production, distribution and consumption habits.

2.4 History and Definitions of Sustainability

As the master signifier (Zizek, 1989) of a new discursive field, the term sustainability is gaining more and more significance within socio-economic structures and in politics. However, the more inclusive it gets, the greater the danger of sustainability becoming an empty signifier (Laclau, 2006) that includes many things without being able to describe anything at all (Lele, 2000; Vanlande, 2010). In the absence of clearly defined borders, specification of sustainability criteria and techniques to measure compatibility with these criteria, the vagueness of the sustainability concept reduces its functionality and makes it simply a collection of ethical values about the environment. Therefore, prior to the utilization of the concept in policy development, it is important to define sustainability and develop sustainability indicators with which people can measure the sustainability of their practices.

Sustainability is a living concept. It is being created and recreated through daily practices by both those who own and manage the economic capital, and all other political agents of the society ranging from NGOs to the individual, the smallest unit of politics. The content of sustainability and the rules of sustainable human practice are being redefined constantly through new research, indicators, projects and conferences, as well as through political activism which all aim to institute a “more sustainable lifestyle”. Therefore answering what sustainability is requires more than just an investigation of the literature. Similar to the techniques that Foucault used to pursue the archeology of concepts (discipline, subject, discourse, etc.) an archeology of “sustainable practices” is needed to see the limits and possibilities of the idea today. Given its recognition and acceptance by almost all different parts of the society, defining sustainability is also a valuable effort to disclose the responsibilities that should be taken by all of these parts, in order to be a sustainable society.

As Cohen (Cohen, 2011) puts it, it is not possible to define sustainability without referring to the famous 1987 report of the Bruntland Commission, where sustainable development is defined as meeting the needs of today's generations without compromising the needs for the next generations. But use of the sustainability concept actually dates back decades before. In the 1930s, the first sustainability calculations were devised by Russell (1931) to evaluate the sustainability of fisheries. By introducing "maximum sustainable yield" he developed a basis for calculating the optimum amount of fishing without harming the fish population. In 1980, the International Union for Conservation of Nature and Natural Resource (IUCN) published the *World Conservation Strategy* (Bentivegna et al. 2002) including a section on sustainable development. Although there are several other earlier uses of the world sustainability, the definition in the 1987 *Report of the World Commission on Environment and Development* (WCED) is the most-well known one and is still being used internationally. Many secondary texts borrow this definition. However, WCED's report does not actually define "sustainability" but rather "sustainable development". According to the report:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. […] it is the satisfaction of human needs and aspirations in the major objective of development. The essential needs of vast numbers of people in developing countries for food, clothing, shelter, jobs - are not being met, and beyond their basic needs these people have legitimate aspirations for an improved quality of life. A world in which poverty and inequity are endemic will always be prone to ecological and other crises. Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life (WCED, 1987).

The innovation this definition introduces is the notion of time (Cornelissen, 2001). Sustainability refers to a continuity of actions or state of things over a given time period. Unlike the traditional protectionist perspectives in environmentalism, sustainability does not focus solely on the destructive effects of humans on the environment but also addresses the self-destructive potential of human activities. It asks if human actions can continue over a given period of time without terminating the means of living for the human race and the surrounding environment.

Four different aspects of sustainable development can be delineated through an analysis of WCED's definition.

1- Sustainability is an expression setting its boundaries with of the following term (development). It defines a new condition for "development" which is to meet the needs of the next generations. In this way it can be reinterpreted as a call for regulation on "development".
2- The aspects of this new condition for development are not only ecological but are also social and economic.
3- Sustainability assumes a positive correlation between ecological degradation and social inequality or poverty. In this sense, while referring to development, it proposes the necessity of improvement in people's life and protection of the ecological structure for the development to be sustainable.
4- Despite its various aspects, the semantics of "sustainability" within this paragraph only refer to "continuations of development". The rest of the concepts are supportive additions of WCED to clarify its perspective.

Other international institutions' documents and webpages also give clues to the boundaries of the definition of sustainability. In its official webpage, the World Bank (WB) describes sustainability by borrowing the definition of WCED (WorldBank, 2009) and expanding it by introducing economic, social and environmental constraints to WB's definition. Major trends such as climate change, natural resource depletion, food scarcity, and urban expansion are included in WB's agenda as primary problems that sustainability discussions should address. WB's study is also an example for how sustainability is constantly being (re)defined through institutional practices. By developing sustainability indicators WB shows that the definition of sustainability can be extended to address a wide range of issues including social equity, health, education, housing, security, atmosphere, ocean coasts, biodiversity, economic structure and institutional frameworks (Segnestam, 2002).

The United Nations (UN) presents a similar perspective by uniting various actions under a multi-year work program for its Division of Sustainable Development. For the period between 2004 and 2017, the UN is planning to engage in programs related to water sanitation, energy for sustainable development, agriculture, transportation, forestry, oceans and vulnerability to natural disasters, which are all listed under sustainable development (UN, 2009). By doing so, UN is implying that in addition to ecological preservation, sustainability includes public security, public health and food security.

In the World Wildlife Fund's texts, sustainability refers to environmentally conscious business processes. In their Sustainability Training Program the Fund offers business training options dedicated to creating sustainable businesses in order to mitigate the worst effects of climate change and environmental degradation. The organization also runs the Sustainable Seafood program, under which it cooperates with seafood businesses for their transformation to be consistent with the sustainability standards of the Marine Stewardship Council (MSC). Various other definitions or connotations of sustainability can be found in many other texts issued by NGOs, companies, governments and other institutions. But even the limited number of examples presented above gives a sense of how many different issues and practices they refer to.

During the 1992 Rio UN Conference, an international effort was made to decrease the vague character of sustainability and draw easily understandable clear boundaries for the concept by introducing 27 principles aimed to set the rules for a responsible relationship between human beings and nature (UNCED, 1992). Key points of agreement were to integrate natural preservation into development, to establish sustainable development, to eradicate poverty and social disparities, to establish global partnerships, to preserve the ecosystem and to provide appropriate access to information by all. This was the first step in developing universally accepted sustainability indicators (Rametsteiner, Pülzl, Alkan-Olsson, & Frederiksen, 2011).

One way to reduce the confusion about sustainability is to categorize its meanings, based on their embodiment in different practices. An early attempt at this kind of categorization was made by Gatto (1994). He pointed out three different possible uses of the term sustainability for connecting human actions and the environment:

1- Sustained yield of resources that derive from the exploitation of population and ecosystems, continuum of the existing production;
2- Sustained abundance and genotypic diversity of individual species in ecosystem subject to human exploitation or, more generally, intervention;
3- Sustained economic development without compromising the existing resources for future generations.

With this three-part definition, Gatto reinterprets "sustainable development" as a subcategory of sustainability and draws a distinction between two different approaches on eco-related processes based on the relationship between the ecosystem and the humans. The second type of sustainability (2 above) addresses regeneration of the ecosystem not for the sake of human survival but for its own sake. However, the first type of sustainability refers the ecosystem as a necessary source of sustained production of goods and services by humans. In other words, sustaining the ecological yield for the human race is not the same thing as sustaining nature itself; and they are both different from sustaining nature for the sake of future generations, which is a third type of sustainability.

Pelt (1992) reformulated sustainability as a function of *current social welfare* and *the available ecological resources for future generations*. For sustainability to be achieved, both variables should at least be preserved at their current level, no matter how much aggregate gain changes. Pelt's definition defined a dual axis for sustainability between economy and ecology. This dual axis was later enriched with the introduction of "social sustainability" as a third variable, which refers to the institution and preservation of social justice in daily practices (McKenzie, 2004). Effects of human actions on social processes such as justice, human health, social capital, safety and working conditions are covered by social sustainability (Hutchins, 2008).

A similar categorization occurs in Lele's (2000) study, based on two basic categories: environmental and social. He emphasizes the interactive relationship between these two categories and reminds us that one cannot be neglected for the sake of the other. The ecological side can be subcategorized into management of renewable and nonrenewable resources and vital environmental processes. Social aspects refer to processes related to sustaining the social and political structures. In this sense, culture, which is mostly neglected, can also be named as an issue related to sustainability as well.

In the 1990's Elkington's (1994) categorization became a cornerstone for the definition of sustainability. He introduced the "triple bottom line (TBL)" approach (Figure 2.4), which later became widely accepted almost like a motto in sustainability debates. The idea was based on his critique of early environmentalists who followed an oppositional politics against industrialization and growth. Elkington's critique proposed a new dimension which tried to set linkages among the benefits of companies, customers and the environment. In his later works, these three components were reintroduced as the "3Ps of sustainability" -- *people, profit* and *planet* (Elkington, 1997). According to him, sustainability debates should pay attention to all t three aspects equally since all are interdependent components of sustainability in the long run. This approach aims to measure financial, social and environmental performance of a firm, in some sense working as a balanced scorecard, which later became a major point of critique of super-profit making companies such as Nike or Tesco (Management, 2009).

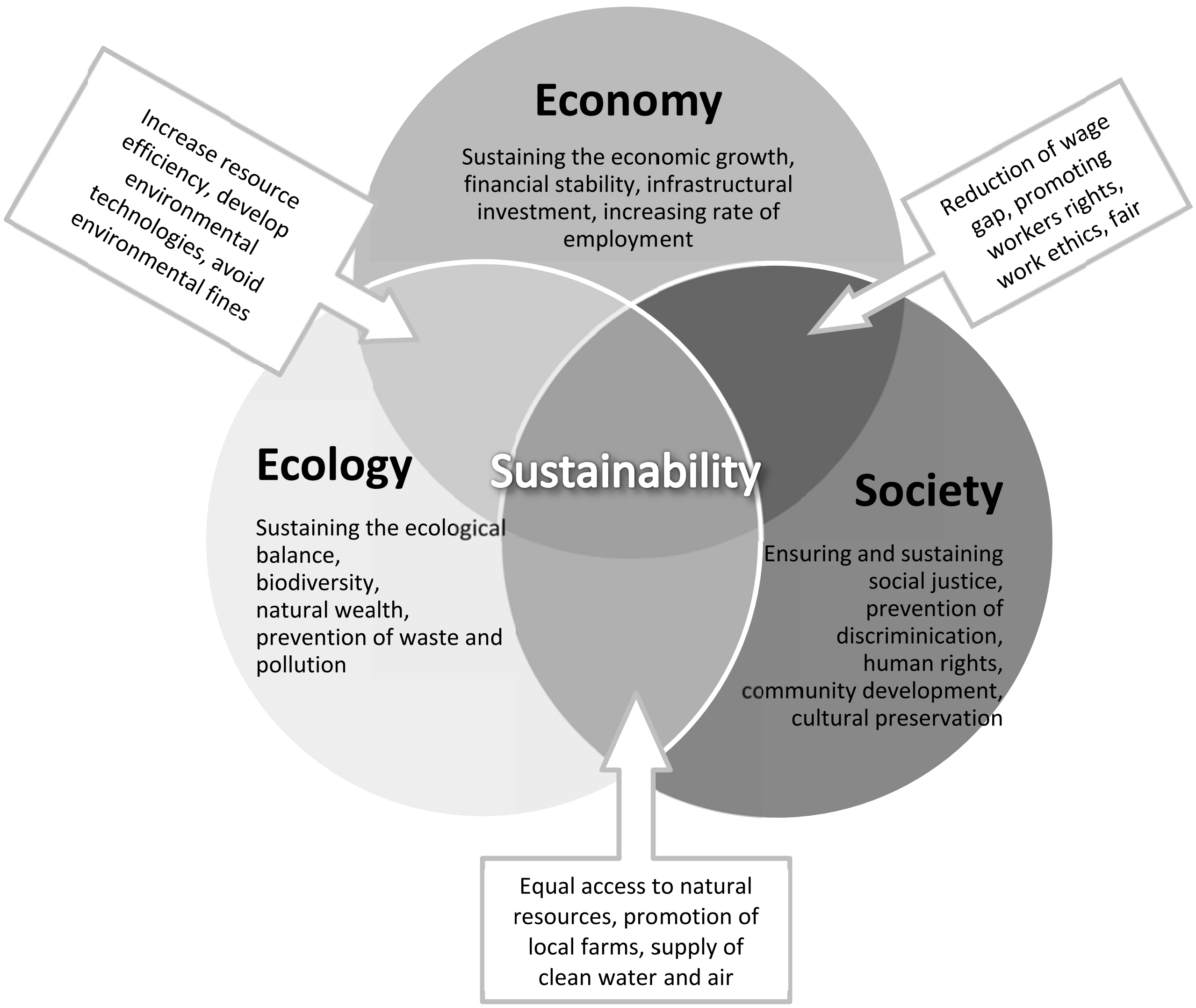

Figure 2.4 Triple bottom line perspective.

Sources: *Elkington, J. (1994). Towards the Sustainable Corporation: Win-Win-Win Business Strategies for Sustainable Development. California Management Review, 36(2), 90-100.*

Although his study focused on sustainability at the corporate level, many groups adopted Elkington's definition (academicians, companies, NGOs, etc.) and it became the basis for a widely accepted categorization for the major aspects of sustainability: economy, society and ecology. Various texts use this three dimensional categorization in their definition of sustainability (Dyllick, 2002; McKenzie, 2004; Segnestam, 2002; Seuring, 2008). Contemporary discussions still focus on the possibility of establishing a balanced relationship among social equity, environmental protection and economic viability.

The TBL approach not only extended the borders of sustainability but also introduced a synergetic relationship among economy, ecology and society. Changes in each of these sectors or in their sub-categories have the potential to trigger changes in other sectors, hence affecting the overall sustainability of a process. Energy saving technologies and green roof applications in buildings are examples of this type of synergetic structure. While contributing to ecologic sustainability through cutting carbon emissions, energy saving technologies also contribute to economic sustainability by decreasing energy costs. As another example, green roof applications serve in all three sectors by preserving biodiversity, decreasing the heat island effect, increasing the heat resistance of roofs, controlling storm water and creating livable green spaces.

Despite its advantages in promoting proactive policies by reconciling three different sectors of society, many scholars criticized the TBL approach. One of this criticisms was raised by Lele (2000) who addresses the common assumption that social equity, as a requirement of sustainability, will ensure environmental sustainability. Referring to land reform in Rajasthan (India), Lele reminds us how equity in land ownership caused the neglect of pastures, which had been well maintained under the earlier feudal structure. This example challenges the deterministic perceptions of the TBL approach, which assume the existence of positively correlated relationships between economy, ecology and society. In other words, Lele reminds us that practices directed towards social sustainability will not necessarily lead to environmental sustainability. He also points out that management of the creation and the use knowledge can be crucial for attaining overall sustainability. Reorganization of an existing social structure might destroy some other institutions or entities that are crucial for sustaining current practices. For example, an urban development project that consists of green buildings might lead to the destruction of the local economy if it causes gentrification and change of the resident profile, triggering further decomposition of the local structure in the long-run. Therefore, absence of such knowledge, which mostly exists in a tacit form, being embedded in the social networks of local communities, can lead to further problems, effectively reducing sustainability.

Lele's argument brings out another dimension to the sustainability debate where poverty-environment relationships can be questioned. In many of the aforementioned texts of WB, WTO, WHO and WWF, poverty is presented as a significant cause of environmental degradation. There are two weak points in this argument. The first is that the environmental degradation that is created by the "poor" may not be related to poverty but may result from profit-related incentives or a lack of government regulations. Without investigating the capital and governmental mechanisms, relating environmental detriment to poverty may lead to unjustly blaming the poor. On the other hand, even if environmental degradation were directly related to poverty, the Rajasthan example shows that reducing poverty and increasing social equity does not necessarily lead to environmental sustainability, unless the policy makers have thorough knowledge of local mechanisms. Lele's study shows that sustainability's role as a new criterion to judge our actions may hide the systemic origins of the socio-environmental problems we are attempting to solve. In other words, if the problem behind environmental and/or social degradation results from a larger, systemic problem, the environmental or social degradation cannot be reduced only by finding a better balance among economy, ecology and society. It may require more radical changes in the basic socioeconomic structure -- that is changes in the way humans produce, distribute and consume, as well as changes in the ownership and management of resources.

Prior to these critiques, in the same year Elkington introduced the TBL perspective, Gatto (1994) raised a more existential critique of the very heart of sustainability to show that sustainability was an inconsistent concept. As mentioned earlier, he defined sustainability as the association of three different processes: economic development, ecological preservation and resource management. He formulized the relationship between these three processes as the summation of four different types of capital: man-made capital (Km), natural capital (Kn), human capital (Kh) and moral/cultural capital (Kc). In his definition, the simplest form of sustainability requires that the overall stock of capital assets (Km+Kn+Kh+Kc) remain constant. Assuming that the population will grow constantly[3], increase in production to match population growth cannot be attained without decreasing this summation. Even with high productivity rates, it is still questionable how these rates can be maintained without depleting natural resources, hence decreasing Kn. On the other hand, if a high rate of population growth

[3] Many studies predict that world poplulation will be around 9 billion people by 2050.

leads to inequality, which is highly probable, Kc will decrease as well. For these reasons, Gatto argues that given current population trends, the very basics of the term "sustainability" are inconsistent. In other words, according to Gatto's view, given current production, distribution and consumption habits, the three basic elements of sustainability contradict each other. Therefore, parallel to Lele's argument, Gatto's approach also requires a deeper change in the socioeconomic structure.

These critiques are important for understanding the potentials and the boundaries of the concept of sustainability. Drawing these boundaries and defining the problems that are inherit to the definition of sustainability (its vagueness and challenges of applying the definition to reality) can demystify the concept and transform sustainability from the catchall toy of a metanarrative to an operationally defined tool for developing policies that aim at balancing economic, environmental and social development.

As the two elements of politics, *lexis* and *praxis* do not exist independently but mutually transform each other, the definition of sustainability cannot be thought independent from the "sustainable practices." Practices not only operate through the discourse, but (re)create it by changing our understanding, worldview and lifestyles. For this reason, on the one hand defining sustainability by determining its potentials and its boundaries will provide a conceptual ground for sustainability practices; on the other hand, these practices -- such as the development of the sustainability indicators, issuance of regulatory systems to promote sustainability and introduction of rating sustainability mechanisms -- will reformulate sustainability by changing those potentials and boundaries. For example, accepting the TBL approach as the definition of sustainability makes practices that will help establish a balanced relationship among economy, society and ecology a prior goal. But it is the policies developed to achieve this goal and different methods to implement these policies determine how TBL approach can actually be applied in real life. Determining the challenges of attaining this goal and possible solutions for these challenges practices constantly reinterpret the definition of sustainability in detail.

This author recognizes the relationship between the definition of sustainability and sustainable practices and their role in determining urban politics; therefore I do not claim that there is one absolute definition for sustainability or that there should be one. But I take TBL approach as the definition to be used for the rest of this study because of its ability to cover a large spectrum of problems from different aspects of life and prioritizing a balance among problems rather than focusing on one and ignoring the others. As a researcher, I see TBL approach as a new discursive opportunity of the 21th century which can create a new socioeconomic system that is respectful to the ecology and the society, without compromising the economic needs. It is important to understand that sustainability cannot be considered as a magic wand that will solve all the socioeconomic and socioenvironmnetal problems, such as gender discrimination, wage gap, gentrification, race-related issues and global inequality in access to resources. But it provides significant tools that can help solve these problems. As Cole et al. (2000) state attaining sustainability can help solve many socio-environmental problems and "it is presumably an 'ideal' goal. But it must be a *shared* goal." (p.2)

CHAPTER 3

ASSESSING SUSTAINABILITY

3.1 Indicators

As a policy-related concept, sustainability requires measures that evaluate the success of human practices in establishing a balanced relationship among economy, ecology and society, which will secure future generations' access to resources. Policies aimed towards increasing sustainability require tools that can measure the capability of existing socioeconomic structures to attain sustainability and provide guidance for surpassing current achievement levels. For this aim two types of assessment tools are needed. The first type is rating systems that summarize the strengths and weaknesses of the current state of economic relations, social structures and ecologic systems while providing clear thresholds that will rate the sustainability of human practices based on their impact in each of the three fields of TBL approach. The second type of tools are guidelines that consist of protocols and strategies which guide individuals and institutions (consumers, companies, NGOs, state agencies, managers, workers, etc.) toward sustainable alternatives for their current activities, also providing them with the ability to self-assess. Both the rating systems and the guidelines operate through *sustainability indicator*s (SIs) which process existing data and transform it into a language that will describe how sustainable a system is and what can be done to make it more sustainable.

According to Boulanger (2008), an indicator is the "translation of theoretical (abstract) concepts into observable variables so that the scientific hypotheses involving these concepts could be submitted to empirical verification" (p.3). The Food and Agriculture Organization (FAO) of the United Nations defines an indicator as a tool for monitoring changes in a complex system. By quantifying and simplifying a phenomena, an indicator decodes a system and makes it easier to conceptualize (FAO, 2011). According to the 1993 OECD document on environmental performance, an indicator is a parameter or a value which describes the state of a phenomenon, an environment or an area with a significance extending beyond that directly associated with a parameter value (G. B. Guy & Kibert, 1998; OECD, 1993; Rametsteiner, et al. 2011). The 2002 report issued by the Mining and Energy Research Network (Warhurst, 2002) states that indicators are important tools that "simplify, quantify, analyze and communicate otherwise complex and complicated information … and reduce the uncertainty in the formulations of strategies, decision and actions" (p.10).

This researcher accepts all of these definitions and based, on them, has developed his own definition of indicators that is used throughout this text: A sustainability indicator is a tool that translates the data collected from the complex systems of economy, society and ecology, or from human activities that affect these systems, into pieces of information that capture the ability of these systems to sustain current and future generations, or the effects of human activities on this ability. This definition assumes that there are two major sources of data: 1) the current structure of the economic, social or ecological systems; 2) human activities that affect these systems. By using data collected from these systems, sustainability indicators can be used to do two things: (1) to take a snapshot of a complex system, then simplify, quantify and analyze it in order to decide if a social, economic or ecologic system has the capacity to meet the needs of both today's and future generations; and (2) To evaluate the possible consequences of a human activity in order to decide whether this particular activity contributes to or reduces the sustainability of these systems.

Indicators are developed for particular purposes. Therefore their area of use is usually limited to the context in which they were developed. However this limitation gives them the advantage of describing the state of a phenomenon using a limited number of parameters, hence simplifying the communication process during the delivery of information (OECD, 1993). In other words, indicators allow those who develop and employ them to standardize information, deliver information quickly, produce comparable data and increase the number of cases to be examined.

Introduction of the term "indicator" to the academic world dates back to Paul Lazarsfeld's work *Evidence and Inference in Social Research* in 1958 (Boulanger, 2008). In his work, indicators were presented as dependable tools in a research method, where statistics and statistical research were given the highest priority. In 1966, Bauer, Biderman and Gross's (1966) report on social indicators highlighted the political aspects of indicators, pointing out that even statistical measures are grounded in some norms and values. The use of indicators in the social sciences became common with human welfare studies. With the emergence of the notion of sustainability, social indicators became necessary components of social planning processes (Boulanger, 2008).

International attention to the development of indicators started increasing after the late 1980s. The Canadian and Dutch governments started developing environmental indicators during this time. In 1989, OECD introduced its first environmental indicators. The 1992 the UN Conference on Environment and Development in Rio de Janeiro became a cornerstone for both sustainability debate and the development of indicators.

Agenda 21, which was released as a result of this conference, triggered an international effort to develop indicators to measure environmental approaches in economic development (Hammond, Adriaanse, Rodenburg, Bryant, & Woodward, 1995).

Indicators are crucial tools for carrying sustainability from the amorphous state of conceptualization to the materiality of the physical environment we live in. They can help determine whether a human activity is sustainable or the existing condition of an ecosystem poses threats for its own future. In other words, indicators are the link between speech and practice, the two components of the politics of sustainability. However, a single indicator is usually not enough to determine if a system or a human action is sustainable, because it provides information about only one aspect of a single system (Mayer, 2008). Due to the multidimensional character of the relationships among economy, ecology and society, more complex tools are needed that can measure changes in each of these systems simultaneously. Therefore, indicators are mostly used either to form an index or a standard.

Mayer (2008) describes an index as “a quantitative aggregation of many indicators” which “can provide a simplified, coherent, multidimensional view of a system” (p. 279). Indices provide a snapshot of the current state of a system and these snapshots can provide information about the sustainability performance of system over time if data is collected periodically. Indices use certain calculation methods to aggregate the data provided by individual indicators and present them as a single number. Many indices normalize the final results and present them on a scale such as the one used by Environmental Sustainability Index (ESI), ranging from 0 to 100 (Esty, 2005). Indicators may also consist of more than one variable. For example the “air quality” indicator of ESI consists of four different variables, which provide information about the levels of NO2, SO2 and TSP concentration, and indoor air pollution from solid fuel use.

The biggest advantage of using indices is the increased applicability of the data during decision making processes and the easy comparison of different results. For example, ESI uses 21 different indicators to determine the final sustainability score of a country, addressing many different fields including air quality, biodiversity, water quality and quantity, environmental governance, science and technology, etc. Without aggregation of data collected through each of those 21 indicators into one number, it would be very hard to make judgments about the sustainability of a country, or to compare countries' performances with each other. Reducing all of the calculations into a single number on a standard scale makes it easier both to make decisions (for example to determine if a country can pass a certain sustainability score) and to compare the achievements of different countries.

However, representation of data collected from different fields and processes has also a significant weakness deriving from the loss of data. Despite the conveniences it provides for decision making processes and conducting comparisons, the aggregation of indicators under indices can also cause a loss of data, data which could be vital in some cases. For example, a country that is showing an acceptable performance regarding many environmental issues such as air quality, water resources, and eco-efficiency could have a very poor performance in environmental governance. In the aggregated result, this poor performance might be camouflaged by the positive results from other indicators. And poor environmental governance might soon lead to rapid deterioration in the other fields if not improved. Therefore, although they may crucial in the application of sustainability principles, indices should be used with caution and their limits and weaknesses should be acknowledged.

Standards are another way of bringing indicators together in order to help decision-making processes. Unlike indices, standards do not summarize different indicators through one single value, but rather are grouped to form sets of indicators which might be used for various purposes including for guiding best practices and forming protocols for a certain type of practice. ISO 14000, Environmental Management Standard, ASTM Standards on Sustainability and Food Alliance Sustainability Standard for Crop Operations are among examples of standards. Standards do not necessarily consist exclusively of indicators; they may also include instructions and protocols to describe how to follow the sustainability criteria during human activities. But indicators can be an important part of these instructions, determining what data to collect, prescribing ways to measure and interpret the data collected and to decide if a process is being executed in compliance with the sustainability criteria. For example, while an index depends upon indicators to calculate a final value of achievement of a company in sustainability assessment, a standard can be used as a means of guiding a company for self-assessment while following through certain protocols.

The relationships between and the hierarchy among indicators, indices and standards are presented in Figure 3.1. As is also shown in this schema, both indices and standards operate within certain frameworks. Frameworks are conceptual grounds that define the basis for bringing indicators together and for making calculations. They give consistency to a set of indicators (indices or standards) by providing rules regarding which aspects of sustainability will be addressed, what types of data will be collected and what measurement techniques will be used. While indicators, indices and standards are designed to provide unbiased information that is free from politics, frameworks are the consequences of political decision-making processes, including a phase called materiality analysis, which consists of discussions to identify the issues that are primary and secondary for the sustainability assessment. Participants in these discussions can significantly affect the list of issues to be included in sustainability assessment, as well as the structure of the indicators to be used. Therefore, while using these indices and standards, it is also important to understand the framework in which they operate in order to be able recognize the limits of the results and use them appropriately in decision making processes to use them appropriately in decision making.

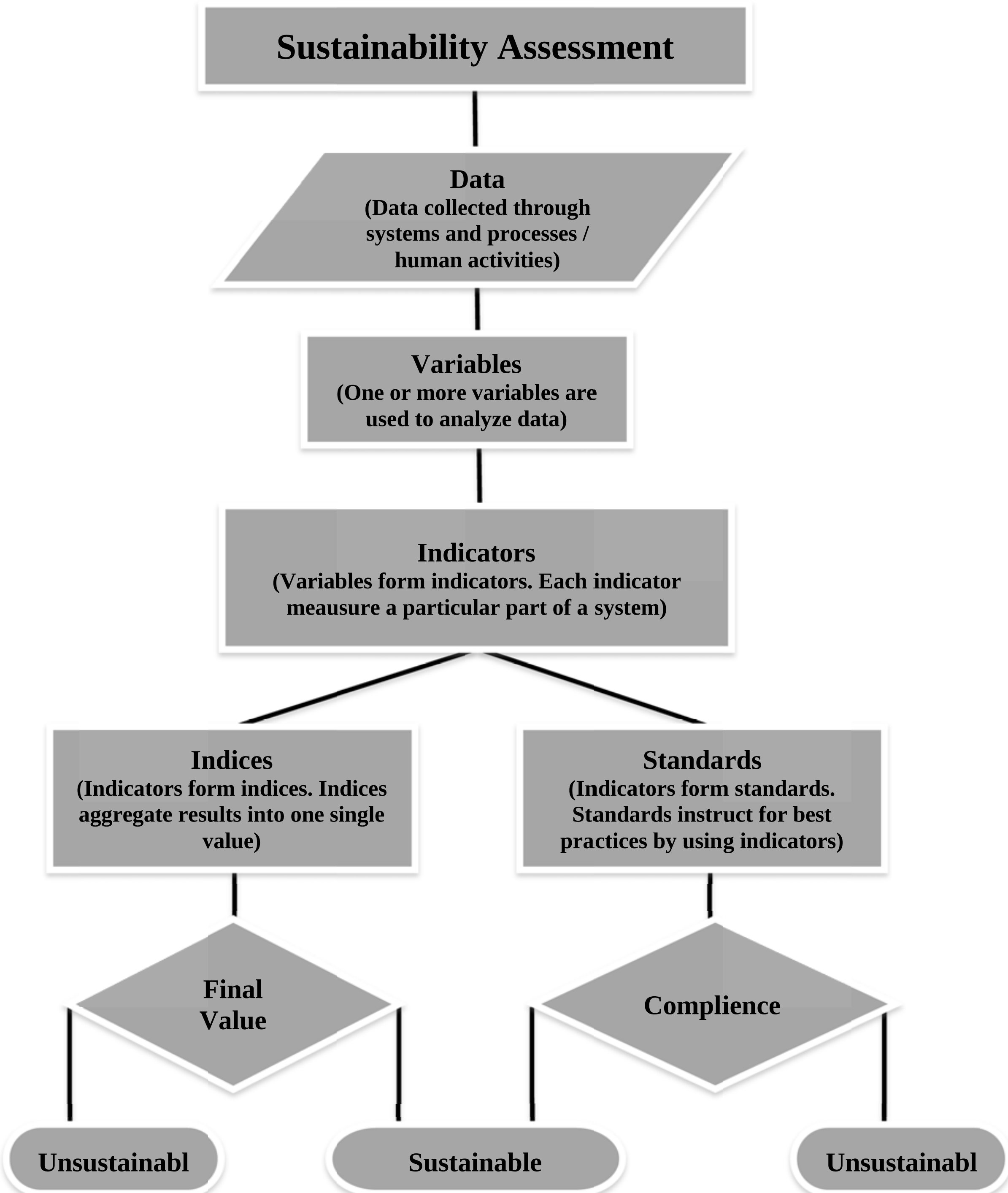

Figure 3.1 The structure of sustainability assessment process.
Sources: *(Adinyira, 2007; Esty, 2005; G. B. Guy & Kibert, 1998; Mayer, 2008; Ugwu, 2005)*

3.2 Assessment Approaches

Frameworks in which sets of indicators (indices or standards) operate not only determine which issues are important for a particular system to be assessed, they also define the assessment approaches to be employed. (An assessment approach simply refers to the combination of the distinguishing features of an assessment, addressing both their object of measurement and their measurement techniques.) What will be assessed and how it will be assessed depend on the approach employed. For example, for assessing the relationship between human activities and fisheries, one should first decide which aspects (social, economic, environmental) of this relationship will be analyzed, in which direction (humans' effects on fisheries, vice versa, or both), which sub categories will be considered (pollution, number of fishes, biodiversity, access to food, economic growth, etc.), or what will be the spatial and temporal scale of the assessment and if the assessment will be conducted more than once and, if so, when.

Three main assessment approaches commonly used during sustainability assessment are: "end-use impact assessment," "lifecycle assessment" and "lifestyle assessment." These approaches do not contradict each other and often they are used simultaneously within the same set of indicators. While indicators are most likely to have only one type of approach, sets indicators can have many indicators with different approaches.

3.2.1 End User Impact

"End-user impact" is an assessment method based on the calculation of negative externalities created by the activities of the end-users. Direct impacts of the use of a product or a service on economy, ecology or society are taken as a means of deciding if a particular process or a human activity is sustainable. Externalities such as carbon footprint, hazardous gas emissions or waste production are calculated by looking at the consumption processes of goods and services. This approach distinguishes itself by limiting the scale of time and space of the direct activity, disregarding the aggregated effects of previous activities that have occurred during the supply-chain. For example, if the energy consumption of a building will be measured by using an end-user impact approach, then it would be sufficient to calculate only the actual energy that is being consumed within the boundaries of the building (either in the form of electricity, gas, coal or other fuels). This would not include the amount energy that was produced to deliver this energy to the building (energy consumed to produce electricity by utilities), energy consumed during the construction of the building or during the production of the construction materials.

The end-user impact approach is mainly preferred where the collection and analysis of data throughout the whole life-cycle of products or services are costly and not efficient. In many cases, agencies (building owners, business owners) have little or no effect on the supply chain of their activities, while they can create significant changes during their operations. In these cases using an end-user impact approach to track and manage impacts on sustainability becomes more plausible than running a sustainable assessment for all phases of the supply chain.

The first sustainability calculations employed the end-user impact approach to evaluate the sustainability of fisheries in the early 1930s. Russell (1931) introduced "maximum sustainable yield" as a basis to calculate the optimum amount of fishing. This method was later criticized and revised (Larkin, 1977), but the main idea of evaluating human actions through their effects on nature remained the same. The first well-known use of the end-user impact method was Carson's (1965) work on the detrimental effects of chemicals, particularly pesticides, on the environment. Her work provided various data showing the role of pesticides in immature bird fatalities and paved the way towards the ban of pesticides in 1972. Herman Daly's sustainability principle, which prohibits reducing the stock of natural capital below a level that generates a sustained yield and the discounting method, which calculates the future cost of externalities of human actions (Elliott, 2005) are also examples of the end-user impact approach.

In order to calculate human effects on the environment, some researchers have developed an approach where nature is defined as capital stock. The researchers categorized the negative externalities of human actions under certain categories such as gas regulations, climate regulations, water regulations, soil formation, waste treatment or pollination (Costanza, 1997). Most sets of indicator today (indices and standards) employ indicators that measure the first-hand impacts of activities on these issues. Indicators which measure the direct impact of economic activities on CO2 emission levels, deforestation rates, soil erosion, employment changes and infrastructural capital are among the first examples of end-user impact type indicators.

3.2.2 Lifecycle Assessment Approach

A life cycle assessment method was first publicly introduced during the UN Earth Summit in Rio in 1992 (Adinyira, 2007). Contrary to the end-user impact method, this method puts all different stages of production, transportation and consumption of a product or a service under the spotlight. Assessing a building's energy consumption with this method, for example, requires more than just calculating how much energy is consumed throughout its use. It requires inclusion of the energy consumption during the excavation, production and transportation of the construction materials as well as the construction of the building. Additional energy costs that occur during the production and delivery of the energy that is used within the building should also be added to the calculations. This list can even get even longer with the inclusion of energy needed to transfer the building workers to their worksite, the production and transportation of the food that is provided for the workers.

The idea of the lifecycle assessment approach relies on the "environmental footprint" analysis, which was introduced by Rees (1992) and Wackernagel et.al (Wackernagel et al. 1997). The environmental footprint approach is based on the assumption that the majority of the resources consumed and waste produced by humans can be traced and quantified with common units such as global hectares, hectares with world average bio-productivity. By this method, the ecological footprint of humans can be compared with nature's bio-capacity and if humans demand more resources than nature can supply, this can be recognized by this comparison (Ewing, Reed, Galli, Kitzes, & Wackernagel, 2010). Ecological footprint methodology uses a consumer based approach which calculates direct and indirect bio-capacity needed to support the consumption demands of humans. The formula that was developed to calculate the ecological footprint of consumption includes both imported and exported commodity flows as well as the consumption itself within a country.

$$EF_C = EF_P + EF_i - EF_E \qquad (3.1)$$

According to the formula 3.1, the ecological footprint (EF_C) of consumption of a country is calculated by adding the footprint of production within the country (EF_P) to the imports of a country (EF_i) and subtracting the footprint of exports (EF_E) from this summation (Ewing, et al. 2010). By doing so, ecological footprint calculations include the demand on bio-capacity that occurred during all stages of national consumption, including extraction, manufacturing and distribution.

The lifecycle assessment approach can be described as an extended version of the ecological footprint methodology which not only considers the stress on ecology but also on society and the economic structure. This approach follows a similar path to the Global Commodity Chain (GCC) methodology, which was developed as a variant of the World Systems theory (Wallerstein, 1974). According to the GCC methodology each and every step in the production of a single commodity can affect the entire production process, hence their effects on sustainability. Gereffi and Korzeniewicz (1994) defined the global commodity chain as "sets of interorganizational networks clustered around one commodity or product, linking households, enterprises and states to one another within the world economy" (p.2). According to this method, in order to fully calculate the effects of human activities on earth and on society, a single product or a service should be deconstructed into its phases of production starting from the excavation of resources it uses through its delivery to the end-user; and how sustainability is being affected in each of these phases should be calculated.

The lifecycle assessment approach brought an innovative view to sustainability studies allowing a more thorough analysis of the consolidated impacts of human activities on the carrying capacity of ecological and social systems. But the idea of GCC and therefore lifecycle assessment is not a new one. It actually follows a very similar pattern to Marx's "Labor Theory of Value", which basically claims that each and every product is nothing but actualized labor in the form of a product. Once decomposed into its elements, the final product will always be embodiment of different types of labor occurring through different phases of production including extraction of resources, production of intermediate products, transportation of these materials, manufacturing, marketing and delivering to the end-user. Even the means of productions used to produce these goods, says Marx, are forms human labor that are manifested as complex machines (Marx, 1992). For this very reason, it is possible to represent all the economic activities with the amount of labor expended in production, which is calculated by the number of hours spent. In a similar manner, the lifecycle assessment approach aims at developing a global unit for all human activities, which will represent not the value that is being created but the amount of stress that is created on sustainability because of the exploitation of natural wealth and the deterioration of social structure during those activities.

Given that every stage of production has its own responsibility for creating the end-product, sustainability analysis through life-cycle analysis requires the development of measures that are specific to each of the stages and the decision whether a human activity is sustainable depends on the aggregated effects throughout the lifecycle of each human activity. For example a solar panel can be considered a very sustainable product due its ability to reduce carbon emissions resulting from electricity production. However carbon emissions that occur during its production, the working conditions of the workers and the jobs that are being created or terminated through its production would also affect the impact of a solar panel on sustainability. Therefore, while an end-user approach might suggest that incorporating solar panels in a building project contribute to its sustainability, a lifecycle assessment could suggest that it actually challenges with the social aspects of sustainability.

Besides ecological footprint assessment, another well-known application of lifecycle assessment is the Fair Trade certification. With the introduction of Fair Trade principles (FINE, 2001; Jaffee, 2007; Moore, 2004; Raynolds, 2002), consumers are given the opportunity to trace the life cycle of a certified product, including where it was built, how much revenue is allocated to its workers, how much waste is produced, and so on. A similar project is currently being conducted by Sourcemap Inc., the makers of the web application "Sourcemap," which allows users to follow the origins of their products, the way they travel before reaching the end-user and the estimated CO2 production throughout this process. Projects such as Fair Trade and Sourcemap rely on lifecycle analysis and provide practical solutions for the problem of consolidating sustainability data that appears scattered across different phases of production. Although it is still costly for the majority of products and services, collecting data on social, economic and ecological effects of different phases of human activities is likely to be much easier with the introduction of similar products in the future.

3.2.3 Lifestyle Assessment Approach

As the third method of assessment, the “lifestyle” approach differs from the previous two methods by its focus on lifestyles of users rather than quantifying the impacts of human activities on the sustainability of systems. Lifestyle originally derived from a critique of the two other approaches which disregard the importance of lifestyle in achieving sustainable human practices. One of the advocates for this approach is Lutzenheiser (1992) who criticizes the mainstream measures of sustainability for being limited to technological solutions. His studies of households’ energy use show that lifestyle is also a significant factor that affects energy use. He criticizes the general tendency of solving the energy-efficiency problems only through technological fixes and suggests changes in lifestyles to attain sustainability.

Diamond’s (2003) research on the potential energy use in US buildings in 2020 supports Lutzenheiser’s statement. Diamond's study is based on interviews conducted in the US to find out people's anticipations about the changes related to future energy use. He asked “what might our future lifestyles be like, and how would our homes and workplaces reflect these activities” (Diamond, 2003, p. 1). His results show that there is an agreement that the future will bring technological solutions for our energy problems; however no changes in lifestyles were forecasted by interviewees. According to the respondents, by 2020 home-based life styles will expand, bigger screen TVs will be introduced, there will be a variety of new home appliances to ease daily life, work spaces will merge with coffee-shops, air conditioning systems will improve and education will be home-centered. If these proposed scenarios come true, life will get more individualistic and energy problems will be solved through the proliferation of photo voltaic (PV) systems or increases in the energy-efficiency of home appliances.

The lifestyle of the future that is depicted by respondents in this research is, however, contradicts what many contemporary arguments propose as a sustainable urban setting. Preserving today's consumption oriented, individualistic vision and curbing the externalities of people's unlimited desires by technological advances conflict with the concepts of "collective thinking" and "common good", which are significant components of the sustainable design process (Donough, 2002). Since sustainability is a culmination of political decision making, individualistic patterns make collective decisions harder to reach and prevent development of sustainable solutions at the level of communities, by limiting it only to private consumption. Technological advancements can lead to various opportunities to create a more sustainable life by introducing more energy efficient devices, facilitating data collection hence helping measure humans' environmental footprint or creating new ways of production with minimum footprint. However whether these advancements will be used effectively is also a matter of people's lifestyles. For example, although recycling stations are now available in many cities people may still choose not to recycle or despite the existence of high efficiency lighting equipment in many buildings, potential savings from this technology might be offset by lighting unoccupied spaces.

Measures developed for attaining sustainability require consideration of changes in lifestyles along with the consideration of end-user and lifecycle effects of human activities. However, a common critique of the lifestyle assessment method is the difficulty of developing quantifiable measures of it. Unlike end-user impact, where more quantifiable measures are available such as CO_2 emissions per person or energy use per square foot, it is harder to develop quantifiable measures of collective thinking, conscious use of resources, responsible design or contributions to the fight against poverty. But indicators designed to assess end-user impacts and lifecycle effects provide information that can be significant to evaluate people's lifestyles and identify possible changes toward sustainability. Additionally, indicators can be part of policies that aim at creating incentives for lifestyle changes. If used within a guideline that requires reducing energy use to achieve certification, indicators become part of a policy focusing on lifestyles. But it is also possible to develop new indicators that will provide more information about people's lifestyle to find out how their social habits affect overall sustainability. Do social norms, traditions, eating culture or educational practices affect overall sustainability? These questions require use of socioeconomic and more qualitative indicators that will focus on lifestyles.

Lele's and Lutzenheiser's critiques raise two question. First, are end-user and lifecycle assessment tools sufficient to lead to significant increases in the sustainability of human actions? And second, if sustainability is also related to lifestyles, what possible policies can create, change lifestyles for a more sustainable future? Answers to these questions will help add qualitative values to the findings of significant amount of studies that focus on quantifying the data as to the impacts of human activities while carrying sustainability to the field of politics. Since this study focuses on the relationship between the building industry and sustainability, these questions also becomes a means to understand how buildings can contribute to the creation of a more sustainable lifestyle.

Although solving poverty and attaining social equity are beyond the limits of the building industry, the building industry could still employ strategies to contribute to the solution of these problems. Ranging from affordable housing supply to improvements in working conditions of construction workers, from use of fairly traded materials for construction to the creation of public spaces, various practices can be employed to support social equity and social collaboration. But practices like these also require tools that regulate the building market and construction processes. Green building rating systems can fill this gap by bringing new criteria to those who want to build sustainable buildings and by including concerns about the socio-economic impact of the buildings.

Table 3.1 shows examples of how different indicators can be placed under the three different assessment methods. The means of assessment for the table were randomly chosen to give several examples from different dimensions of sustainability. This comparison does not show that one method is better than another but presents instead the range of methods for assessing sustainability. In many cases, practicality, cost and time concerns necessitate employment of the end-user impact method only, whereas regional reports, such as those of the UN might need to use all of these methods.

Table 3.1 Comparison of Assessment Methods through Sample Indicators

Means of Assessment	Assessment Method: End User Impact	Lifecycle	Lifestyle
Actions taken in response to incidents of corruption.			✓
Coverage of the organization's defined benefit plan obligations.			✓
Direct economic value generated and distributed	✓		
Direct energy consumption by primary energy source.	✓		
Emissions from production process		✓	
Energy saved due to conservation and efficiency improvements.	✓		
Indirect energy consumption by primary source.		✓	
Initiatives to provide energy-efficient or renewable energy based products and services, and reductions in energy requirements as a result of these initiatives.			✓
Number of persons voluntarily and involuntarily displaced and/or resettled by development, broken down by project.	✓		
Percentage of operations with implemented local community engagement, impact assessments, and development programs.			✓
Prevention and mitigation measures implemented in operations with significant potential or actual negative impacts on local communities.			✓
Procedures for local hiring and proportion of senior management			✓
Relevant indirect greenhouse gas emissions by weight.		✓	

3.3 Categorizing Indicators by What They Measure

In 1993, the OECD introduced the "pressure-state-response" (PSR) approach as a significant step in developing categories of environmental indicators that are internationally agreed upon. The PSR approach examines the relationship between humans and the environment by looking at how humans affect the environment, how much the environment is affected and what type of actions are taken to mitigate these effects. According to PSR, changes related to this relationship can be measured by:

1- The pressure that is being exerted on the environment by human actions (Pressure).
2- The changes in state of the environment that occurs as a result of this pressure, including quality and quantity of the natural resources (State).
3- Society's responses to these changes including socio-economic policies, including measures taken to mitigate the negative effects of the human actions on the environment and effectiveness of these measures (Response) (OECD, 1993; Wolfslehner, 2008).

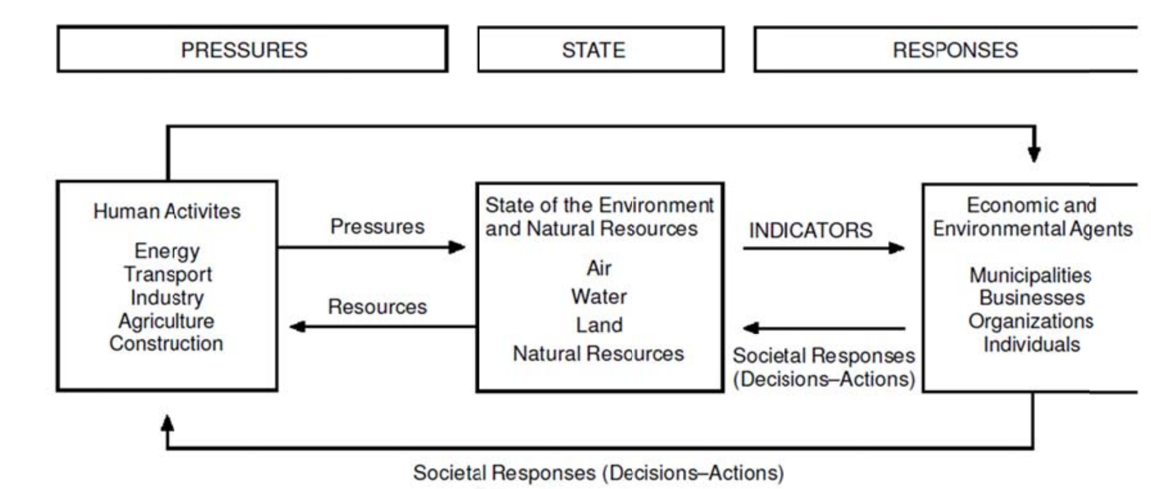

Figure 3.2 PSR model diagram.

Source: *Guy, G. B., & Kibert, C. J. (1998). Developing indicators of sustainability: US experience. Building Research & Information, 26(1), 39-45.*

The PSR approach has become a major way to categorize and use indicators and continues to form the basis for many studies. As shown in the diagram (Figure 3.2) borrowed from Guy and Kilbert's (1998) study, it presents a useful model for avoiding confusion between indicators that are policy oriented and those that are descriptive.

According to this model, indicators that are introduced through green building rating systems would mostly fall under the category of “response” since they measure the type and effectiveness of the measures taken by project developers and users of buildings to mitigate the negative impacts of construction processes and buildings. But response type indicators can rarely exist without pressure and state type indicators because in order to create measures, the potential pressure of the human activities must be known as well as possible changes in the environment related to these activities.

3.4 Developing Indicators: The Decision-Making Process

Rametsteiner et al. (2011) suggest that indicators are more than tools for reducing a large quantity of data to a simpler form; they are also tools for understanding how a system operates. Understanding the system is an essential step toward controlling it and the next step should be the development of indicators that will measure the effectiveness of this control. Therefore, Rametsteiner et al. (2011) say that development and use of indicators are not independent of politics but include it. Even though indicators seem to be developed and selected through a purely scientific4, value-free process, politics is still part of that process. But the technocratic, science-driven structure of the process of development of indicators usually hides this political character. Indicators not only provide information about the current state of a system; they also build up a network of information -- a new system that the information will flow through. This is a knowledge

[4] Only if there such thing called “pure science”, given that all human actions are political in the end as they occur and interact within the society. Especially starting with the discussion that was instigated by Thomas Kuhn, which was then responded by Karl Popper, involvement of politics in science became more questionable then before. Kuhn’s introduction of the concept of paradigm into the philosophy of science opened up new discussions on whether science can be purely independent of any political process, or does the language and systems of verifications used in scientific research make it political despite its claim of objectivity.
Hutcheon, P. D. (1995). Popper and Kuhn on the Evolution of Science. *Brock Review, 4*(1/2), 28-37.

creation process. By setting the rules for what type of information will be collected (e.g., social, economic or environmental), how it will be collected (e.g., by looking at the changes in energy consumption per capita, energy per square-feet or aggregate energy consumption, etc.) and the ways that it can be interpreted (e.g., how indictors are brought together, how they are weighted, etc.) indicators define the limits of the knowledge to be created. Further policies are defined and actions are taken based on that knowledge.

Historical examples indicate that development of appropriate indicators and the collection of correct data are vital in the development of policies. As the recent famine in Somalia in 2011 summer shows, if the system of information that is constructed through indicators fails to provide useful predictions about how the conditions of a system might evolve, the responsive policies may fail to prevent the sometimes deadly consequences. In the Somalia example, effective early warning was needed to produce information to answer three questions: "who needs help, how much relief is required and when is it needed?" Nevertheless, the indicators that were developed in 1970s were based on simple measures such as precipitation, crop production and food prices. These measures, which still constitute the basis for today's indicators in Somalia, are far from answering the above questions. The recent famine in Somalia could not be predicted precisely, hence preventing the necessary enactment of precautionary policies (Petty & Seaman, 2011).

Petty and Seaman's study shows that decision-making mechanisms determining which approach will be used by an indicator and what type of data will be collected is a crucial part of sustainability assessment. Therefore success of sustainability assessment is also related to the ability of these decision-making mechanisms to create indicators that will reveal multiple effects of a single human action on different segments of the society and different parts of the environment. This is also true for the building industry. In order to identify how a single building project will change the social, economic and ecological structure, creators of the sustainability indicators for buildings should be able to represent each of these aspects. This is hard to achieve with a non-diverse decision-making body, which represents only a small portion of the building industry or a limited portion scientific community, such as architects and engineers. To avoid a vital mistake in determination of the crucial sustainability related issues, such as in the case of Somalia, creators of indicators should aim at forming an information network which will provide sustainability data concerning various political agents in the industry, including construction and architecture firms, developers, real estate agents, government agents, NGOs such as USGBC and building users. But the creators of indicators should also be aware of how building projects affect the rest of the population that are not within the building industry.

A closer look at how indicators are developed and selected can help reveal how politics is embedded in this process and can contribute to new approaches for improving indicator sets. Based on Lazarsfeld's work, Boulanger et al. (2008) divide the indicator development process into four phases. The first phase consists of the identification of different dimensions of the field or topic to be examined. For poverty, for example, these dimensions can be *material* (income), *social* (exclusion) or *cultural* (cultural capital). Each dimension can also be divided into sub-dimensions (material: income, health, housing, etc.). Identification of these dimensions is crucial for determining the type of measures to be developed. Measures related to income are different from measures related to education. The dimensions included or excluded will also define what "poverty" is for that specific indicator or set of indicators.

The second phase Boulanger et al. (2008) describe is the transformation of variables into indicators. Once the dimensions are set, they need to be translated into variables. Some of these variables can be used as indicators. Income, for example is a variable by itself and it can also give information about the material dimension of poverty, therefore it can be used as an indicator since it is measurable, easy to interpret and there is available data for it. However, once variables are selected, development of thresholds appears as another problem to be solved (Boulanger, 2008). Where will the thresholds be set for poverty? Will absolute values be used or will they be normalized according to average income? Answers to these questions require some normative decision making processes and they mostly rely on current definitions of poverty in existing studies.

The third phase is the development of measurement techniques that will be consistent for all the indicators in a set. The differences between quantitative and qualitative measures (e.g., income level vs. occupation) necessitate development of a common language with which data from each indicator in a set can be interpreted through a simple and consistent grading mechanism, such as a scale from 0 to 100 or color codes. This however requires the transformation of units and measures of indicators to simpler forms at the expense of the complexity and thoroughness of raw data. Achieving this makes the fourth and the last step possible: construction of a new indicator system, in other words a set of indicators.

Boulanger et al. (2008) point out that indicators are meaningless unless they come together and form an indicator set. In other words, detached from their set, individual indicators usually cannot provide accurate information about the system they are being used to analyze. This is because indicators are brought together to satisfy the needs of certain tasks, such as developing a system that will be the basis for: deciding if or when buildings have negative impacts on the environment, assessing the resilience of a social system to climate change, defining weak points of the economic well-being of a community. Therefore each set of indicators operates within certain frameworks that are made up not only of a scientific vision but a social one as well. Behind the frameworks are social norms, which can be defined as unwritten commonly accepted rules such as sanctity of life, preservation of the ecology, prevention of human rights violations, and promotion of social equity. In the light of these norms, each framework sets up certain goals such as the reduction of poverty, the protection of biodiversity, increasing the living conditions of children and so on.

For this reason bringing indicators together to build assessment frameworks cannot be seen solely as a technical process but the task of creating indicators and sets of indicators should be conducted in accordance with the current socioeconomic structure as well. For the building sector, besides agents of the construction sector, such as project developers, financial agencies, architects, construction companies, building users and the NGOs, sustainability indicators and indicator sets should also appeal to the other parts of the society by collecting data and creating information about how construction workers, manufacturing workers of the building materials, regional communities where building materials are extracted and other components of the society and the environment are all affected during the lifecycle of a building project.

3.5 Common Features of Indicators

Studies of the development and implementation of indicators suggest that indicators should follow certain rules to be effective and efficient. Although indicators can be used for many different purposes and can serve in different sets, these rules usually apply to all of them. Below are some of the features taken from different studies (FAO, 2011; G. B. Guy & Kibert, 1998; OECD, 1993; Spangenberg, 1998; Ugwu, 2005):

- Indicators should be capable of helping the decision makers understand why the change is occurring: Do they link environmental, economic and social issues?
- They should have world-wide recognized methods to be proper for international comparisons.
- They should be capable of providing links with the players, causes and instruments
- They should be easily understandable: Are they simple enough to be interpreted by everybody?
- They should be capable of showing changes over time
- They should include thresholds or reference values to be compared. This is crucial for interpreting the data collected.
- The data to be collected for the indicators should be available for a reasonable cost: Can they be collected on a regular basis?
- The data to be collected for indicators should be available to be documented easily.
- Community involvement in the development of indicators is important: the degree that different stakeholders contribute to the development process.

Consideration of these features is essential in comparative analyses of sustainability indicators and sets of indicators. This helps the researcher understand the capabilities of each indicator for fulfilling the requirements of assessment, while also guiding development of new indicators. Although these are widely accepted rules, not all of them apply to every indicator. For example "showing a trend over time" does not fit for an indicator that focuses on place of origin of building material. Therefore, studying indicators also requires outlining the depth of each indicator and its ability to refer various dimensions such as international validity, showing trends, being suitable for public understanding, hence allowing researchers to judge if an indicator is suitable to be used in another set, besides its own. In this study the list of features helped to determine whether some of the new indicators could be included in newer versions of LEED, in order to expand the context green building assessment towards a more socioeconomic perspective.

3.6 Sustainability and the Building Sector

In the building sector urban politics is embodied and manifested in the form of design, positioning, use of space, relocation of people and body-politic. Buildings not only affect the spaces people where live and work but they also define how we do so. A building project can determine if the lifestyle in a specific region will be organized according to the rules of dense urban areas, where people live above and below each other, sharing common spaces for transportation, laundry, parks or even for walking to their apartments; or if they will abide the rules of a low density residential area which are centered on the private space and where life is more car dependent. Buildings are materialization of politics that shape the movements of the body and educate them to do certain moves. For example, using an elevator with other people, walking in publicly shared corridors or use of stairs all require performing certain type of body movements or the absence of movements, such as being quite or being totally silent, not running, waiting for other people pass, not standing still, etc. These are all actualization of certain types of limited and trained body moves that are imposed by the built environment.

In other words, buildings are the means of body-politic as defined by Foucault: "a set of material elements and techniques that serve as weapons, relays, communication routes and supports for the power and knowledge relations that invest human bodies and subjugate them by turning them into objects of knowledge" (Foucault, 1995, p. 28). Buildings not only limit movements of the body, but they also encourage their users for certain activities. It is mostly the design of the building which encourages or discourages use of stairs, use of artificial lighting, use of excess heat or utilizing common spaces.

While directing and shaping people's bodily routines and lifestyles, buildings link different discursive fields with daily practice. They create the opportunity to transform theories on the living space and the building environment into material reality through the use of different resources (financial capital, human labor, energy, water, minerals, etc.). With the help of globalization, the act of constructing also serves as a nexus binding many different industries and different forms of capital (natural, economic, social and cultural) to each other, creating a global hub that circulate these forms of capital from different parts of the world. Therefore, the building sector can contribute to sustainability in two ways: (a) by shaping the living spaces and encouraging a more sustainable relationship between humans and their built environment; b) by influencing the global commodity chains through creating demand for sustainable building materials, responsible use of human labor and efficient use of financial capital.

3.6.1 Buildings and Environmental Sustainability

In 2011, buildings accounted for 40 percent of the total energy use in the U.S. (EIA, 2012) (Figure 3.3). They also accounted for 39 percent of the annual CO2 emissions; 21 percent from residential buildings and 18 percent from commercial (EPA, 2009). Besides CO2 emissions, another significant effect of buildings on the atmosphere is the formation of heat island effects, which lead to summertime energy peaks, air conditioning costs, greenhouse gas (GHG) emissions, and negatively affect the biodiversity. EPA (2009) states that temperature of cities with 1 million people or over can be 1.8 °F to 5.4 °F warmer than its surroundings.

Buildings also have effects on water and land use. They accounted for 13 percent of the water use in the U.S. in 1995. Increase in the demand for water is higher than the rate of increase of the U.S. population. Only for showering 1.2 trillion gallons of water is consumed each year. Majority of the 26 billion gallons of water used on a daily basis in the U.S is being spent for landscaping, on which suburban lifestyle has significant effect (EPA, 2009). Similar to water use, land use also increased disproportionately with population increase. Between 1945 and 2002, land use has increased twice the rate of population in the U.S. This development has accompanied with an increase in waste production and the use of material and resources. In 2007, more than 250 million tons of municipal waste was created. In addition to this, 63 million tons of recycling was created each year. 160 million tons of this waste is from construction and demolition debris (EPA, 2009).

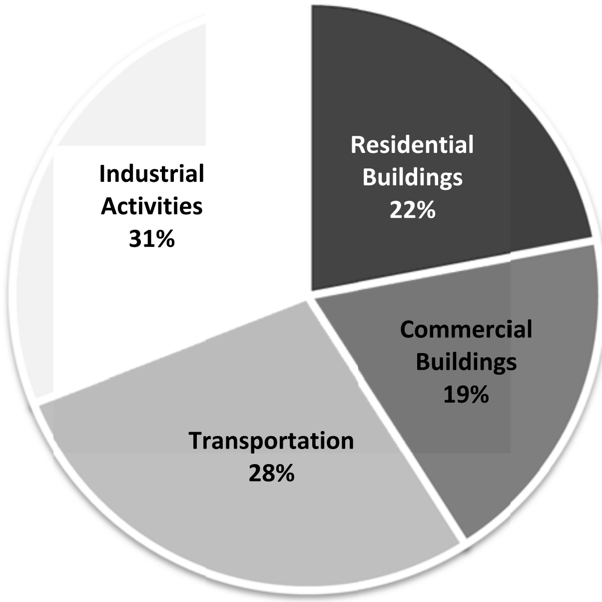

Figure 3.3 End-use sector shares of total consumption of energy in the U.S.
Source: *EIA. (2012). Annual Energy Review. Washington, DC: U.S. Energy Information Administration.*

Although buildings impacts on the environment occur in several areas, sustainability in the building sector has long been associated with mostly energy conservation. Several studies address energy related issues in order to discuss sustainability criteria for buildings (Alnaser & Flanagan, 2007; Alnaser, Flanagan, & Alnaser, 2008; Boelman & Asada, 2003; Chwieduk, 2003; Juana, Gaob, & Wangc, 2010; Kong et al. 2011; Lehmanna et al. 2010; Lutzenhiser, 1992; Nicol & Humphreys, 2002; Nielsen, 2005). Two possible reasons behind this focus on energy are the role of CO2 emissions in climate change and the significant share of energy used in the operational costs of buildings. Over the last two decades CO2 emissions have attracted significant public attention for being the major anthropogenic contribution to global warming. The 2013 report issued by the International Panel on Climate Change stated that scientists are at least 95% certain that climate change is caused by human activities (IPCC, 2013). As the evidence of anthropogenic global warming become visible, policies towards decreasing CO2 levels became a prominent topic of environmental discussions and energy related processes have been put in the spotlight as the main sources of CO2 emissions. Since buildings are responsible for 30 percent of the energy consumed all over the world (40 percent in the US), energy saving techniques for buildings have a distinctive place in sustainability discussions.

3.6.2 Buildings and the Economic Sustainability

Although most of the studies concerning the relationship between buildings and sustainability are centered on the environmental impacts of buildings, buildings also have significant effects on the economy and the social structure. Buildings play a significant role in determining the strength of the national economy due to their 40 percent share in the total energy consumption. In 2010, energy consumption accounted for 8.3 percent of the U.S GDP, equal to an estimate of 1.2 trillion dollars (WorldBank, 2012). 22 percent of this expenditure came from imports (in 2012 the share of exports dropped to 15 percent). In 2011 the total amount of fossil fuel imports was estimated to be 453 billion nominal dollars, negatively affecting the trade balance of the U.S. Data from World Bank and the US. EIA shows that despite the increase in energy efficiency in the production of goods and services, share of energy expenditures in the total GDP did not change much since 1970s (Figure 3.4, 3.5). One of the reasons for the unchanged share of energy expenditures from GDP, despite improvements in energy efficiency, is the significant increase in the unit price of energy per BTU during the last 40 years. From 1970 to 2010, the cost of energy jumped from $1.5 per BTU to $19 per BTU, eliminating the positive effects of energy efficiency improvements on the economy. The prices of all energy sources have increased during this period, but the most noticeable increase was observed in the natural gas and oil (Figure 3.6).

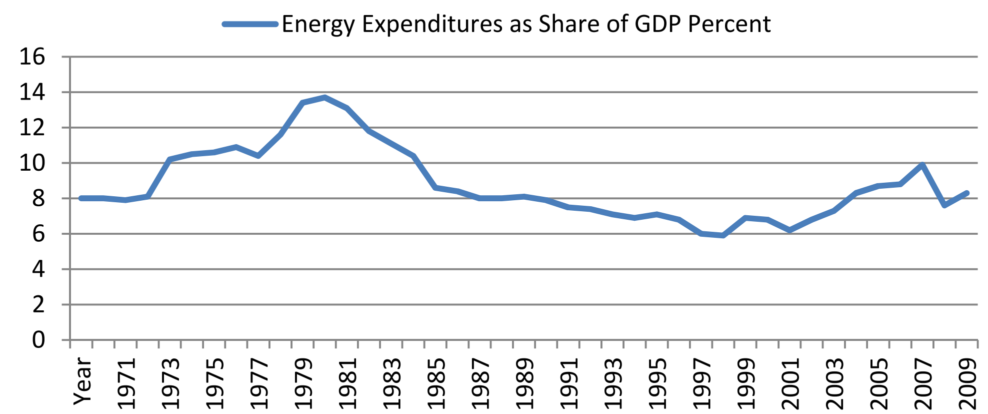

Figure 3.4 Energy expenditures as share of GDP percent.
Source: *US Energy Information Administration*

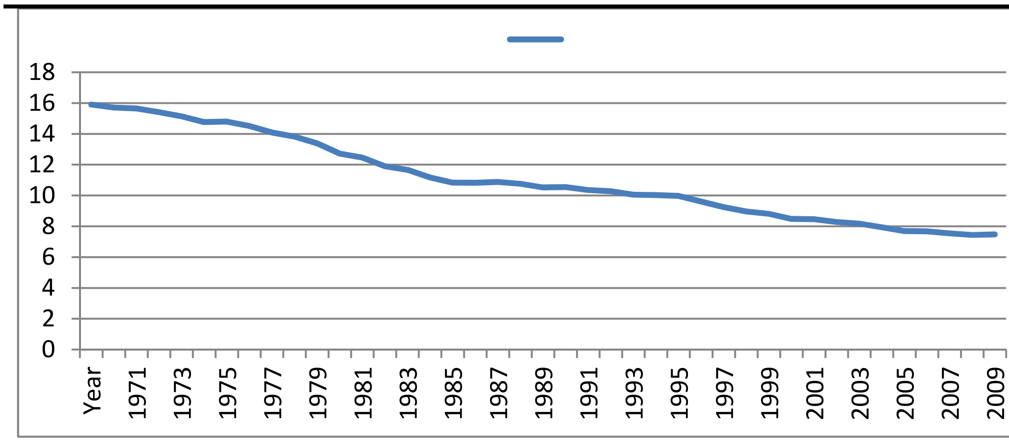

Figure 3.5 Energy consumption per real dollar of GDP (thousand btu per real 2005 Dollar).
Source: *US Energy Information Administration*

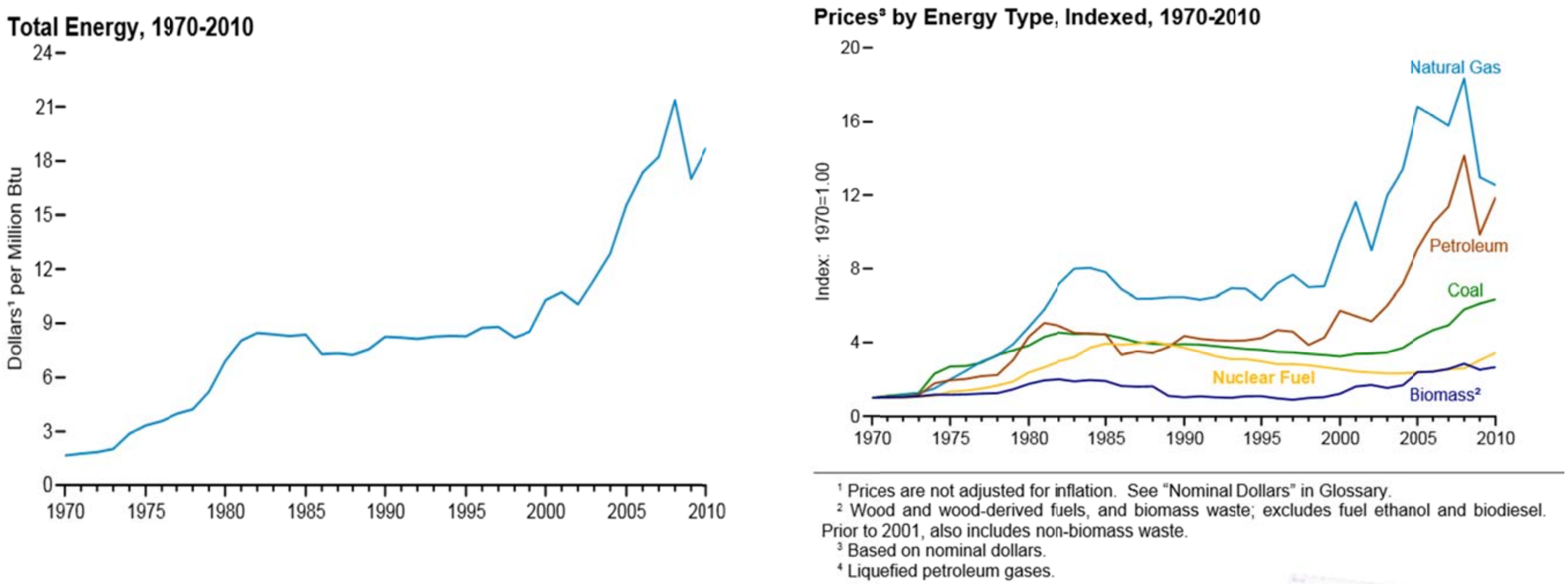

Figure 3.6 Change in unit energy prices ($/btu).
Source: *EIA. (2012). Annual Energy Review. Washington, DC: U.S. Energy Information Administration.*

In years, the share of energy cost in GDP does not change significantly. This shows that the efforts spent on energy efficiency improvements and finding alternatives for fossil fuels will be crucial components of economic sustainability, in addition to their environmental benefits. In this respect, the green building industry can play a significant role in reducing the total share of energy cost by promoting energy efficient technologies and switching from fossil fuels to renewable energy resources. Given the 40 percent share of the buildings among all types of energy consumption, research on energy efficient building constitutes a significant linkage between environmental and economic sustainability.

Nevertheless, energy efficiency is not the only field in which the building industry can contribute to economic sustainability. Buildings have also significant impacts on the U.S economy through the creation of value and contribution to employment. According to the EPA (2009), the number of residential buildings in the US was 128 million in 2007 and the number of office buildings was 4.9 million in 2003. Between 2005 and 2009 every year approximately seven million new residential units were built. For the office buildings this number was approximately 170,000 and 44,000 office buildings were demolished each year. According to the U.S. Census Bureau of the Department of Commerce the estimated seasonally adjusted rate[5] for the construction spending in

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[5]From the webpage of U.S. Census Bureau:
"The Survey of Construction estimates the amount of new, privately-owned construction in areas that require a building permit and in areas that do not require a building permit. Areas that do not require a building permit are referred to as non-permit (NP) areas. Less than 2 percent of all new construction takes place in NP areas. Census Field Representatives collect data for both of these areas. For areas requiring a permit, they visit a sample of permit offices and select a sample of permits authorizing private new residential construction. These permits are then followed through to see when they are started and completed, and when they are sold for single-family units that are built to be sold. Information on physical and financial characteristics are also collected. For NP areas, roads in sampled NP areas are driven as least once every 3 months to see if there is any new construction.

October 2012 was $872.1 billion. This amount is equal to 5.5% of the estimated seasonally adjusted rate of U.S. GDP ($15,707 billion) at the third quarter of 2012, calculated by the U.S. Department of Commerce Bureau of Economic Analysis (Commerce, 2012). Private sector accounted for 67.8% of this spending with $592 billion, which was almost evenly distributed between the residential (295 bn.) and non-residential (297bn.) sectors.

According to the US Bureau of Labor Statistics (BLS) 5.5 million people were employed in the construction business by September 2012 (Bureau of Labor Statistics, 2012c), constituting 3.8% of the number of people employed all over the U.S (Bureau of Labor Statistics, 2012d). Figure-2.8 shows the change in number of people that are employed in the construction sector between 2002 and 2012. Effects of the 2008 mortgage crises and the following recession can be seen through the sharp decrease in numbers of employees between January 2008 and January 2010. Employment in the construction sector stayed stagnant at roughly average of 5.5 million workers.

The U.S. Census Bureau defines the "seasonally adjusted annual rate" as follows: "Most of the seasonally adjusted series are shown as seasonally adjusted annual rates (SAAR). The seasonally adjusted annual rate is the seasonally adjusted monthly value multiplied by 12. The benefit of the annual rate is that not only can one monthly estimate be compared with another; monthly data can also be compared with an annual total. The seasonally adjusted annual rate is neither a forecast nor a projection; rather it is a description of the rate of building permits, housing starts, housing completions, or new home sales in the particular month for which they are calculated" U.S. Census Bureau. (2012). Press Release FAQs. from http://www.census.gov/construction/nrs/faqs/faqs_nrs_release.html#quest4,accessed on June 2013.

3.6.3 Buildings and Social Sustainability

With a share of approximately four percent of the total employment in the U.S., the construction sector also plays an important role in the formation of the social structure in the U.S., having the potential to lead to positive changes in social sustainability. According to the BLS data (Bureau of Labor Statistics, 2012c), by September 2012 average hourly earnings of all employees in the construction sector was $25.87, exceeding the US average in private sector by $2.27. The difference between the lowest (10 percentile: $11.03) and the highest (90 percentile: $35.91) hourly wage was $24.88. The highest wage was earned by the construction managers with an hourly average of $44, whereas the lowest rates were earned by helpers with an approximated hourly average of $8.

The BLS (2011) estimates show that in 2011 construction laborers (11%) and office and administrative support occupations (10.2%) were the two biggest occupational group in the industry, constituting 21% of the total number of employees with an average hourly wage of roughly $16.5. They were followed by carpenters (8.6%), installation maintenance and repair occupations (8.3%), electricians (6.8%), first-line supervisors of construction trades and extraction workers (6.1%), management occupations (5.9%) and plumbers, pipefitters and steamfitters (5%). Parallel to the higher levels of skills, these groups were compensated with relatively higher wages than the first two groups; they were paid $21.42, $21.53, $25.23, $30.13, $50.79 and $25.09 respectively for an hour of work on average.

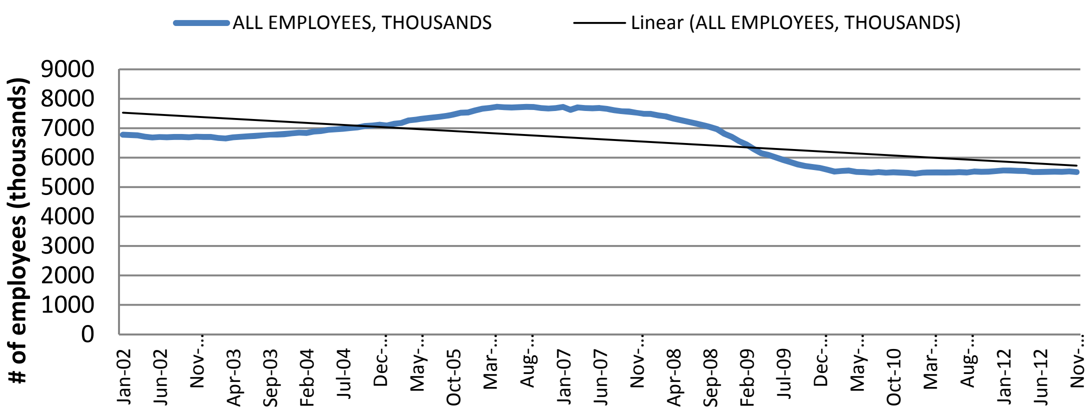

Figure 3.7 Number of people employed the constuction sector (Thousands).
Source: *US Bureau of Labor Statistics Series CES2000000001*

According to the BLS data, the hourly mean wage of workers does not show extreme differences from the national average and it remains slightly above the national average. The seven largest working groups that constitute the majority of employment in the sector maintain an hourly wage between the interval of $18 and $40 on average. Except for managerial occupations and helpers for electricians, hourly wages do not deviate from this interval. However, this can be misleading in annual wage calculations of workers, because construction sector is a sector with high turnover rates. For example, by September 2012, 11.9 percent of those who were previously employed in the construction sector were unemployed. Since the industry is project based, in most of the cases continuity of work is not guaranteed and there might be many months without work for a worker. For this reason annual wages might show higher rates of escalations than the hourly rates do. However, the data only data provided by BLS for the annual wages is calculated by multiplying the hourly average by 2080 hours; for this reason it was not possible to compare the difference in actual annual earnings among different working groups, by the time this research was conducted.

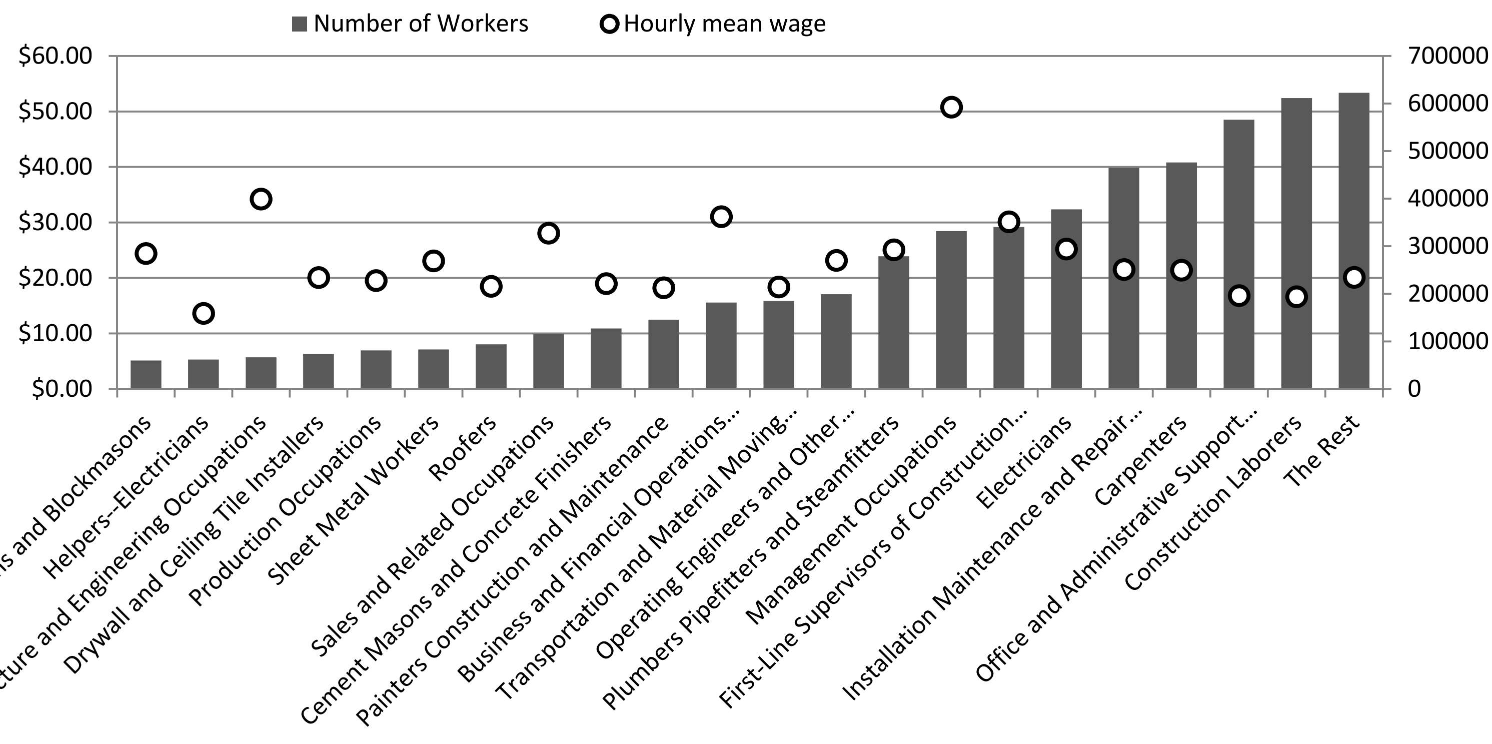

Figure 3.8 Number of workers in the construction sector and their wages.
Source: Bureau of Labor Statistics. (2012). *Construction and Extraction Occupations*. Washington, DC Bureau of Labor Statistics.

In addition to wage levels and temporary unemployment, there are other factors that can affect the social condition of workers in the construction industry. Benefits, unionization rates, working conditions and health related incidents are among these factors. In 2011, 14 percent of the construction employees had membership in a union, slightly exceeding the national average of 11.8 percent. However in representation by a union, construction sector stays below the national average by having only 14.9 percent of the employees represented by a union, which is below the national average of 16.3 percent. The unionization numbers are at their historical lows. In 1973 unionization among the construction workers was more than 80%, but thanks to the deregulatory policies of the post-1980 era and the increasing role of the subcontractors in the industry unionization rates have significantly dropped, accompanying with a 25 decrease in average wages (Torres et al. 2012).

Fatal injuries and health related incidents are two significant problems in the construction industry that have effects on social sustainability. Construction is among the top four industries with the highest number and the highest rate of fatal injuries in the US. Data provided by BLS shows that by 2011 the 721 fatal injuries has occurred in the private construction industry, placing the industry second in the number of total fatal injuries by sector, coming after the transportation and warehousing. By the fatal work injury rate construction is the fourth industry having the highest fatal injury rate with 8.9 per 100,000 full-time equivalent workers, which is significantly above the average for all workers within the U.S., which is 3.5 (Bureau of Labor Statistics, 2012a).

Another aspect of the building industry that affects social sustainability is the business structure, in which contractors and subcontractors play a significant role in the production and delivery of goods and services. Most of the workers in the construction sites are employed through subcontractors. Although there is no data informing the exact portion of workers hired by the subcontractors for the construction industry, portion of the revenue allocated to the subcontractors provide clues about significance of subcontractors in the industry. In 2002 cost of construction work subcontracted out to others accounted for 26.6% of the total value of the construction business done. In 2007, this ratio dropped to 21.7%, but still representing a significant portion of the total business (Bureau of Labor Statistics, 2012b). Allocation of work to subcontractors might have several advantages such as flexible work environment and specialization in tasks, however, the dominance of the subcontractors in the employment structure of the construction industry also poses significant risks to the working environment in construction. Hardship in managing and implementing operational health and safety (OHS) protocols is one of them. Loosemore. and Andonakis (2007) underline that OHS management and reporting is harder in a working environment where contractual relationships are constantly changing.

Another problem that emerges from the (sub)contractor dominated business structure of construction is the negative pressure on wages. Torres et al. (2012), who conducts a study with a focus group of 312 construction workers employed in various projects in Austin, Texas, one of fastest developing urban environment in the US, finds out that despite the lucrative character of the construction business in Austin, compensation of the workers that are hired by subcontractors can be as low as $10 per hour. This rate is below the national average and the legal poverty rate.

The ability of building industry to affect all three aspects of sustainability, the ecology, economy and the society, supports the international efforts for developing rating systems that will assess the sustainability of building projects and guide the building business for more sustainable practices. But, as this study shows in the following chapters, the majority of these rating systems and guidelines focus exclusively on the environmental effects of buildings, mostly missing the chance to improving their impact on social and economic sustainability. Nevertheless, the building industry actually holds a very significant position in the socioeconomic setting since it has the capacity to shape human behaviors, affect the strength of the national economy, provide a secure working condition for at least five percent of the population and promote institutions that helps establish social equity.

In addition to these impacts, the building industry can also influence the structure of other sectors and direct them towards sustainability. One of the main privileges of building projects in the economy is their ability to reallocate financial resources among different industries at a global scale. By doing so, the building market obtains a decisive role in determining which industries will be funded and what type of production practices are going to be promoted. Their ability to manipulate global commodity chains through demand is also an opportunity to promote suppliers that produce environmentally building materials in better working conditions. By defining rules of sustainable construction, building sector can rearrange its business structure according to the sustainability principles which can have worldwide snowball effects on many other industries in the long run. Introduction of green building rating systems, such as LEED, is a very important step towards this goal; and by expanding the boundaries of the concept of "green building" to include social and economic aspects of sustainability, building sector can make a significant contribution to the global sustainability.

3.7 Sustainability Assessment in the Building Sector

Sustainability related studies for the building industry can be traced back to the design of Paxton's Crystal Palace in 1851 which aimed at maximization of daylight by minimizing the need for artificial lighting. Additionally, the modular and simple prefabricated structure of the parts of the exhibition center both decreased the amount of materials used and allowed the reuse of materials in other buildings after demolition. But the public focus on energy efficient buildings did not emerge until the early 1970s. The energy shortage due to the oil crisis in 1973 and increasing national security concerns in the energy field triggered research on less oil dependent energy alternatives and more energy efficient technologies. Energy saving alternatives were supported by the environmentalist movement already evoked by Carson's (1965) work *Silent Spring.* Simultaneous developments in new solar technologies in the space quest and government support for the research on eutectic salt energy storage batteries paved the way of introducing alternative energy sources in the public sphere (Kibert, 2004). These innovations and the new political environment found its way into the building sector with the establishment of an energy committee under the American Institute of Architects (AIA) in 1973. The committee issued several papers on energy efficient buildings and became involved in lobbying in Capitol Hill for promotion of energy efficient buildings. In 1977, the US Department of Energy was founded under the Carter Administration as a response to the oil crisis; the department also funded research on energy efficient buildings (Gould, 2007).

Although in the 1980s, the downward movement in oil prices decreased concerns about the energy use, also weakening the influence the environmental movement, the 1987 Bruntland Report and the 1992 UN Rio Conference revived the movement and once again environmental issues became a significant concern in the building industry. However this time the concerns included several other issues besides energy conservation such as public health, conservation of nature and water use. In the 1990s, parallel to increasing concerns about the depletion of the ozone layer, the AIA issued a resolution stating that members should not specify materials with CFCs or HCFCs. In 1990, these different concerns about environmentally responsible and user friendly buildings were gathered under a new institution called the AIA Committee on Environment (Gould, 2007).

In 1993, the AIA held a joint meeting with the International Union of Architects (IUA) in Chicago. At the end of the meeting the Declaration of Interdependence for a Sustainable Future was issued to show architects' commitment to the principles of sustainability. Simultaneously with these attempts by AIA, a green building council (USGBC) was established in Washington DC. The establishment of the US Green Building Council in 1993 started a new era in the building sector, because for the first time the discussions on the environmental sustainability of the buildings were translated into actual policies that can be measured and implemented.

Establishment of USGBC was followed by the launch of first version of LEED in 1998, which carried the concept of environmental or "green" building beyond the boundaries of energy efficiency. Starting from this first version, LEED has measured the impacts of the buildings on the environment and human health through five basic sections: Energy and Atmosphere (EA), Water Efficiency (WE), Material & Resources (MR) and Indoor Environmental Quality (IEQ) (USGBC, 2009a, 2013a).

LEED has showed distinctive success in introducing "green building" to the market and to the architecture profession. Between 2000 and 2011 the total area of the LEED registered buildings all over the world (excluding LEED for homes) jumped from 100 thousand square feet to more than eight billion square feet (Katz, 2011). This success in numbers is also represented in the differentiation of the certification types. By 2009 LEED had nine different rating systems for different needs from the construction industry, including commercial buildings, homes, schools, retail, etc. Successes at the international level carried LEED to the position of an international advocate and a worldwide accepted rating system for the building industry. What had first emerged as a set of guidelines for green building construction soon became one of the major brands of sustainability in the building industry. This association is supported by LEED itself. In the LEED document (USGBC, 2009b) USGBC states that following the establishment of the council the "sustainable building industry needed a system to define and measure 'green buildings'" (p .xi).

Simultaneously, other green building rating systems started to emerge in different locations of the world. One of the most significant of these systems is BREEAM, which is a widely used rating system in Europe. Despite its reputation and success in covering the green building market, LEED is not the only green building rating system that is being used. In 1990, earlier then LEED, the British green building rating system

BREEAM (the Building Research Establishment Environmental Assessment Method) was launched by Building Research Establishment (BRE), which was an older government, now private, institution. Similar to LEED, BREEAM also aims to serve a wide range of different building types including retail, residential, offices, education buildings, prisons, courts, healthcare, etc. On its webpage, BREEAM claims that there are more than 250 thousand BREEAM certified buildings all over the world (BREEAM, 2013). By 2003 being rated "good" by EcoHomes (a version of BREEAM specific for homes) became mandatory for social housing projects in Britain. By 2005 the mandatory certification level was raised to "very good". By April 2007 CSH became the mandatory code for all new houses in England, Wales and Northern Ireland (BREEAM, 2011).

The first decade of the third millennium witnessed a rapid proliferation in the number of green building rating systems all over the world. While some of these codes reinterpreted the criteria of LEED or BREEAM into local needs (e.g., LEED Canada, LEED Brazil, BREEAM Netherlands, LEED Mexico) some others introduced promotion of new practices that has started to expand the definition of green building. Living Building Challenge, for example, is an innovative rating system the describes its purpose straightforwardly as: "defining the most advanced measure of sustainability in the built environment possible today and acting to diminish the gap between current limits and ideal solutions" (LBC, 2011). In addition to concerns about site selection, energy, water, material and resources, LBC introduces "social justice" and "beauty" as other dimensions to be included in sustainable building design. Differing from BREEAM and LEED, LBC grounds its evaluation process on actual data from buildings rather than anticipated outcomes. Whereas in LEED and BREEAM building simulations are used as tools for data collection, LBC evaluations take place after the building is occupied for at least 12 months (LBC, 2011). With these features, LBC applies a broader definition of sustainability both by including more criteria from the social sector and employing the time dimension through post-occupancy evaluation.

Sustainable Building Challenge (SBChallenge) is another international attempt at developing tools for assessing sustainable buildings. The movement was first launched in 1996 as Green Building Challenge (GBChallenge) and was then carried on through international conferences in 2002, 2005 and 2008. Similar to LBC, SBChallenge aims at expanding the definition of green building to include more aspects of sustainability. SBChallenge claims to offer its users flexibility of choosing as many criteria as desired to be evaluated and a region-specific context where weighting can be partially modified. In its 2004 report IISBE (Larsson, 2004), the mother institution of SBChallenge, describes it as a “rating framework” while naming LEED and BREEAM as “labeling systems”. SBChallenge operates at a prior stage before the rating system; it sets criteria to be used as guidelines by regional authorities to develop weights and benchmarks for sustainable construction. In addition to the major concerns of LEED and BREEAM, SBChallenge pays more attention to social, economic and cultural aspects of buildings, such as personal security of users, maintenance of the buildings, spatial and volumetric efficiency, effectiveness of facility management systems, flexibility in use, visual privacy, access to open spaces, life-cycle cost, construction cost, impact on streetscape, maintenance of heritage and aesthetic quality of façade.

CHAPTER 4

RESEARCH TASKS

The research conducted for this dissertation addressed two main questions: (1) To what extent and in what ways does LEED address social issues? (2) How could LEED be more socially effective in the future?

These questions generated detailed, subsidiary questions, as shown in Table 4.1 below. In order to collect and analyze the data needed to answer these questions, seven research tasks were completed, not necessarily in consecutive order as research in one task would sometimes contribute to a previous task not yet completed. The seven tasks, as described in this chapter, were: (1) comparing sets of indicators; (2) analysis of literature and industry references to sustainability; (3) selection of GRI indicators to be considered for LEED, (4) selection and examination of LEED buildings, (5) in-depth interviews, (6) analysis of accessibility to LEED certified spaces and (7) trying out new indicators.

Table 4.1 Research Questions and Related Tasks for Answering Them

Primary Questions	Secondary Questions	Related Tasks	Related Chapters
To what extent and in what ways does LEED address social issues?	**Question 1:** What is the framework behind LEED?	Task 1, Task 2, Task 5	Chapter 5
	Question 2: Which aspects of sustainability are addressed in LEED? What are possible new indicators to be included in LEED?	Task 1	Chapter 5, Chapter 6
	Question 3: What is the difference between the indicators in LEED and in GRI? Which indicators does LEED omit that are included in GRI?	Task 1, Task 3	Chapter 5, Chapter 6
	Question 4: Can LEED achieve social sustainability more fully by only providing better spaces, or is there room for more improvement?	Task 6	Chapter 5, Chapter 6
How could LEED be more socially effective in the future?	**Question 5:** Is it possible to introduce new credits to LEED that will address social issues?	Task 2, Task 4, Task 5, Task 7	Chapter 7
	Question 6: Does the current structure of LEED allow its expansion to address social issues? Are there already existing applications, documents, and examples for such expansion?	Task 2, Task 4, Task 5, Task 7	Chapter 7

4.1 Comparing Sets of Indicators

There are many sets of indicators designed to evaluate sustainability of processes both within the building industry and in other fields. By examining the indicators of these sets it is possible to identify different approaches in addressing sustainability. Among the sets that focus on the building industry, twelve of them were selected that are commonly used within the US and Europe. Three of these twelve sets were selected from LEED guidelines. Two of them are the most commonly used LEED guidelines, LEED NC and LEED EBOM. The third one is LEED ND, which was selected because of its scope that has more socioeconomic aspects than the other two. In addition to these twelve sets, four sets were selected from non-building sectors. This allowed the researcher to determine how sustainability assessment in the building industry differs from other approaches employed by non-industry specific sets of indicators.

These sixteen sets of indicators were systematically compared in order to: (1) identify the elements of the framework of LEED; (2) identify which aspects of sustainability are addressed in LEED and which are omitted (3) choose a benchmark system to be compared with LEED's point systems; (4) determine which indicators of this benchmark system can be introduced into LEED.

The four sets from outside the building industry are GRI, GPI, UN CSD and Global 100. These four sets were selected by looking at the scale of their units of measurement, the number of indicators they include and their respective frameworks. Differences in these features, rather than similarities were considered in selecting the four sets of indicators. Selection of non-industry sets of indicators that differ in these characteristics (number of indicators, unit of measurements, frameworks and scale) made it possible to examine different techniques of sustainability assessment currently being used by different agencies. Comparing the differences in the approaches of these four sets of indicators also allowed the researcher to decide if any of these sets provide an example benchmark to be compared with LEED.

The other 12 sets of indicators, which are from the buildings industry, are: LEED New Construction (LEED NC), LEED Neighborhood Development (LEED ND), LEED Existing Building Operation and Maintenance (LEED EBOM), Building Research Establishment Environmental Assessment Method (BREEAM), Green Globes (GG), Whole Building Design Guide (WBDG), American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 189, International Green Building Code (IGBC) California Green (CAL Green) ASHRAE Advanced Energy Design Guide (ASHRAE AEDG) New Building Institute Advance Building Guide and the Massachusetts Stretch Energy Code (MA Stretch). These sets of indicators were selected from a basket of widely used assessment tools within the US and Europe, in order to identify the techniques of sustainability assessment that are commonly in the building industry. Each of their indicators were categorized and scored together with the indicators of non-industry sets, in order to depict the difference that distinguish building industry from other sectors in addressing and managing sustainability related issues.

For this comparative analysis a scorecard was created. In this scorecard indicators from 16 sets of indicators were categorized under 30 different categories (Table 4.2). After this categorization distribution of indicators among these categories was examined to determine how sustainability is addressed by each set. As explained in detail below, this comparative analysis consisted of three steps: (1) creating categories that would represent different aspects of sustainability; (2) distributing the indicators in the appropriate categories with weights assigned to the indicators; (3) analysis of the final results.

The scorecard was created following a simple rule: placing indicators from each set (rating systems, guidelines, codes, etc.) in related categories. For example indicators addressing water efficiency, water use reduction or rain water collection systems were placed in the category *Water Efficiency.* This technique was expected to map clusters of indicators in certain categories, hence showing which categories are addressed. Additionally, these clusters were also expected to give a general idea about how each set of indicator address sustainability; in other words, which categories do they address more.

Table 4.2 Development of Categories to Represent Different Aspects of Sustainability

Categories	Changes	Notes
Accessibility and Social Enhancement	Modified	Social enhancement was added to indicate accessibility not only to buildings but also to resources.
Acoustic Comfort		
Commissioning / Management	Modified	Definition was expanded to include management related issues
Community Involvement	Removed	Removed due to absence of indicators
Community Use	Removed	Removed due to absence of indicators
Cultural Preservation	Added	
Daylighting		
Economic Efficiency		
Energy Efficient Appliances	Added	Added because there were several indicators addressing this particular category.
Energy Performance		
Environmentally Preferable Material and Products		
Environmentally Responsive Site Planning		
Flexibility and Adaptability		
High Performance Building Envelope		
High Performance Electric Lighting		
High Performance HVAC		
Indoor Air Quality		
Information Technology		
Learning Centered Design	Removed	Removed because this category is not inclusive, it addresses issues related to only schools.
Life Cycle Cost		
Plug Load Management	Added	Added because there were several indicators addressing this particular category.
Pollution / Waste Production	Added	Added because there were several indicators addressing this particular category.
Regional	Added	Added because there were several indicators addressing this particular category.
Renewable Energy		
Safety and Security	Modified	Its definition was expanded to include issues related to different forms of safety and security..
Service Life Planning		
Spatial Efficiency	Added	Added because there were several indicators addressing this particular category..
Stimulating Architecture		
Thermal Comfort		
Transport	Added	Added because there were several indicators addressing this particular category.
Visual Comfort		
Water Efficiency		
Water Quality / Health	Added	Added because there were several indicators addressing this particular category.

The categories to represent different aspects of sustainability were created based on earlier studies conducted by the Center for Building Knowledge (CBK), the Sustainable Building Industry Council and the New Jersey Schools Construction Corporation (NJSCC) (Evans, 2008; SBIC, 2007). These studies aimed at developing high performance buildings, by following 25 basic *design criteria,* which were used in this study to develop categories to represent different aspects of sustainability (Table 3.2). In order to be able to respond the objectives of this research, minor changes were done in these 25 original categories; some categories were removed or modified and some new ones were added.

Addition, modification and removal of categories were based on three criteria: (1) Removing: Categories that do not address sustainability issues related to all building types were removed. For example, *Learning Center Design*, which was in the original list introduced by SBIC (2007), was removed since it covers issues specific to schools as a building type. Additionally, after all the indicators from different sets were distributed under related categories, categories without any indicators were removed. Therefore *Community Use* and *Community Involvement* were excluded from the final list of categories. (2) Modification: Where possible, definitions of some of the original categories were expanded to include indictors that cannot be placed under any of the existing categories. *Accessibility*, for example, which originally refers to inclusiveness of people with disabilities and equal access to building services was expanded to include a broader concept of accessibility, including equal access to all resources not only by users but also all those engaged with the building over the life of the building. With that logic, issues related to human rights and social equity were also categorized under *Accessibility. Safety and Security* is also expanded to include issues related to physical and mental safety and security of those who are engaged with the building all throughout its lifecycle. Therefore, in addition to users' safety, worker safety, work injuries and job security were also included in this category. (3) Addition: Where there are indicators that do not fit under any of the existing categories and it is not possible to expand the definition of an existing category to include them, a new category was created. Description and boundaries of these categories are presented in Table 4.3.

Indicators from the 16 different sets were placed in these categories. Placement was made according to three criteria: (1) the definition and boundaries of the categories; (2) intent behind and measurement tools for the indicator; and (3) original categorization of the set of indicators if there is any. Most of the sets of indicators have their own categorization. These categorizations were taken into consideration during the placement of indicators. For example, in a rating system, if an indicator was placed in a category called "energy efficiency", first the possibility of placing that indicator in *Energy Performance* was tested. If the intent and the unit of measurement of the indicator matched with the definition of *Energy Performance,* it was placed in there. But in many cases placing indicators posed several challenges. The primary challenge was the absence of an existing category within the 25 original categories that were borrowed from studies by SBIC and NJSCC. For example "percentage of population having paid bribes" is an indicator of UN CSD. The indicator is placed in *Governance*, which is a category in UN CSD. But the 25 categories selected for this study do not include *Governance.* One strategy is creating the category *Governance.* But there are not any other indicators from either UN CSD or other sets that could fall in this category, for this reason, before doing so the possibility of including this specific indicator in any of the existing categories was examined. The intention of the indicator is taken into consideration in doing so, which is to report the amount of corruption in the society. Since, the scope of safety and security covers the problem of bribery as a threat against socio-economic wellbeing this specific indicator was placed under safety and security.

Another challenge was the complicated and multidimensional character of the aspects of sustainability, which are usually strongly interdependent. Therefore, placing indicators under certain categories does not mean that they are ineffective on other aspects of sustainability. A single indicator can affect more than one aspect of sustainability, as is exemplified in the UN CSD indicator, *percentage of population having paid bribes,* which has impacts on governance and economic development at the same time. On these occasions, the intent and measurement tools of the indicator were considered in order to decide which aspect of sustainability it affects primarily and so in which category it should be placed.

During the placement of indicators in categories, their weights were calculated with respect to the total number of indicators in their set. Where sets of indicators have a point system, such as the one in LEED, the weight of each indicator is calculated based on the total points and then normalized to percentages. If no such point system is employed, then equal weights were assigned to each indicator, again to be normalized in the form of percentages. For the indicator sets that employ a point system, if there are prerequisites, those were omitted in calculating the weights, but they were examined separately in order to show which fields are prioritized through prerequisites.

This technique was developed as a preliminary step of defining a roadmap for the research. It was expected to the following questions: (1) Do indicators from different sets form clusters in certain categories, do they form an even distribution? (2) Regarding the previous question, is it possible to say that some aspects of sustainability are addressed more than the others? (3) Do different sets of indicators (LEED, BREEAM, GRI, WBDG, etc.) differ in the way they address these categories? In other words, do their indicators form clusters under different categories? (4) Do the set of indicators used by the building industry differ from those sets that are not being used by the building industry?

For those categories that did not have clusters of indicators after the placement was completed, further investigation was needed to determine if they were not actually being addressed. In some cases it is possible that those categories are partially addressed by indicators that were placed in other categories. For example, after the preparation of the scorecard, if became clear that LEED NC does not have any indicators in the *Accessibility and Social Enhancement* category, it would still be possible that indicators (LEED credits) placed in other categories actually had measures that did address *Accessibility and Social Enhancement.* When necessary, further research was done to determine if categories without clusters were not really being addressed. In the opposite vein it is possible to say that a category is being addressed significantly if there are indicator clusters in it. For example, if the scorecard showed clusters in *Energy Efficiency,* it meant that many indicators for measuring or guiding energy efficiency were present. These indicators might also be addressing other categories but they definitely address energy efficiency.

It is important to note that the categorization of indicators completed in this research is not definitive; there might well be other ways to categorize them. Many sets of indicators already have their own categories based on their respective frameworks. However, the technique used for this research meets its main purpose: to determine which aspects of sustainability are addressed more frequently and which are addressed less often. The results of the comparison of indicator sets are presented in Chapter 5, along with a discussion of how different sets of indicators address sustainability and how the building sector distinguishes itself from the other sectors. At the end of the analysis, GRI was chosen as the benchmark to be compared against LEED and the reasons of this selection is also listed in Chapter 5.

Table 4.3 Categories Representing Different Aspects of Sustainability Based on the Studies of SBIC (2007) and Evans (2008)

Categories	Definition	Possible Topics/Problems/Policies Addressed
Accessibility / Social Enhancement	Ensuring equal access to all resources by both users and other people who were engaged with the building during the lifecycle of the project. In addition to the needs of building users with disabilities, this indicator also covers other issues that lead to social enhancement and increase social sustainability, including access to human rights, social equity, prevention of discrimination, etc.	Regulating suitability of the design for people with disabilities, elderly; ensuring respect to human rights during the lifecycle of the building (includes extraction of resources and the construction phase), guiding for social enhancement (training programs, unionization rights, and collective bargaining), regulating access to social services.
Acoustic Comfort	Building living spaces with minimum noise through reducing sound reverberation in spaces, limiting transmission of noise from outside and minimizing background noise from the building's heating, ventilating, and air conditioning system.	Regulating noise levels and sound transmission classes, specifying sound absorbing materials, guiding for background noise minimization.
Commissioning / Management	Regulating systematic process of ensuring and documenting that all building systems perform in accordance with design intent, and that they meet the owner's operational needs.	Guiding for documenting the design intent and operation protocols, in-place system performance verification, preparation of comprehensive operation and maintenance manuals, training for building operations staff and system performance monitoring.
Cultural Preservation	Guiding for building practices without damaging the historical and cultural heritage of the site.	Promoting reuse of historical buildings, preserving culturally significant sites, historic districts, etc.
Daylighting	Regulating controlled admission of natural light into a space through windows, skylights, or roof monitors with the aim of increasing use of daylight as much as possible, while avoiding excessive heat loss, heat gain, and glare.	Guiding for window design, promoting natural light supplements for electric lighting systems, use of daylighting analysis tools, roof monitors, skylights; and guiding room designs and layouts that maximize daylight.
Economic Efficiency	Development of strategies that will minimize the construction cost and encourage reinvestment in neighborhoods and enhance the economic structure of the surrounding environment.	Ensuring that the economic effects of the project is discussed through community planning and engagement processes, needs of the community such as housing, employment, community service, and facility needs are met, guiding to consider all available local, state, federal, and private funding sources, including grants, loans, equity investments and tax credits.

Table 4.3 Categories Representing Different Aspects of Sustainability Based on the Studies of SBIC (2007) and Evans (2008) (Continued)

Categories	Definition	Possible Topics/Problems/Policies Addressed
Categories	**Definition**	**Possible Topics/Problems/Policies Addressed**
Energy Performance	Reducing short- and long-term energy costs as much as possible, while maintaining a high-quality indoor environment	Promoting reduction of energy intensity, use of architectural design tools for energy efficiency, load calculation and HVAC sizing, energy monitoring and calculating productivity per energy use.
Environmentally Preferable Materials	Promoting use of durable, non-toxic materials that are high in recycled content and are themselves easily recycled, locally manufactured.	Guiding for construction waste recycle, promoting use of environmentally friendly, recycled, locally produced materials.
Environmentally Responsive Site Planning	Guiding for the right site selection that helps the building function at peak efficiency, minimizes adverse impacts on the local environment, and serves as an amenity for the surrounding community.	Guiding for preservation of local vegetation, reduced parking, minimized stormwater runoff, reduced impervious surfaces, reduced heat island effect, reduced light pollution, reduced erosion, increased community connectivity.
Flexibility and Adaptability	Ability to adapt changing building use in order to allow short-term rearrangements and create a facility that is expected to last for more than one generation.	Guiding for adaptability through designing the size, capacity and configuration of the building's basic systems; promoting avoidance fixed stations for equipment, designs that can accommodate numerous furniture layouts, accommodate numerous furniture layouts, promoting raised floors for both flexibility and adaptability with ever-changing technology.
High Performance HVAC	Guiding for strategies that will ensure peak operating efficiency in HVAC systems.	Promoting use high efficiency equipment, 'right-sized' equipment for the estimated demands of the facility, including controls that boost system performance. Also promoting use of economizers, energy recovery systems, guiding for proper use of air pressure indicators, training services, etc.
High Performance Electric Lighting	Guiding for solutions that will optimize 'watts per square foot' while retaining visual quality.	Guiding for proper lighting design, avoidance of overlighting, analysis of lighting system on HVAC system, optimizing the number and type of luminaries, incorporate controls to ensure peak system performance, integrating electric lighting with daylighting strategies.

Table 4.3 Categories Representing Different Aspects of Sustainability Based on the Studies of SBIC (2007) and Evans (2008) (Continued)

Categories	Definition	Possible Topics/Problems/Policies Addressed
High Performance Building Envelope	Use of building envelopes that will enhance energy efficiency without compromising durability, maintainability, or acoustic, thermal or visual comfort. An energy-efficient building envelope will reduce overall operating expenses while easing the strain on the environment.	Regulating minimum compliance with the 'prescriptive' and 'mandatory' requirements on building envelope, guiding for design of glazing that represents the best combination of insulating value, daylight transmittance, and solar heat gain coefficient, regulating minimum insulation requirements, use of exterior shading devices, promoting use of thermal mass to store heat and temper heat transfer.
IAQ	Regulating the quality of the air inside building in order to increase health and performance of users.	Regulating air contamination level, adequate ventilation systems, and unwanted moisture accumulation; promoting use of low VOC or VOC-free materials, regulating ventilation schedules; guiding for location of exhaust fumes and guiding for design to keep precipitation out of the building.
Information Technology	Promoting use of information technology during the design and operation of the building.	Promoting use of "technology-enabled" infrastructure to support both wired and wireless applications, guiding for integrated technology and design process, advance telecommunication systems, promoting installation of distributed data.
Lifecycle Cost	Calculating the long-term costs of a building including operating and maintaining costs, in addition to building and design costs.	Indicators calculating lifecycle costs including maintenance, replacement, energy consumption, cost of materials used; promoting durability.
Plug Load Management	Guiding to decrease the energy consumption of the temporarily installed equipment, such as computers, water dispensers, audio visual systems, etc.	Promoting use of Energy Star or other energy efficiency certified equipment, use of smart plug systems, installation of energy monitoring systems for plugs, etc.
Pollution / Waste Production	Guiding to decrease pollution and waste production during the lifetime of the building, including spills, emissions, solid waste, construction waste, etc.	Guiding to reduce construction waste, emissions from heating an cooling, refrigerant management, recycling by occupants, preparation of waste management plans, reporting on emissions, etc.
Regional	Promoting designs and policies that will enhance the socio-economic structure of the regions in which the projects are constructed.	Promoting achievements that address geographically-specific environmental priorities, development of infrastructural investments that help regional growth and other contributions to the economy and social mechanism of the surrounding region.

Table 4.3 Categories Representing Different Aspects of Sustainability Based on the Studies of SBIC (2007) and Evans (2008) (Continued)

Categories	Definition	Possible Topics/Problems/Policies Addressed
Renewable Energy	Maximizing the cost-effective use of renewable systems to meet the energy needs and promoting purchase of green power.	Promoting use of daylighting, passive solar heating, solar hot water, solar thermal, wind, photovoltaic or green power.
Safety and Security	Includes all safety and security issues related to both physical and mental health of the people that is engaged with the building during its lifecycle, as well as prevention of violation of laws and preservation of socio-economic wellbeing. Therefore this category includes issues related to users safety, construction related accidents, job security of workers, bribery, disasters and other safety and security related issues.	Guiding for security control strategies (fencing, surveillance, lighting, etc.), limiting entries and exits, regulating fire hazard prevention strategies, guiding for landscape design to minimize places that are hidden from view; regulating workers' safety and security, promoting safety and security training programs, regulating against corruption and promoting job/income security.
Service Life Planning	Calculating the construction costs of operating systems and the costs to maintain, repair and replace these systems over their service lives.	Guiding for calculations of the maintenance and operation costs of walls, fenestration, flooring and other components of the building.
Spatial Efficiency	Guiding for designs that will provide maximum use with minimum amount of space, without sacrificing from comfort and health.	Promoting compact development, guiding to understand integral relationship between form and function, ensuring appropriate programming occurs, space planning, and optimization of the building program.
Stimulating Architecture	Stimulating new architectural practices that will help increase sustainability of the buildings. Indicators aiming at innovation in design fall under this category.	Promoting innovative design solutions that will enhance the building features and increase sustainability.
Thermal Comfort	Regulating temperature and relative humidity levels in a closed spaces to prevent them from being too hot or too cold, in order to create comfortable living environments.	Addressing room configurations and HVAC distribution layouts, guiding for thermal comfort.
Transport	Promotion of cost effective, environmentally friendly transportation solutions.	Promotion of use of public transport, mixed use, use of bike, installation of bike racks and showers, reduction of vehicle parking, calculation of environmental impacts of transportation.

Table 4.3 Categories Representing Different Aspects of Sustainability Based on the Studies of SBIC (2007) and Evans (2008) (Continued)

Categories	Definition	Possible Topics/Problems/Policies Addressed
Visual Comfort	Increasing visual experience by balancing the quantity and quality of light in each room, and by controlling or eliminating glare. Tasks such as writing, reading printed material and reading from visual display terminals are considered during the design. Usually important for office and learning spaces.	Regulating light levels, guiding for uniformity and flexibility, control of glare, guiding for the brightness of surfaces and other design issues affecting visual comfort, including shades, louvers, blinds, overhangs, trees, etc.
Water Efficiency	Guiding for strategies that will increase water efficiency.	Promoting reduction of potable water consumption for irrigation and plumbing fixtures, planting drought tolerant vegetation, use of efficiency irrigation technology, use of high efficiency equipment, automatic lavatory faucet shut-off controls, installation of low-flow showerheads with pause control, on-site wastewater treatment.
Water Quality / Health	Regulating practices that effect the health of building users and other people who are engaged with the building throughout its lifecycle. This includes the quality of water provided to the building users. Does not include IAQ, since it is included in a separate category.	Promotion of use of cleaning products that does not have adverse health effects, regulating compliance with the health codes, quality of drinking water, effects of the space on the mental health of users, reports on public health.

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4.2 Analysis of the Literature and Industry References to Sustainability

In Task 2 references in relevant academic research on sustainability of buildings were compared with references to sustainability in the green building industry. The purpose was to examine the validity of the argument that LEED does not address social issues sufficiently. While Task 1 (comparison of rating systems) could demonstrate that the green building industry is not paying much attention on the issues related to accessibility and social enhancement, it was still a question why it should pay more attention on these issues. If the discussions in academic research on sustainability and the building sector were focusing on social issues more than the green building industry, this would indicate a gap and hence a possible niche towards which LEED could expand its focus.

In order to examine the possibility of expanding LEED through including new indicators, the following method was followed:

1. Problems that are most frequently addressed in the literature on sustainability and buildings were identified.
2. These problems were categorized using the same categories used to categorize indicators in Task 1.
3. Categories that are emphasized in the literature on sustainability and buildings were compared with the categories that are emphasized by the green building industry (results from the twelve related sets of indicators selected from the building industry) in order to determine which problems are addressed by the literature but missing from the scope of the green building industry.

In order to determine which problems are emphasized in the literature on sustainability and buildings, searches were conducted in three online academic databases (Jstore, ScienceDirect and EBSCOHOST) using four different key phrases: "sustainability and building," "social and building," "economy and building." and "environment and building." Search results were filtered by choosing the "most relevant" option, which is also the default setting of the search engines in these databases. Another filter was applied to eliminate results from sources before 2000. After applying these filters, the first 50 results that appeared for each key phrase were selected and transferred to a spreadsheet, summing up to 200 studies in total. During this selection, studies that are irrelevant to the building sector (i.e. *building social capacity and sustainability, sustainability and building a healthy generation*, etc.) were omitted. Databases were used with a hierarchical order by searching ScienceDirect first, Jstore second and EBSCOHOST last. The first search was always conducted in ScienceDirect since this database hosts a significant amount of journals related to the building sector and sustainability discussions. After application of the filters and elimination of the studies irrelevant to the building industry, if not enough results appeared on ScienceDirect, then JStore and EBSCOHOST were used for searches (Figure 4.1).

After selecting 200 studies, each study was assigned the appropriate keywords or key phrases to identify the problems that study focused on. For example, for Geva's (2008) study, *Rediscovering Sustainable Design through Preservation: Bauhaus Apartments in Tel Aviv,* four keywords/key phrases were used: "cultural preservation," "natural ventilation," "regional materials," "remediation / retrofit."

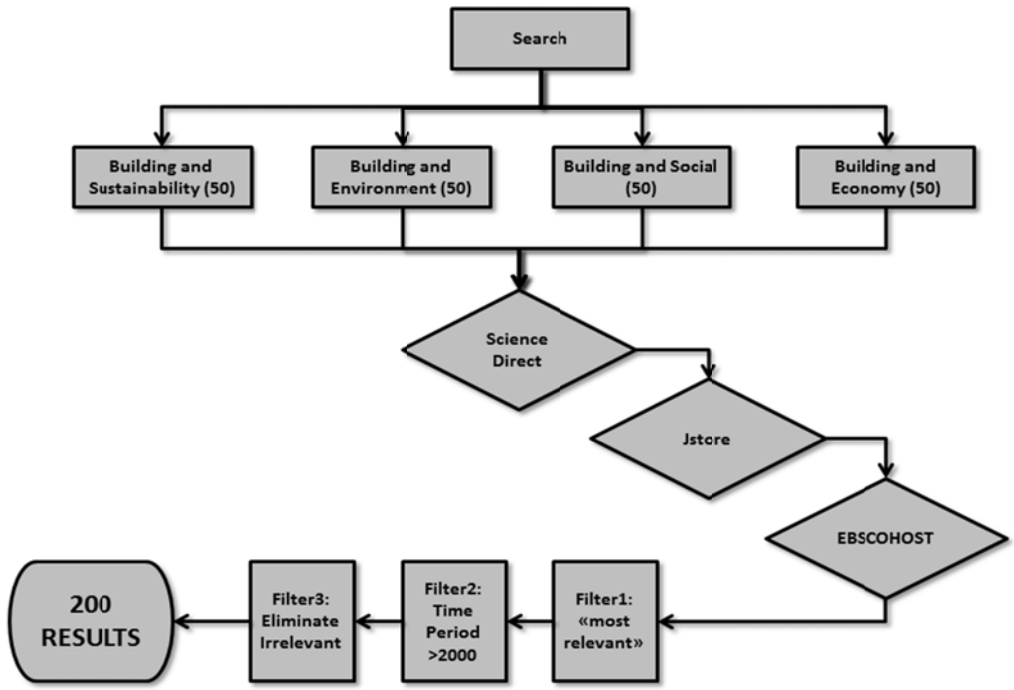

Figure 4.1 Selection of the studies on sustainability and building industry.

To assign keywords, the list of keywords provided by the journal was used. After assigning keywords to each study, a second review was conducted to ensure consistency across keyword assignments. This was done by determining whether there were keywords that were used for one particular study but not for another one although relevant to both of them. For these cases consistency was established by assigning these keywords to both studies. A sample showing how key words were assigned is presented in Table 4.4.

After assigning the appropriate keywords to the each study, a score was calculated for each keyword by looking at how many times it had been used. For example, if a keyword was assigned to X different studies, its score was X. These scores were then normalized to sum up to 100. Each keyword was then associated with one or more indicator categories created for this research, as listed above in Table 3.3 in order to determine which indicator categories are being emphasized in the literature. For example, the key word "affordability" addresses issues related to both *Accessibility/Social Enhancement* and *Economic Efficiency*. Therefore it was associated with both categories (Appendix A). The point of "affordability" is 0.94. This means it is contributing to both of these two categories 0.94 points each.

Once keywords were associated with related categories, the overall score for each category was calculated as the sum of scores of the keywords for that category. For example, the category *Acoustic Comfort*, has four keywords or phrases associated with it: "acoustic comfort," "building information and modeling," "orientation and ratios," and "sound absorption." The total point for these four keywords is 1.5; therefore acoustic comfort received a point of 1.5. This point is equal to 0.002 percent of the total of 525 points that were allocated to all of the categories. In other words, issues related to *Acoustic Comfort* receive very little attention in the research on building and sustainability.

Findings from this task were used to test the validity of the argument that LEED is not addressing social issues sufficiently and there is need for it to address it more. While the previous task (comparison of rating systems) could demonstrate that green building industry is not paying much attention on the issues related to accessibility and social enhancement, it was still a question why it should pay more attention on these issues. However, if the discussions in the academia on sustainability and the building sector were focusing on social issues more than the green building industry, this would indicate a gap and hence a possible niche towards which LEED can expand its focus. The calculation process and the results are presented in Appendix A. The discussion of these results is in Section 5.2.

Table 4.4 Example for Assigning Keywords to Selected Studies on Buildings, Sustainability, Environment, Economy and Society

Title	Source	Date	Author/Contact	Keyword1	Keyword2	Keyword3	Keyword4	Source
Rediscovering Sustainable Design through Preservation: Bauhaus Apartments in Tel Aviv	APT Bulletin, Vol. 39, No. 1 (2008), pp. 43-49	2008	Anat Geva	Cultural Preservati on	Natural Ventilation	Regional Materials	remediatio n / retrofit	Jstore
Space against Time: Competing Rationalities in Planning for Housing	Transactions of the Institute of British Geographers New Series, Vol. 25, No. 4 (2000) (pp. 503-519)	2000	Jonathan Murdoch	Policy	Governance	Planning		Jstore
Sustainable Solutions for Historic Buildings: Geothermal Heat Pumps in Heritage Preservation	APT Bulletin Vol. 40, No. 2 (2009) (pp. 21-28)	2009	Thomas Perry and Carl A. Jay	Cultural Preservati on	remediation / retrofit	HVAC		Jstore
Reinterpreting Sustainable Architecture: The Place of Technology	Journal of Architectural Education (1984-) Vol. 54, No. 3 (Feb., 2001) (pp. 140-148)	2001	Simon Guy, Graham Farmer	Discourse	Policy	Life Cycle		Jstore
Sustainable Restoration of Yale University's Art + Architecture Building	APT Bulletin Vol. 42, No. 2/3, Special Issue On Modern Heritage (2011) (pp. 29-35)	2011	Russell M. Sanders, Benjamin Shepherd, Elizabeth Skowronek and Alison Hoffmann	Cultural Preservati on	remediation / retrofit	Community Enhanceme nt.	Drainage System	Jstore

4.3 Selection of New Indicators to be Considered for LEED

After the differences among various sets of indicators were identified and GRI was selected for further comparative research against LEED (Task 1) and after references to sustainability in academic research were compared to references in the building industry literature (Task 2), particular GRI indicators were chosen for possible inclusion in LEED. To complete this third research task three steps were followed:

1. LEED was compared with GRI which was selected based on the findings on Task1.
2. Indicators from GRI that address those topics/issues/problems identified in Task 2 were selected.
3. From this group of indicators identified in GRI, 10 were selected for further examination for their potential to be included in LEED.

Once GRI was chosen as a benchmark to be compared with LEED, these two sets (LEED and GRI) were compared regarding their intents, frameworks, units of measurement and the categories of indicators in details. The main focus of the comparison was the differences in their assessment techniques (Section 5.1) because it is possible to introduce new indicators to LEED only if they are suitable for the existing assessment techniques (data collection methods, the way this data is used and the way the help in attaining sustainability).

Documents released by the mother institutions of each set (LEED and GRI) were used to examine their respective frameworks and their boundaries. For example, documents issued by the U.S. Green Building Council (USGBC, 2008, 2009a, 2009b, 2009c, 2009d, 2010, 2011a, 2011b, 2012a, 2012b, 2013a, 2013b, 2013c) were used to determine how LEED was formed and how it evolved over time, what the main intentions were behind its formation, what the pillars of its framework are and how this framework has evolved. Similar research was conducted for GRI.

After the comparison of LEED and GRI, findings from Task 2 were used to determine which new indicators would be best to introduce into LEED. For this purpose, categories that received more attention in the academic literature than in the building industry were used. These categories are listed with a (-) sign in Table 5.3. Then, findings from Task 1 were used to identify how GRI addresses these categories (Table 5.4). For example, what percentage of the indicators in GRI does fall in *Accessibility / Social Enhancement* or in *Service Life Planning*? This question is answered in Table 5.4. If the answer is "zero," then those categories were automatically eliminated from analysis. Then, three criteria were used to select the categories from which the indicators were selected for possible introduction into LEED:

1. The extent of difference between the green building market and the literature in addressing each category (the absolute value of the difference in points). For example the absolute value of the points of the difference for the Information Technology is 0.07, which indicates a slightly stronger attention from the literature, whereas Economic Efficiency has the highest absolute value by 9.74, which means among all the other categories most of the difference between the literature and building industry appears in this category.
2. The percentage indicators or points (if it is a point system) allocated for each category. Even though Economic Efficiency addresses the biggest difference between the focus of literature and the building industry, the benchmark system might not have enough indicators to address this issue. In this case, it would not be possible to select indicators from this category.
3. Absence of LEED credits to address this category. As described in Task 1, some indicators address multiple categories. For example, although none of the indicators in LEED were placed in the Economic Efficiency category, because none of them directly address this problem, some of the credits such as those that are energy efficiency indirectly relate to economic efficiency. However, there are no credits that can address the issues that are listed under Accessibility / Social Enhancement. In other

words, there are not similar LEED credits to those indicators from other sets listed under this category.

After the selection of the category, indicators of the benchmark system that fall in this category were listed. Findings that are presented in Section 5.2 showed that there are more than 10 indicators. Examination of the possibility of introducing all of these indicators into LEED thoroughly would not be possible within the time limits of this research; therefore a final elimination was done to shrink the number of indicator down to 10. This elimination has targeted indicators that can construct a framework around a certain topic/problem, preferable one that is not being addressed by the green building industry at all, although it has significant effects on sustainability. The details of the selection process and the selected indicators are presented in Section 6.2, through Tables 6.5 and 6.6.

4.4 Selection and Examination of LEED Certified Building Projects

In many parts of this research, documents submitted to USGBC for actual LEED registered projects were examined. These documents were mainly used to answer two questions. First, is it possible to expand LEED by introducing new indicators, specifically the ones determined in Task 3? Second, is the current structure of LEED suitable for the introduction of these new indicators and are there already existing assessment methods, documentation procedures and data collection processes that will help introduce these new indicators?

Three of these projects were chosen from the NYC area and one project was chosen from Newark, New Jersey. Three criteria were used to select these projects. First, projects pursuing LEED Homes were excluded because the certification process for LEED Homes is significantly different from that for other building types and these projects mostly serve for a smaller number of people compared to offices, schools, health institutions, etc. Second, proximity to the researcher was taken as a basis of selection. Due to the resources allocated for this research, only LEED projects that are accessible to the researcher were used in order to reach the consulting offices, consultants, managers and other people engaged with these projects to conduct interviews with them. Third, attention was paid to increase the variety in types of certification. This was done in order to examine projects with different types of certification. Hence, two projects were selected from LEED New Construction, one from LEED Existing Buildings and one from LEED Neighborhood Development. The selected projects and their features are presented in Table 4.5. Project names, addresses and any other features that could disclose their identity were not included for confidentiality purposes.

Table 4.5 Selected LEED Registered Projects as Cases

Project Name	Type	Certification Level	Area (sq ft)	Location	Function	Number of Occupants	Ownership
Project A	LEED NC	Certified	96,371	NYC	Multi-Family Residential: Apartments	268	Owned
Project B	LEED ND	Silver	102,801	NYC	Multi-Unit Residential and Retail	918	Owned
Project C	LEED EBOM	Silver	541,827	NYC	Office and Retail	1,357	Owned and Leased
Project D	LEED NC	Silver	214,000	Newark	Dormitory / Educational	7000	Owned

4.5 In-Depth Interviews

In order to understand the LEED certification process as it is actually practiced and the possibilities for expanding LEED's scope to address sustainability more completely, in-depth interview were conducted with 13 people, all of whom who have expertise in sustainability or green building related fields. These interviews were aimed at answering three questions: (1) What is the framework behind LEED? (2) Is it possible to introduce new credits to LEED that will address social issues? (3) Does the current structure of LEED allow its expansion to address social issues? Are there already existing applications, documents, and examples for such expansion?

Interviewees consist of two groups of people. The first group of eight people, are engaged with at least one LEED registered project at the time of the interview. This group consists of a vice president of building management of a university in New Jersey, the technical facility manager of the same university, the owner of an architecture and LEED consulting firm in New Jersey, an engineer in the same consulting firm, five architects who also work as LEED consultants for two different companies in Manhattan and the vice president of one of these companies. The second group consists of three specialists who are not engaged with LEED projects but work in a sustainability related field. They are the CEO of a GRI consulting company in California, a manager from a federal government agency who manages green building related issues on the East Coast and the vice president of an international NGO, who serves outside the US to develop strategies to promote sustainable forestry and tourism processes. Eight people in the first group were engaged with at least one of the projects investigated in this research. Two of them were engaged with LEED projects that were not investigated in this research, but their general insights in the LEED certification process and the framework of LEED were used. Details about the people interviewed are provided in Table 4.6.

One interview protocol (Appendix B) was designed for both groups but in two sections. The first section includes general questions about sustainability and sets of indicators (in LEED and GRI specifically); and a set of specific questions related to the topics covered by the proposed GRI indicators, such as workers' benefits, human rights, job training, labor security, etc. Questions in this first section were posed to all of the interviewees. The second section includes questions specific to the LEED projects examined, to be asked only for those who are engaged with any LEED project. These questions inquire about details such as the intention of the owner in obtaining LEED certification, decision on the certification level, selection of contractors and challenges that were encountered during the certification process. Each interview lasted between 30 minutes to one hour. Each interview was digitally recorded. The names of the interviewees are not disclosed for confidentiality purposes; pseudonyms are used instead. The full list of interview questions is presented in Appendix B.

Data collected from these interviews were used to answer the questions listed at the beginning of this section and findings are given mostly in chapters 5, 6 and 7. Findings from the interviewees are presented where ever they are relevant in these chapters. People's answers helped clarify the details and boundaries of LEED, its capability to include new indicators, boundaries of its lifecycle assessment method, the building industry's approach to sustainability and the willingness of representatives of the industry to introduce social indicators, availability of the necessary data required for this and future policy improvements that can make the introduction of these new indicators possible.

Table 4.6 List of Interviewees

Pseudonym	Organization Description	Position	Related Project	Roles
Mark	A University in NJ	Associate Vice President for Facilities Management	Project D	Manages the buildings in a university, oversees the construction processes.
Alex	A University in NJ	Technical Services Director	Project D	Manages the technical processes of the construction processes in a university.
Roger	Architecture office in NJ	Director of Design	Project D	Owner of an architecture company that designs LEED projects.
Victor	Green Design Consulting Firm in NJ	LEED Consultant	Project D	Engineer in the same company with Rogers and a LEED consultant.
Jamie	International Architecture Firm	LEED AP BD+C Environmental Specialist	-	Architect and LEED consultant
Arthur	International Architecture Firm	AICP, LEED AP ND Senior Associate Principal	-	Architect and LEED consultant
Dan	International NGO on Forest Preservation	Vice President of Sustainable Tourism	-	Manages the foreign activities of an NGO on sustainable tourism
Carrie	Building Design and Consulting Firm in Manhattan	LEED AP BD+C, LEED-ND Senior Sustainability Consultant	Project B	Architect and LEED consultant
Mary	Building Design and Consulting Firm in Manhattan	Senior VP	Project A&B	Architect, LEED consultant and VP
Alice	Building Design and Consulting Firm in Manhattan	LEED AP O+M, Sustainability Consultant	Project C	Architect and LEED consultant
Sandy	Building Design and Consulting Firm in Manhattan	LEED AP BD + C, Sustainability Consultant	Project A	Architect and LEED consultant
Nicky	GRI Consulting Firm	CEO	-	CEO of a GRI consulting firm, provides external assurance service.
Hally	Government Office on Environmental Issues	Program Analyst/Life Scientist	-	Manages the green building related processes of a government agency.

4.6 Analysis of Accessibility of LEED Registered Projects

When asked if it would be possible to expand LEED by introducing new social indicators, some of the interviewees claimed that LEED already addresses social aspects of sustainability by providing better spaces and healthier built environments. By providing spaces with indoor environmental quality LEED serves large communities while also contributing to the well-being of the world's population by decreasing the negative effects of buildings on the environment.

Although this is not a totally false statement, it is questionable if the provision of healthier and environmentally responsible spaces is enough to be considered socially responsible. If these spaces are not equally accessible to people from different income groups, the validity of this argument becomes even more problematic. For example, the amount of the LEED certified office space in Manhattan is expected to be high because of its population density but it is not known who exactly enjoys the benefits of these spaces. While majority of the people who work in these offices are expected to live either in Manhattan or in the larger metropolitan area, it is not clear if people who work in other boroughs have the same chance to work in LEED certified spaces.

This question is also valid on a larger scale: Do people who live in cities with high population densities have similar chances to enjoy the benefits of LEED certified spaces or does this chance vary based on the median income of the location of the certified spaces? Are there other factors that affect the accessibility of LEED registered spaces, such as educational levels, population density, occupational profiles, etc.? These questions can be asked from the perspective of the location of LEED registered projects: What are the factors that determine the location and the extent of LEED registered space?

While these questions are significant for determining why certain areas have more LEED registered space than others and why some people have better access to these spaces, the questions do not directly address the main research questions of this research. However, they possess the potential for leading to further research in green building certification, mainly opening up possibilities of identifying incentive mechanisms that determine the location and amount of LEED certified spaces. They also help clarify some of the social potential of LEED and how it can be improved in the future.

For this reason, although the constraints of this research limited the amount of effort that could be put into answering these questions, it was possible to develop a preliminary approach that to understanding the possible factors that affect LEED certification in a given location. Such an analysis cannot include all possible factors, such as levels of education, occupational profiles, business structure of locations or transportation services, but it can investigate the relationship between LEED certification and one or two a major variables by testing a simple model.

This research developed a regression model based on simple logic: If LEED projects meet the needs of social responsibility by providing better spaces for people, then accessibility to these spaces should not be related to the median income of a region but should rather be related to the population density of an area. In other words, it was expected that the amount of LEED certified or registered spaces (measured by total square footage) should increase as population density increases, but not with the median income of the region. This study excludes LEED Homes and focuses on the certification of office spaces. Certification of the office spaces has a particular case: being a business district or not can affect the number and total area of LEED registered projects significantly. For this reason, one can argue that median income is irrelevant to the total area of LEED registered spaces. However, such a statement would assume that business districts are the only spaces where people work and only the offices in these districts can obtain LEED certification. However, this is not true. In many mixed used regions, such as Astoria, New York, significant numbers of people work in small offices, groceries and workshops. Technically, most of these spaces are also suitable for pursuing LEED certification, but few of these small offices or shops are LEED certified. For this reason, people who work in these places cannot enjoy the benefits of LEED certified spaces. It is assumed that business districts would host residents with higher incomes and people who work in these districts would earn higher incomes than those who work in smaller businesses such as groceries, workshops, etc. For this reason, even though being a business district can be a significant variable affecting the total LEED certified office spaces this variable is not independent from the median income of that region.

Regression models were used to examine possible relationships between the square footage of LEED registered building space in one location and the median income and the population density of that location. If everyone within a city or state has fairly equal chance of using LEED registered spaces, the extent of LEED certified or registered building spaces (measured in total square footage) should not have a statistically significant positive relationship with median income. Accordingly, one would also expect that LEED certification would increase as population density increases, showing that in different regions the area of certified space per person does not differ significantly.

The data for this research task was collected from the LEED Project Directory, which was available through USGBC's website, from the U.S. Census Bureau (2013) and previous research conducted by Tan (2012). A revised version the USGBC data that was retrieved in April 2013 was no longer available at the time this research was completed in October 2013. The version of the directory published by USGBC at that time was missing fields such as zip code, address and building use, which were crucial for this research task. For this reason, the data retrieved in April 2013 was used.

The regression analysis was conducted at two different scales. First, data from New York State (NY) was analyzed and then the analysis was narrowed downed to New York City (NYC). The NY area was chosen for consistency with the selection of LEED certified case studies, three of which are located in NYC. For each project in the LEED Project Directory the zip code is disclosed, unless it is confidential. Therefore, the area defined by a zip code was taken as the unit of analysis. Then the data provided by USGBC was merged with the data from U.S Census to match median incomes with zip codes by using Tan's (2012) research.

A regression model was designed to predict the total square footage of the LEED registered buildings within a given zip code. Total square footage was used instead of the number of registration, since each registered project can serve different numbers of people depending on its size. The model assumes that the total area of LEED registration within a given zip code will change depending on population density and income level. It is expected that there are more registered buildings in urban districts, where population densities are high compared to suburban or rural areas because of the high concentration of office buildings in urban areas, which accounts for a significant portion of LEED certification.

Previous studies show that there is strong possibility for finding a positive relation between the median income of a region and the total area of LEED registration. According to leeduser.com, which is one of the major websites addressing green building related issues; there is an extra cost of building a new LEED certified building varying from 3¢ to 5¢ per square meter (LEEDuser, 2013). In return for this extra cost buildings gain better indoor environmental quality, higher efficiency of systems and deductions in the costs of resources. Both the extra costs of certification and the improvements also lead to higher building values and possibly higher rents for spaces with green building certification. According to recent research conducted by the Royal Institution of Chartered Surveyors, green buildings increase rents by 3 percent and building values by 16 percent (Andrea Chegu, Piet Eichholtz, & Kok, 2012). As a result of this premium it is expected that either these buildings will be constructed in locations with higher income, or they will eventually attract business and households with higher income, possibly accompanying to a gentrification effect.

Data collected from USGBC's *Public LEED Project Directory* and the US Census Bureau were used to find out if there is enough evidence to support these assumptions. For the associations between the zip codes and median income, Tan's (2012) results from his research were used. Data fields created by the aggregation of data from these three sources are presented in Table 4.7. Since three of the case studies are located in NYC, NY State and NYC were chosen for analysis, as two different locations with different scales. First set of analysis was conducted for the whole NY State and a second analysis was conducted for the New York City. The final data set was analyzed using regressions and GIS mapping. R-Studio was used for the regression analysis and ArcGIS10 was used for the GIS mapping.

The relationship between the total area of LEED registered space and median income and population density was analyzed by using three different regression models both for NY State and for NYC. Three variables were used for the regression analysis: (1) The total gross area of the LEED registered buildings, the dependent variable (y); (2) the median income of an area (x_1); and (3) the population density (x_2). Areas defined by the US Postal Zip Code were used as units of analysis. The relationships among these variables were tested through three models presented in Table 6.7. Model 1 and Model2 analyze the individual relationships of the total area of the LEED registered buildings with income and population density, respectively; and Model3 analyzes the relationship of the area with both income and population density simultaneously.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \qquad 4.1$$

Pearson's Product Movement Correlation was used to test the multicollinearity of the two variables. For the NY State area, the correlation between median income and population density is 0.1 at 95% confidence interval with a significance level of $p<0.001$. For the NYC area, the correlation between the two is -0.2, at 95% confidence interval with a significance level of p equal to 0.001. In both cases, the correlation between the two variables is acceptable and there is extremely strong evidence that the null hypothesis is not true, therefore these two variables can be used for the analysis.

The results are presented in Section 6.3. In addition to the regressions results, GIS maps comparing LEED certified space with the population density and median income levels are presented in Section 6.3. These maps are based on zip codes. Only for NYC a specific map was also prepared showing only the areas where median income is below $50,000 and population density is above 50,000 per square mile. This final map shows whether the amount of LEED registered space decreases in locations with low income and high population density. These locations are where larger groups of populations live in dense areas with lower levels of income; therefore even small improvements in the quality of spaces in these regions are expected to create important positive impacts in lives of significant numbers of people. For this reason these regions were given special attention.

Table 4.7 Data fields for LEED Certified Area-Income-Population Research in the NY State and NYC Areas

	Abbreviation	Variable
Zip code	Zip Code	
Median income	Income	x_1
Population density	Population density	x_2
Number of registered LEED projects	Number of registration	
Number of certified LEED projects	Number of certification	
Sum of gross square footage of registered LEED projects	Area	y
Sum of points achieved	Total points	

4.7 Trying Out New Indicators

Identification of which aspects of sustainability have received less attention from the building industry together with the identification of new indicators that could address aspects of sustainability in the future is a significant step towards expanding LEED. While this step will help LEED and other green building rating systems cover sustainability more fully, it is not possible simply to import indicators from other sets and include them in the LEED point system. This is not only because their units of assessment might, differ (LEED focuses on building projects whereas UN CSD focuses on communities and GRI focuses on organizations) but also because indicators imported from other sets might be useless for the building sector.

For this reason, all indicators selected for further investigation in this study were examined to determine if they would be applicable to the green building industry. This was done by determining whether the candidates for inclusion meet the following criteria:

1. **Framework:** Does the indicator fit into LEED's framework?
2. **Pilot Credits:** Is the indicator suitable to be proposed as a pilot credit?
3. **Access to data:** Is the necessary data to be used for the indicator accessible?
4. **Legal structure:** Do the requirements for the indicator comply with local and national laws?
5. **Market structure and the incentive problem:** Is there an existing incentive mechanism in the market to support the application of the indicator, or is there a possibility of creating one?

4.7.1 Framework

Sets of indicators are usually based on certain frameworks. These frameworks determine the characteristics and type of indicators to be included in the set and what type of relations will bind them together (a point system, guidelines, a system of required items, etc.). LEED has such a framework, which determines its boundaries, types of indicators it can include, its unit(s) of measurement, and the type of data it can use. In order operate coherently with the other credits in the point system, new indicators to be considered for inclusion in LEED as new credits should not conflict with LEED's framework

Three characteristics distinguish LEED's framework from other frameworks. First is the lifecycle approach it adopts: LEED employ's a lifecycle approach that is result oriented as different from many other sets of indicators which employ a European lifecycle approach. The second characteristic is timeframe: LEED employs a discrete timeframe as opposed to a continuous one. The certification process is a one-time event and is not repeated again for the same project; certifications are not renewed on a regular basis. The third distinguishing characteristic is the unit of assessment: LEED takes the individual building project as its unit of assessment whereas for other sets of indicator the unit of assessment can be organizations, cities, profit oriented institutions, trade activities, activities related to forestry, etc.

Details of these characteristics and how they apply to LEED are presented in Section 6.1 based on analysis of documents issued by USGBC and other LEED related institutions. Section 6.1 also sheds more light on how some indicators may fall short of complying with one or more characteristics that constitute LEED's framework. The 10 indicators that were selected for further investigation are analyzed in Section 6.1 and the findings from that analysis were used to determine if it is possible to introduce the new indicators into a future version of LEED.

4.7.2 Pilot Credits

The LEED Pilot Credit process, introduced by USGBC (2011a, 2013a, 2013b), provides a way to determine whether a new indicator is suitable to be a new LEED credit. For this reason the suitability of each of the 10 indicators to be a pilot credit was tested in order to determine their compliance with LEED's framework. Pilot Credits are the experimental credits USGBC members develop to improve LEED. These credits are presented under the *Pilot Credit Library* (PCL) section of USGBC's official website (2013a, 2013b). USGBC defines this library as "rating system development tool designed to encourage testing of new and revised LEED credit language, alternative compliance paths, and new or innovative green building technologies and concepts, through the collaboration and increased engagement of USGBC stakeholders and LEED users" (USGBC, 2011a). It functions as a feedback mechanism to receive comments from project team members about proposed changes in LEED, which USGBC presents as an essential part of a "more dynamic LEED evolution and innovation process". Pilot credits are evaluated based on this feedback by the Pilot Credit Library Working Group, who sends recommendations to the LEED Steering Committee for the final decision about accepting or rejecting credits.

USGBC defines three types of pilot credits: (1) alternative compliance paths to existing LEED credits and prerequisites; (2) new credit ideas; and (3) newly proposed prerequisites. The introduction of selected indicators from GRI to LEED falls into the second category since these indicators do not define an alternative path to an existing LEED credit nor can they be proposed as prerequisites, given the current structure of LEED.

PCL consists of 50 pilot credits at a time, which USGBC periodically changes on a rolling basis. USGBC offers LEED users the opportunity to test these credits. Project teams that wish to test a pilot credit are required to submit a feedback survey about the credits and the specific documents that are listed under the "submittal" section of each pilot credit. PCL also allows everyone from public to participate in the forum section and give feedback about the credits. Registering for pilot credits and using them for registered projects allows LEED users to obtain credits for innovation in design and/or operation (ID/IO), hence providing an incentive for project teams to support new credit options.

USGBC uses the feedback mechanism to evaluate pilot credits. This evaluation process is effective in deciding whether a pilot credit can become an actual LEED credit. USGBC lists six basic questions for this evaluation process:

1. "Are LEED project teams able to achieve and document compliance with the requirements of the Pilot Credit?
2. Does compliance with the Pilot Credit requirements yield outcomes that support its intent?
3. Does compliance with the requirements yield decisions that produce same/better/worse outcomes (environmental, social, economic) than would have otherwise been achieved? What evaluation criteria have been used to prove these outcomes?
4. Does compliance with the requirements spur market innovation or transformation? If so how?
5. Does compliance with the requirements have unintended or previously unforeseen negative consequences?
6. Does this pilot credit align with the overall direction and advancement of LEED?" (USGBC, 2011a, p. 3)

These six items are consistent with the survey provided on USGBC's website accessed on 04/23/2013. For each pilot credit proposed, the survey asks the project team to answer the questions above along with others addressing the appropriateness of the thresholds of the credit, appropriateness of the credit to be a prerequisite, applicability of the credit to the rating system used, applicability to the building type, benefits for the current project, cost/time/effort effectiveness.

For the pilot credit survey to be taken, registered project teams need to test the pilot credits on actual projects. Therefore, it is not possible to answer these questions for the GRI indicators selected for this study, unless they become pilot credits to be tested in actual projects. Nonetheless, these questions can be used as guidelines for proposing new credits to the LEED framework if restated. In addition to these six questions there are some other items required by USGBC for any new credit to be introduced into LEED. These items have to be submitted along with the new credit proposal (USGBC, 2011b). To conduct Research Task 7, these six questions and other USGBC required items to be submitted along with new pilot credit proposals were reorganized in the form of a checklist (Table 4.8).

Table 4.8 Pilot Credit Qualification Reduced Checklist

Pilot credit number and name
Pilot credit intent
Impact categories addressed:
Required Information
1. Are submittals and performance metrics clearly defined?
2. Are the resources clearly defined?
3. Is the credit applicable to at least one rating system and one project type?
4. Are there any resources provided to guest expert?
Required Qualification
1. Is the credit achievable?
2. Does the credit support the intent?
3. Does the credit lead to better outcomes in environment, society or ecology?
4. Does the credit support market innovation?
5. Does the credit align with the direction and advancement of LEED?
6. Is the credit effective in cost, time and effort?

Source: *Developed by this study based on the pilot credit requirements of USGBC*

In this research task, Task 7, the ability of the selected GRI indicators to fulfill the requirements in the checklist above was examined to decide whether they can be proposed for future versions of LEED. During the reorganization of the USGBC required items to prepare the checklist, some of the items were dropped out for several reasons: First, not all types of information listed by USGBC have enough discriminatory potential. For each indicator it is possible to submit a bio or CV and background information. Therefore it is not decisive whether a credit submitter has a bio or CV. Credit language is also non-discriminatory since it is the essence of any credit to be submitted, as no communication is possible without a credit language. Second, certain types of information require that credits be listed in PCL and be tested by project teams. For example conflict of interest for the submitter/guest expert is a type of information that is related to the person who is making the submission; therefore it is not possible to predict if such a conflict will occur by solely examining the credit itself. In a similar way, unintended or unforeseen negative consequences cannot be known unless the credit actually is tested by registered project teams. Therefore, these types of information could not be used in this study to evaluate if a credit can be suggested as a pilot credit. The checklist consisting of the reduced items presented in Table 4.8 was used to analyze the 10 selected indicators from GRI, which were grouped in two categories (labor processes and human rights).

4.7.3 Access to Data

The introduction of new sustainability indicators will be impossible if the necessary data does not exist. For example, if a new indicator is to be introduced to the building industry requiring use of building materials manufactured in socially responsible working environments, application of this indicator would be possible only if data about the social conditions of their manufacturing environment is available. There should also be clearly defined criteria distinguishing socially unacceptable working conditions from the acceptable ones. Even though the necessary criteria for such distinction is available, if countries where building materials are produced do not employ control mechanisms that monitor the application and fulfillment of these criteria, there would be no data to be used by this new indicator. However, in some cases it is possible to create an incentive mechanism to collect such data,by simply introducing a new indicator, similar to the LEED credit on responsible forestry that has been supporting the labeling practices of sustainable forestry. The viability of this option should be examined. Therefore, for each indicator analyzed, the possibility of collecting the necessary data and possible costs that will incur from additional data collection were examined in order to determine if that indicator could be introduced as a new credit to LEED.

4.7.4 Legal Structure

Compliance with local, national or international laws is another problem that might affect the applicability of a new indicator. Since LEED is an international rating system that has significant market share in many countries outside the US, this problem becomes even more important. For example, an indicator examining the ratio of unionized workers in a construction project and encouragement for increased employment of unionized workers would not apply in in regions where unionization is not legal. It might also create a bias in favor of regions where unionization is legal and has high unionization rates. Then projects in those regions could easily fulfill the requirements of this indicator while projects in the other region could not. The potential of such an indicator in creating positive incentives for the legalization of unionization in all regions cannot be ignored. However the viability of such an option needs additional investigation. For these reasons, each of the 10 indicators was examined based on their compliance with the legal structure in order to determine if they could be introduced into LEED.

4.7.5 Market Structure and the Incentive Problem

The last criterion considered in this research for determining the possibility of introducing a new indicator into LEED was its suitability to be supported by different incentive options. Some sustainability indicators automatically lead to such incentives by reducing expenses or increasing profitability in the long run. For example, previous research indicates a positive correlation between green labeling (such as Energy Star certification) and the market value of properties (Dermisi, 2009; Eichholtz, Kok, & Quigley, 2009; Fuerst & McAllister, 2011; Miller, Spivey, & Florance, 2008). Study conducted by Miller et al. (2008) shows that there is also a positive correlation between occupancy rates and green labeling. Their data from over 2000 non-Energy Star labeled and 643 Energy Star labeled buildings show that between the third quarter of 2004 and the first quarter of 2008 occupancy levels for Energy Star labeled buildings stayed approximately 2.5 points above the conventional buildings consistently. Throughout the same period, occupancy levels for LEED certified buildings were also higher than for non-certified buildings except during one quarter.

A similar example comes from a study conducted by Eichholtz, Kok and Quigley (2009) which shows that green labeled office buildings can create a premium on rent up to 6% and a premium on sale prices up to 16%. For an average size office building (where average size is calculated by using a control group of 7499 buildings) this can be equal to approximately a $329,000 annual rent increment and a $5.5 increment on the building value. However, such incentives are not always readily available for all types of indicators and they are not always easily visible to investors. Eichholtz et. al.'s (2009) study shows that the rent and price premiums for LEED certified buildings are actually due to their energy saving capabilities, since only Energy Star labeling is found to have statistically significant and consistent effects in the marketplace, whereas no such effect can be established between LEED certification and the market values of the buildings. According to these studies LEED seems to establish a linkage between certification and cost incentives through its energy related indicators. But similar linkages are also needed for the new credits; otherwise they might not get the attention of the building industry. Therefore, for each indicator examined, the possibility of finding similar incentive mechanisms was investigates. If there are no incentives readily available, the possibility of their creation is discussed.

CHAPTER 5

FRAMEWORKS AND BOUNDARIES
LEED vs. GRI: A COMPARISON

5.1 The World of Sustainability Assessment: Selecting a Benchmark

With the emergence of the concept of sustainability, efforts have been made to develop tools that will assess the sustainability of human activities and provide guidance to better practices. The sets of indicators that have been developed to do this are of two types: Industry specific and non-industry-specific. An industry-specific set of indicators brings measures that guide members of a specific industry towards the best practices of sustainability. LEED can be categorized in this group, as a voluntary rating system developed for the building industry.

The boundaries of industry-specific sets of indicators are limited to the needs of that industry and the indicators usually include technical guidance. In other words, how far measures will be taken to assess and mitigate the “upstream” (production process of a good or service, including labor, energy, raw materials, etc.) and “downstream” (post-production process of a good or service including marketing, sale, consumption, disposal, etc.) impacts of industry-specific activities is determined by the needs and technical environment of those specific industries. Many sets of indicators function as rating systems that introduce certain thresholds to be achieved and provide rewards, such as certifications, for those organizations that achieve these thresholds. Global Organic Textile Standard and Organic Exchange 100 which assess the compatibility of textile products with organic cotton standards, Forestry Stewardship Council which regulates the forestry and wood sectors and green building rating systems (LEED, BREEAM, Green

Globes, etc.) are examples of industry-specific sets of indicators. Since these are industry specific guidelines and rating systems, they differ significantly in terms of the problems they address and the measurement techniques they use. Although almost all of the industry-specific sets of indicators adopt the very basic definition of sustainability -the three bottom line approach-, they do not always address all the principles of sustainability such as environmental protection, use of environmentally friendly materials, protection of soil, fair distribution of income, resource conservation. Their focus points can vary significantly according to particular industrial processes they investigate such as cotton production or gold extraction. This makes it difficult to compare sets of indicators or to choose one of them as a benchmark to compare with LEED.

Sets of indicators that are non-industry-specific that span across all commercial, industrial and infrastructural sectors usually have a broader framework and many of them include indicators that address all three sectors of sustainability: economy, ecology and society. Non-industry-specific sets of indicators provide measures at a global scale that is applicable across all organizations and all regions. Their scope ranges from a single firm to a whole nation, including a variety of socio-economic structures such as neighborhoods, cities, countries or supply chains. Unlike the industry-specific ones, they do not always guide towards best practices but they mostly report on sustainability of the existing practices of their unit of assessment. Therefore, instead of introducing thresholds to be exceeded, they provide specific calculation methods that can help organizations or communities recognize where they stand in terms achieving sustainability in different processes such as education, environmental protection, health, economic growth. These calculation methods in these rating systems also help provide reliable data that can be used to create benchmarks and compare overall progress in achieving global sustainability. The United Nations Commission on Sustainable Development (UN CSD), the Genuine Progress Indicators (GPI), the Global 100 Most Sustainable Corporations in the World (Global 100) and reporting principles of Global Reporting Initiative (GRI) are examples of non-industry specific sets of indicators. While most of the non-industry-specific sets of indicators function as reporting guidelines, there are also ones that act as guidelines for best practices such as ISO 14000 which guides commercial organization's to manage their environmental footprint and to comply with environmental laws and *Fair Trade* which promotes a fair distribution of revenue among supply chains.

Sets of indicators also differ in terms of the time periods they focus. Sets of indicators that guide human activities according to certain best practices direct their focus to the future. They provide guidance for future actions of organizations and communities, provide instructions for mitigating negative impacts of goods and services and rate the performance of these activities based in meeting these guidelines. For example, LEED guidelines act as a set of instructions and thresholds for future building projects. Whereas reporting tools such as GRI focus only the past. They provide tools to assess success of past activities in complying with the principles of sustainability. For example, a green building ratings system such as LEED would address sustainable land use practices by directing a new construction project not to build by a wetland and require estimates for future impact of the project on biodiversity. However, reporting guidelines such as GRI would address the same issues by looking at the amount of wetland lost and the negative impacts on biodiversity that have already occurred.

While the industry-specific sets of indicators are important tools for pushing industries towards more sustainable practices, it is hard to use them for mapping fields that are being addressed by different tools of sustainability since they are too specific. The non-industry-specific sets of indicators provide a more general vision in terms of what fields of sustainability are of concern. Since their indicators are designed to address all three aspects of sustainability across different geographies and at different scales, they are more likely to give a general picture of possible topics to be addressed.

While the industry-specific sets of indicators are very significant tools for pushing industries towards more sustainable practices, they are not suitable for mapping the fields that are being addressed by different tools of sustainability, since they bring measures specific only to the building industry. However, the non-industry-specific sets of indicators provide a more general vision in terms of what fields of sustainability are to be concerned during sustainability assessments. Many non-industry specific sets include indicators designed to address each aspects of the TBL approach to be applied in different geographies at different scales. Therefore, they are more likely to give a general picture of possible topics to be addressed during sustainability assessment and to identify which of these aspects are missing in the building industry.

This study has compared four non-industry specific sets of indicators (UN CSD, GPI, GRI CRESS and Global 100) in respect to their units of assessment, their number of indicators and the differences in their scope and framework. The selection process of these four sets was described in Chapter 3. Below are the results of this analysis, which were used by this study to determine a benchmark to be compared against LEED. As described in Chapter 3, this benchmark was then used to identify the aspects of sustainability on which LEED can focus more and develop new credits to expand its scope.

5.1.1 Unit of Assessment

These four sets of indicators vary significantly in the scale of their units of assessment. The indicators of UN CSD and GPI were designed to analyze the sustainability of large communities, mostly at the size of a township or a city. They may well be applied to a whole country as well. Therefore their indicators focus on the level of achievement of major policies such as education, literacy rate, urbanization, employment rate. Global 100 and GRI, however, take organizations as their units of assessment. Global 100 focuses only on corporate firms, such as Novartis, Renault SA, and Motorola whereas GRI has a broader scope including both corporate firms and other organizations such as airport operators, construction firms, electric utilities, NGOs, food services. There are even cities (Melburne, AU; Penrith, AU and Fall River, US) that use GRI principles for their sustainability reports. Some of these reports include data about both the city government and the city itself, hence providing data at two different scales about the same topic.

The unit of assessment in LEED is the building project. The rating process in LEED is designed to provide information about whether a project is green or not. This information is mainly based on the data that is evident in the final project as built. Therefore impact of a building project on the environment, economy and society are measured only if these effects can be calculated by looking at the final product at the time of certification. LEED's focus is more on the downstream impacts of the projects (after construction) and less on upstream (before construction). For example, energy and water efficiencies of a building are among the major concerns of LEED. But the scope of measures on energy and water efficiencies mostly covers post-occupancy efficiency levels. These levels are estimated through building modelling by looking at the existing systems during the certification of the project and they account for a significant amount of points in LEED. However, energy and water efficiency of the manufacturing process of building materials account for a smaller amount of points and these issues are not directly addressed by an existing credit. Although credits under Materials and Resources section of LEED introduce measures that will reduce the amount of energy and water used during the manufacturing of building materials, there are no credits questioning the exact amount water and energy used for producing the building materials used in a project. But what LEED focuses is how efficient they are used once the building materials are purchased, and what strategies were developed to minimize the amount of new materials used, regardless of them being wood, concrete or steel; although manufacturing of each of these materials have significantly different energy and water intensities.

It could be argued that the right strategy would be to choose sets of indicators with similar units of assessment to be a benchmark for LEED. However, rating systems or guidelines that take buildings as their unit of assessments consist of other green building rating systems, which all address similar aspects of sustainability. This problem can be overcome by employing a set of indicators that focuses on the problems of the construction industry, that do not take single building projects as their unit of assessment. GRI CRESS (Construction and Real Estate Sector Supplement), which provides reporting guidelines specifically for the construction and real estate sector, meets this need since it gives guidance at the organizational level by employing a broader sustainability perspective, while still providing specific measures for the construction industry. Among the other sets of indicators, only Global 100 provides an assessment at a closer scale to LEED. However, as discussed below, its framework and scope are very different from the needs of the building industry and the number of indicators it provides is limited.

5.1.2 Number of Indicators

The four sets of indicators chosen for this research vary significantly in the number of indicators they include. GRI has 80 indicators, whereas GPI has 26; UN CSD has 98; and Global 100 has 16. The number of indicators alone cannot indicate if a rating system or a guideline is suitable to be a benchmark against LEED. Because, it is hard to make any assumptions about the scale of unit of assessment, scope or the framework of a sustainability rating system or a guideline only by looking at the number of indicators it has. A set with a few indicators might be addressing a vast number of problems if its tools of assessments are complex enough and if they include various types of data from different fields. Contrariwise, a set with many indicators may still address a very limited number of problems but give significant amounts of detail for the issues it covers. Hence, there is a tradeoff between the amount of information and the number of topics covered. Given the number of indicators, each new indicator will provide either a new piece of information about the topics that are already being covered or will address a new topic that is not being addressed yet. Therefore a rating system or a guideline with few indicators is expected to provide either detailed information about a few aspects of sustainability or to address different aspects of sustainability with less detail, but not both at the same time.

While a set with many indicators can provide more information, having a large number of indicators can also have disadvantages in terms of comparing results of different assessments. Putting results in a hierarchical order is easier if they are derived from a set with few indicators. For example, comparing only the GINI coefficient (the measure of statistical dispersion intended to represent the income distribution of a nation's residents, developed by the statistician Corrado Gini) of different countries is a quicker way of getting clear information about their income inequality and ranking them hierarchically than comparing the results derived from multiple indicators in a consistent way. Nevertheless, that simplicity comes with a price, which is the loss of significant information. Although GINI coefficient is a useful tool for comparing income inequality of different countries, it does not provide information about average household income level or access to resources. Therefore, two countries with the same GINI coefficient can differ significantly in overall income level, access to education and other determinants of quality of life.

Collecting useful information about the ecological, social and economic impacts of human actions usually requires more than one indicator due to their complicated and interrelated character. However, when the number of indicators increases, such comparisons become harder, even when they employ a point system. A well-known example of this problem are the older versions of LEED, which have been criticized for allowing their users to earn the same number of points for a very simple practice such as installing bike racks and a very complicated and expensive one, such as installing a high-efficiency AC system. For this reason, even with a points system that evaluates a result from different indicators and merges them into a single final result, this final result might still be lacking significant amounts of information. Therefore, before deciding to use a set of indicators, it is important to understand its framework, grasp the logic behind its point system (if there is any) and to know the strengths and weaknesses of the data that can be derived from that set of indicators.

Since this research aimed at comparing the comprehensiveness of LEED with another widely accepted list of metrics developed for sustainability benchmarking, choosing a set of indicators that addresses multiple aspects of sustainability was important. Instead of focusing on a limited number of issues such as impacts of buildings on environmental and human health, such a system should focus on all three aspects of sustainability, giving fairly equal emphasis to the economic, environmental and social aspects of sustainability. In order to achieve this, the benchmark system should have a sufficient number of indicators to address multiple different problems under each of these three aspects. By choosing a set of indicators with these characteristics, those aspects that are not addressed by LEED can be identified and different methods of assessing or reporting these aspects can be examined. For example, such a broad system with different indicators can address labor processes and human rights issues related to the construction process while also addressing environmental concerns such as CO_2 emissions. GRI, in this sense, is the best benchmark, the other sets of indicators either a have limited number of indicators or focus on a specific area despite their large number of indicators.

5.1.3 Differences in Framework and Scope

Indicators vary in their intended purpose and field of use. For example, GPI has an economically centered framework, which translates the sustainability related processes into monetary values and measures their final impact on the GDP of a county. Similar to GDP, GPI is also used to measure economic development but includes more variables, mostly those that have externalities such as crime or ozone depletion. While GPI provides a useful tool to compare the sustainability of the economic development of communities and countries, its framework is far from meeting the needs of the green building rating process.

The UN CSD has a similar framework to GPI's. It aims at providing guidelines for communities and countries that want to monitor the sustainability of their current state. For this aim, UN CSD provides a long list of indicators, spanning a wide area including education, human rights, pollution, biodiversity, oceans and economic development. While the variety of fields addressed by UN CSD makes it a candidate for being a benchmark against LEED, the scale of its unit of assessment is not suitable for the building industry. The measurement tools of UN CSD provide information that allows macro scale comparisons such as "proportion of terrestrial area protected, total and by ecological region" or "GDP per capita". While it can be used to identify the unaddressed aspects of sustainability, UN CSD's measurements tools are not suitable as examples of analyzing the impacts of a building project.

Contrary to UN CSD, indicators of Global 100 provide measurement tools that are easier to modify use in building rating systems. As a rating system developed to list corporate organizations based on their performance in achieving sustainability in their businesses, Global 100 addresses various aspects of sustainability including safety and security, wage equity, taxes, environmental footprint and transparency. However, it has only 11 indicators, which limits the detail of the information provided. For example, the only indicator on water productivity calculates total US$ sales divided by total cubic meters of water consumed. But, there are many other topics that can be examined to report on water efficiency such as total water withdrawal during operations, amount of recycled water, amount of wastewater treated, money spent on water treatment, etc. For this reason an indicator set having the qualities of Global 100 but with more indicators is needed for the purpose of this research.

As a reporting guideline helping organizations report their impacts on ecology, economy and society, GRI provides a long list of indicators that address various aspects of sustainability. The distribution of its indicators among these three areas is fairly even. Since it is a reporting guideline, not a rating system, GRI does not include thresholds that can determine if an organizational practice is sustainable. But they do give a description of tools for how organizations can assess the sustainability of their actions, some of which can be modified and used in the green building industry. The variety of indicators allows for collecting multidimensional information about many aspects of sustainability instead of summing up the results through single indexes. For example, pollution and waste management is addressed by ten different indicators, which look at number and magnitude of spills, amount of hazardous products imported, amount of water bodies polluted and so on. For these reasons, GRI was the best candidate to be a benchmark against LEED.

5.2 How do Sets of Indicators Differ in Addressing Sustainability?

The analysis of the four sets of indicators in terms of their units of assessment, number of indicators and their framework and scope showed that GRI is the best benchmark system for analyzing LEED. While these characteristics give a general view about the structure of these sets of indicators, they do not tell which parts of sustainability are addressed and how their indicators are distributed among these aspects. For this aim, further analysis was conducted to map out the distribution of indicators of each set across 30 different categories that represent different aspects of sustainability. Twelve other sets of indicators (rating systems, guidelines and building codes) from the building industry were included in this analysis. This allowed for depicting how sustainability assessment in the building industry differs from other approaches employed by GRI, GPI, UN CSD and Global 100. The analysis was completed by using the methods described in Section 4.3 and the categories presented in Table 4.2.

Results showing distribution of the indicators under categories are presented in Table 5.1. Percentiles for these normalized results were then calculated to develop a five-tiered hierarchy and a shaded map for the results to visualize the level of significance given to each category by each set, from light to dark (Figure 5.1). With this method, Figure 5.1 gives a picture of which aspects of sustainability are addressed more often or omitted by different systems.

Table 5.1 Distribution of Indicators Under Categories (%)

Categories	LEED NC	LEED EBOM	LEED ND	BREEAM	GR GLB	WBDG	ASHRAE 189	Int Gr. Bld. Code
Accessibility / Social Enhancement			10.91			5.03		
Acoustic Comfort				2.70	3.00	1.26	2.48	2.08
Commissioning / Management	1.82	8.18	6.36	10.40	4.80	0.63	2.48	7.50
Cultural Preservation			1.82					0.83
Daylighting	1.82	0.91	0.91			0.63	3.31	0.83
Economic Efficiency		0.91				6.29		
Energy Efficient Appliances				1.10			1.65	0.83
Energy Performance	20.00	19.09	4.55	14.50	25.00	2.52	8.26	5.00
Environmentally Preferable Materials	9.09	5.45	0.91	6.70	6.00	4.40	3.31	7.08
Environmentally Responsive Site Planning	12.73	8.18	22.73	14.60	11.50	5.66	9.92	7.92
Flexibility and Adaptability						5.66		
High Performance HVAC						1.89	14.05	12.92
High Performance Electric Lighting		0.91		0.50		1.26	5.79	2.92
High Performance Building Envelope						1.26	8.26	0.42
IAQ	9.09	4.55		5.60	10.50	5.66	10.74	6.67
Information Technology						5.66		1.67
LCC				4.80	4.00	2.52	2.48	
Plug Load Management								0.42
Pollution / Waste Production	3.64	4.55	2.73	12.20	7.00	1.89	7.44	1.25
Regional	5.45	3.64	3.64					
Renewable Energy	8.18	6.36	2.73	2.70	2.00	0.63	1.65	1.67
Safety and Security				1.90		23.90		6.67
Service Life Planning				2.60	0.20	2.52	1.65	3.33
Spatial Efficiency			5.45		1.00	8.18		1.67
Stimulating Architecture	5.45	4.55	5.45					
Thermal Comfort	2.73	0.91		1.90	2.00	1.26	0.83	
Transport	10.91	13.64	27.27	8.10	10.00	1.26	0.83	2.08
Visual Comfort				2.80	4.50	3.14	1.65	1.25
Water Efficiency	9.09	12.73	1.82	6.00	8.50	3.14	12.40	23.75
Water Quality / Health		5.45	2.73	0.90		3.77	0.83	1.25
Grand Total	**100 (pts=110)**	**100 (pts=110)**	**100 (pts=110)**	**100 (pts=110)**	**100 (pts=1000)**	**100 (n=160)**	**100 (n=129)**	**100 (n=201)**

Table 5.1 Distribution of Indicators Under Categories (%) (Continued)

Categories	CAL Green	ASHRAE AEDG	NBI ADG	MA Stretch	UN CSD	GPI	Global 100	GRI Cress	Building Sys Average	Other Sys Average	Overall Average
Accessibility / Social Enhancement					17.53	3.85	27.27	24.14	1.33	18.20	5.55
Acoustic Comfort	1.08	0.63							1.10		0.83
Commissioning / Management	4.30	5.06	8.57					2.30	5.01	0.57	3.90
Cultural Preservation									0.22		0.17
Daylighting	0.54	25.32	2.86						3.09		2.32
Economic Efficiency					20.62	46.15	18.18	6.90	0.60	22.96	6.19
Energy Efficient Appliances	1.61								0.43		0.32
Energy Performance	2.15		17.14	31.03	2.06		9.09	6.90	12.44	4.51	10.46
Environmentally Preferable Materials	8.60				2.06	3.85		1.15	4.30	1.76	3.66
Environmentally Responsive Site Planning	12.37	0.63	2.86		20.62	15.38		6.90	9.09	10.72	9.50
Flexibility and Adaptability									0.47		0.35
High Performance HVAC	9.14	25.32	25.71	10.34					8.28		6.21
High Performance Electric Lighting	3.76	16.46	8.57	20.69					5.07		3.80
High Performance Building Envelope	4.30	17.72	14.29	34.48					6.73		5.05
IAQ	14.52		5.71						6.09		4.56
Information Technology									0.61		0.46
LCC	1.61						9.09	3.45	1.28	3.13	1.75
Plug Load Management		3.80	2.86						0.59		0.44
Pollution / Waste Production	8.06				10.31	15.38	18.18	13.79	4.06	14.42	6.65
Regional					1.03			10.34	1.06	2.84	1.51
Renewable Energy	2.69	1.90	2.86	3.45	1.03				3.07	0.26	2.37
Safety and Security					5.15	15.38	9.09	18.39	2.71	12.01	5.03
Service Life Planning	4.30	1.90	8.57						2.09		1.57
Spatial Efficiency		1.27							1.46		1.10
Stimulating Architecture	3.23								1.56		1.17
Thermal Comfort	0.54								0.85		0.63
Transport	2.69				3.09			1.15	6.40	1.06	5.06
Visual Comfort	0.54								1.16		0.87
Water Efficiency	13.98				2.06		9.09	4.60	7.62	3.94	6.70
Water Quality / Health					14.43				1.24	3.61	1.84
Grand Total	**100 (n=187)**	**100 (n=159)**	**100 (n=36)**	**100 (n=30)**	**100 (n=97)**	**100 (n=26)**	**100 (pts=11)**	**100 (n=87)**	**100**	**100**	**100**

Table 5.2 Percentiles and Color Coding for Sets of Indicators

Percentile	Limit Value	Intervals	Color Coding	
20%	1.65	0 < % < =1.65	RGB 242/242/242	
40%	3.04	1.65 < % <= 3.04	RGB 191/191/191	
60%	5.76	3.04 < % < =5.76	RGB 128/128/128	
80%	10.88	5.76 < % < =10.88	RGB 89/89/89	
100%	46.15	10.88 < %	RGB 13/13/13	

Table 5.3 Percentiles and Color Coding for Averages

Percentile	Limit Value	Intervals	Color Coding	
20%	0.67	0 < % < =0.67	RGB 242/242/242	*
40%	1.64	0.67 < % <= 1.64	RGB 191/191/191	**
60%	3.86	1.64 < % < =3.86	RGB 128/128/128	***
80%	6.06	3.86 < % < =6.06	RGB 89/89/89	****
100%	10.42	6.06< %	RGB 13/13/13	*****

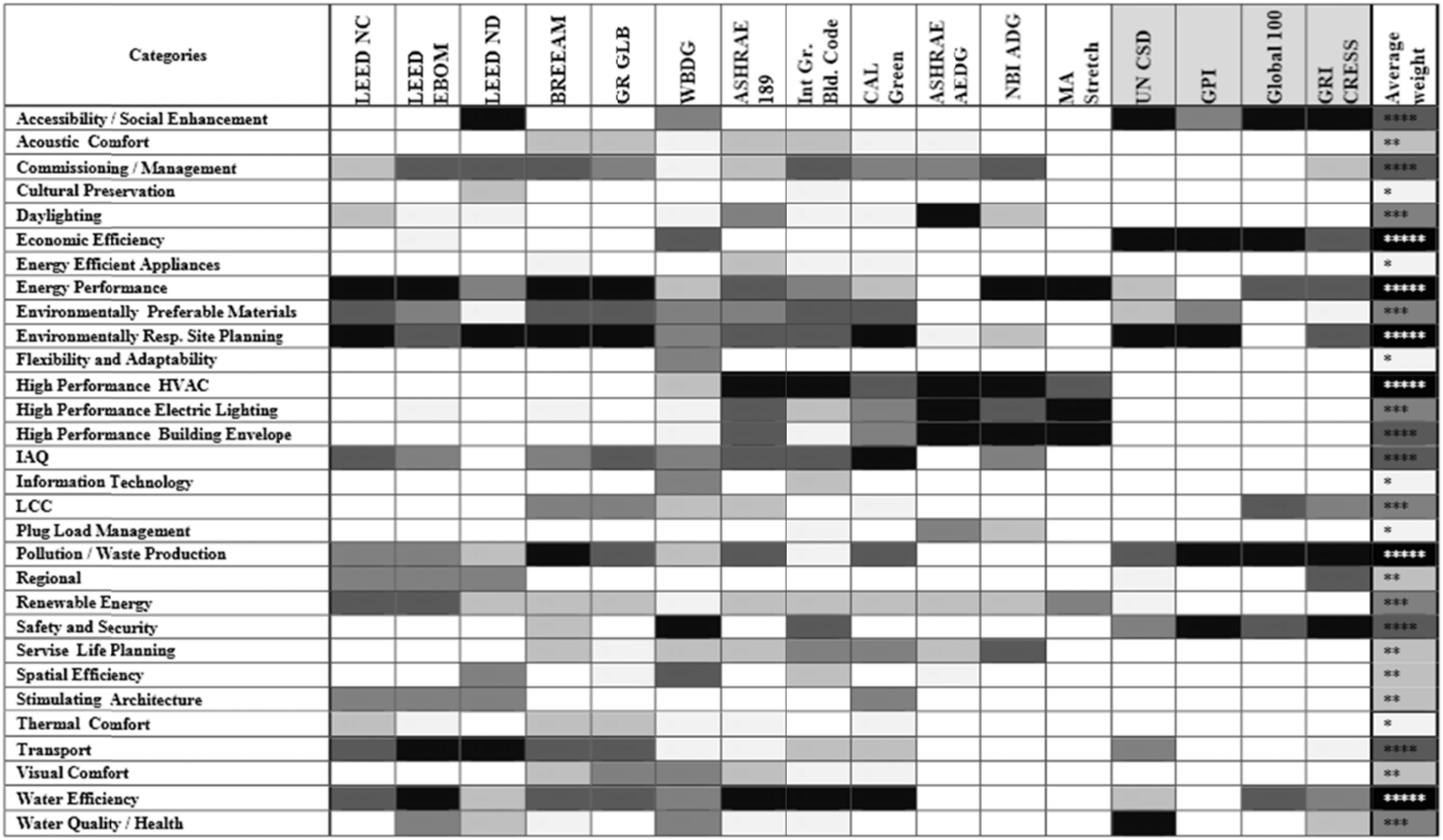

Figure 5.1 Color mapping of the distribution of indicators under categories.

Table 5.1 and Figure 5.1 show that among the 30 categories, six are addressed with an average weight equal to or more than 6.06%, meaning that at least 6.06% of all indicators or points (if it is a point system) within each set has addressed these categories on an average basis. These six categories are *economic efficiency* (6.2), *energy performance* (10.4), *environmentally responsible site planning* (9.5), *high performance HVAC systems* (6.2), *pollution/waste production* (6.7), and *water efficiency* (6.7). Except for *economic efficiency*, the other five categories address the environmental effects of construction practices. However, two points need to be emphasized before deriving any conclusion from these results. The first is that these results heavily represent the structure of the sets of indicators that are designed for the building industry. Only four of the 16 sets are out of the building industry. Therefore the six categories that have the highest 20% of weights mostly show how sustainability is being addressed through the building industry. The second issue is the differences among the scope of the categories. *Economic efficiency,* for example, has a much broader scope than *high performance HVAC systems*, allowing the former to include a wider variety of indicators than the latter. If the indicators under *economic efficiency* were to be split into subcategories, it might not qualify among the top six categories. But, despite the imbalance between the number of indicators in the building industry and others, and the differences in their scope, these results still provide valuable information indicating that a significant number of indicators address economic efficiency along with other efficiency concerns that mostly affect the environmental field, water, energy and HVAC systems. Site selection and pollution prevention are also mostly related to the environmental footprint of human actions, although site selection also includes some indicators that address community connectivity and proximity to dense living areas.

It is also important to identify the fields that are addressed the least by the 16 different sets of indicators. These are *cultural preservation* (0.2), *energy efficient appliances* (0.4), *flexibility and adaptability* (0.4), *plug load management* (0.5), and *thermal comfort* (0.6). Except for *cultural preservation*, all these categories are specific to the use and design of interior spaces. Use of energy efficient appliances and plug loads carry the energy management concerns beyond the building envelope and the large installed systems towards smaller systems over which users have more control. Thermal comfort is a semi-social category concerning the health and comfort of people living in closed spaces. Flexibility and adaptability is a topic that is both related to how closed spaces can be adapted to changes in time and also the degree of freedom that the users of these spaces have in changing their environment. Different from these categories, *cultural preservation* refers to the social assets of the former uses of a transformed space. These assets are the historical and cultural heritage of people, which can be both in the form of cultural imprints on the physical structure of spaces, such as monuments, shrines, gathering spaces or cemeteries, and intangible elements of a culture including language, rituals, or social values.

The general distribution of indicators across categories shows that a significant number of indicators address the environmental footprints of human actions, mostly in fields that are quantifiable such as energy efficiency, water efficiency, amount of waste/pollution produced. For the building industry, these fields also represent processes that are related to design and construction of the buildings, where project owners and designers have control. Consistently, processes that are harder to measure or that are related to the post-occupancy period are mostly omitted, such as plug loads, use of energy efficient appliances, thermal comfort or cultural preservation.

While analysis of the distribution of indicators provides some general conclusions, due to the above-mentioned problems, it is more useful to do this comparison between the groups of sets of indicators developed for the building industry and the other four sets of indicators. This can help reveal how sustainability concerns of the building industry differ from the other globally accepted sustainability assessment tools' definition of sustainability. This comparison shows that indicators in the building industry differ significantly from the others in six categories. These are *accessibility/social enhancement*, *economic efficiency, energy performance, high performance HVAC systems, pollution/waste production, and renewable energy.*

Accessibility/social enhancement has a very large scope including a variety of indicators that address how people gain access to resources and to human rights including the rights of building workers, ability of building users to access resources, rights to access social services and training programs for both building users and construction workers. Despite this large scope, only 1.33 of the total weight of indicators in the building industry is given to this category. LEED ND and WBDG are the only two sets from the building industry that have indicators in this category. While WBDG employs a narrower approach by focusing mostly on the accessibility for the disabled and elderly, LEED ND brings in a socio-economic perspective by addressing mixed-income and diverse communities, visibility and universal design, local food, neighborhood schools, access to civic and public service and access to recreational facilities. In this sense, LEED distinguishes itself from the other rating systems in the building industry by addressing the socio-economic integration of the building users with the rest of the community; hence pushing the borders of the green building concept towards the idea of "sustainable building design". However, the effectiveness of LEED ND stays limited, at least for now, as the proportion of projects that seek ND is comparatively low. Carrie, one of the interviewees, claims that this is because LEED ND is not applicable to every project and is also much harder to achieve due to its requirements and its relatively higher cost to complete. For these reasons, impacts of the positive improvements in ND in terms of addressing socio-economic perspectives through social enhancement and accessibility remains limited.

Unlike the building industry, *Accessibility/social enhancement* is the second most frequently addressed category in the other sets of indicators with an average weight of 18.2%. Among the four sets, GRI has the most indicators in this category, with 21 indicators. These indicators span a variety of topics including benefit plans and compensation for workers, lifelong training opportunities, anti-discriminatory policies, and prevention of unwanted forms of labor and customer satisfaction. Eighteen percent of the indicators of UN CSD are also in this category and address similar topics with a larger scope such as adult literacy rate, lifelong learning, and proportion of urban population living in slums. GPI and Global 100, which have fewer indicators in total also address this category but GPI has only one indicator which is *index of distributional inequality*. Global 100 has three indicators which are more investor oriented, aiming at providing information to the investors of a company about its transparency, equity in the share of compensation and leadership diversity.

Economic efficiency is at the top of the list of categories where the building industry differs from the other fields in addressing sustainability. While 23% of the indicators outside the building industry directly address this category, this number is less than 1% for the building industry. Although many energy and water efficiency indicators are related to the economic performance of buildings, in the building industry this aspect is explicitly stated only by LEED EBOM, IO Cr3: *documenting sustainable building cost impacts* and ten other indicators of WBDG. LEED IO Cr3 promote documentation of the costs before and after LEED certification, in order to assess the financial impacts of LEED certification. While helping building managers plan their future expenses and estimate future gains from LEED certification, IO Cr3 is not enough to develop a comprehensive economic analysis for building projects prior to construction and design. Indicators of WBDG are designed to achieve this. They guide development of a sound budget for building projects and assessment of financial resources, including consideration of financial alternatives, computation of economic performance, risk assessment and choice of proper economic technique for these calculations, hence defining an economic sustainability guideline for building projects, limited with the boundaries of the project.

Contrary to the building industry, economic efficiency has the highest percentage of indicators in the other sets. Half of the indicators of GPI and 20 % of the indicators of UN CSD fall in this category and they are designed to provide information about macroeconomic changes such as debt to GNI ratio, ratio of account deficit to GDP, cost of underemployment and net capital investment. These macroeconomic measures make most of the indicators that fall under *economic efficiency*, which are not very suitable to assess the economic sustainability of individual building projects either through their economic performance or their impacts on the economy of their surrounding neighborhood. Indicators from Global 100 and GRI, however, are more suitable as their units of measurement are single organizations. These indicators aim to provide information about the economic strength of organizations by looking at their tax liabilities, the economic value they generate, their readiness to climate change, turnover rate of the labor force and the amount of financial assistance they receive from the government. GRI contributes to this category with six indicators, providing a comprehensive perspective for those organizations that want to report on their economic sustainability, while the tools of Global 100 are limited to only two indicators.

Energy performance is another category where building indicators from the building industry differ from the others significantly. From the shaded map it can be seen that energy performance is a top priority of almost all sets of indicators serving the building industry. It should be noted that *High Performance HVAC, High Performance Electric Lighting* and *High Performance Building Envelope* are categories that also significantly affect energy efficiency. In many sets, such as LEED, indicators listed under these categories are actually listed under energy performance sections in their original guidelines. Combined with these categories, energy efficiency measures cover a large portion of the darker areas in the shaded map, especially under the 12 sets of indicators from the building industry. While *energy performance*, as an individual category, represents 12.4% of the indicators of the building industry, combined with these other three categories, it adds up to a total of 32.5%. For the other four sets, this sum is only 4.5%, most of which are the indicators of GRI and Global 100. GRI provides six indicators related to energy efficiency, guiding organizations to report their direct and indirect energy consumption by source, their initiatives and their achievement in saving energy and the energy intensity of the buildings they invest in, manage or trade (CRESS only). Indicators developed by the building industry to measure and improve energy efficiency not only make up almost one third of all the indicators available, they are also more comprehensive and detail oriented than the indicators of the other sets. Energy related indicators in the building industry either encourage project owners to exceed the benchmarks developed by building codes (e.g., AHSRAE) or guide them through specific methods such as installing economizers, duct insulation, zone controls, roof insulation, use of vestibules, etc. The share of energy performance indicators in the building industry follow a parallel pattern with the share of buildings from the overall energy consumption in the world, which is roughly 30%. This share even reaches 40% in the US. This parallel structure provides clues to the agreed perception of sustainability within the building industry, which significantly relies on conservation of energy and resources. Given that the major impact of buildings on the environment is through use of energy consumption and CO_2 emissions, this perception might be the outcome of a pragmatic approach that aims at prioritizing goals that will result in the greatest benefit in the shortest time period. This claim is also supported by some of the specialists who were interviewed for this research, who stated that green building rating systems first have to make energy efficiency a norm within the industry before heading towards other goals such as enhancing human rights and attaining social sustainability.

Pollution and waste production is another category that is represented with a much lower percentage (4%) of indicators in the building industry compared to the others

(14.4%). However this is not because there are not many indicators addressing this issue in the building industry, but because GPI and Global 100 allocate a significant amount of their weight to this field, despite the limited number of indicators they have. These indicators focus on waste production, carbon productivity, cost of emissions and ozone depletion. GRI and UN CSD also address this category with 22 indicators. They both require reporting the amount of waste and emissions in addition to initiatives towards water reduction. While UN CSD focuses on a macro scope, GRI focuses on waste production through organizational activities. Although indicators on waste, pollution and emissions constitute only four percent of the total weight in the building industry, 53 indicators in total address this issue. Refrigerant management, solid waste management and construction waste management are major problems covered by these indicators, representing the most prominent ways of waste production and emissions in buildings. Therefore, despite the low percentage, it is still possible to say that the green building industry gives significance to the reduction and management of waste and emissions.

The last category where there is a significant difference between the building industry and the other fields is *safety and security.* While 2.7% of the indicators in the building industry address this category, for the others this number is 12%. But the scope of safety and security varies significantly among different systems. The GRI indicators that were placed in this category address rates of injury, training programs about workplace safety, job security, social benefits and the number of agreements that cover health and safety topics. UN CSD and GPI provide macro scale measures for crime rate, bribery, vulnerability to natural hazards and family breakdown. The only three sets of indicators that address safety and security in the building industry are BREAAM, WBDG and International Green Building Code. All these indicators focus on the safety and security of building users, omitting safety and security risks that may emerge during the construction process. WBDG has 38 indicators that fall in this category, including prevention of occupational injuries (only for users, not construction workers), fire protection measures, incorporation of life safety codes, protection against natural disasters (earthquake, hurricane, flooding) and ballistic threats, such as random shooting, heavy rifles. The other two sets of indicators focus on similar topics but address fewer topics.

In LEED, safety and security issues are not directly addressed by any indicators; however some limited concern can be found in the credits for indoor air quality, which are listed under IAQ in this research. The absence of indicators of safety and security during the construction phase of a building project contradicts the high numbers of fatal injuries (738 incidents for 2011, equal to a rate of 9.1 per 100,000 full-time equivalent workers) and the lost days (14 days) in the US building industry (Bureau of Labor Statistics, 2012a). Given that green building projects have even 48% higher injury rates than conventional buildings (Rajendran, Gambatese, & Behm, 2009), the absence of indicators that address construction safety and security stands out as a problem to be considered by the green building industry.

While indicators help understand how different sets of indicators define sustainability through addressing different aspects of it, prerequisites show which of these aspects are *sine qua non* for sustainable design. Among the four sets of indicators outside the building industry, LEED and GRI have the most similar structure in terms of determining the basics of their definition of sustainability through introducing "must-achieve" indicators.

LEED defines prerequisites as the measures that applicants have to satisfy in order to earn certification. Projects that do not satisfy these prerequisites are not rated according to their degree of compliance with the other credits. GRI employs a similar approach through its "core indicators", but in a more flexible way compared to LEED. GRI defines core indicators as indicators that "have been developed in developed through GRI's multi-stakeholder processes, which are intended to identify generally applicable Indicators and are assumed to be material for most organizations. An organization should report on Core Indicators unless they are deemed not material on the basis of the GRI Reporting Principles" (GRI, 2011b). Therefore, unlike LEED, GRI leaves the possibility of skipping a core indicator open if enough documentation is provided showing that the indicator is not relevant to organization's activities, or its impact on overall sustainability.

Categories including LEED prerequisites or GRI core indicators are shown in Table 5.4 below. The distribution of prerequisites show that energy and water efficiency, commissioning, environmentally preferable materials and site planning, pollution prevention and IAQ are the prominent fields of focus in LEED's definition of green building. In other words, for LEED, it is not possible to be a green building without the proof of minimum performance achievement in each of these fields. While all three LEED systems share this common perspective, LEED ND expands these requirements by adding three more categories; those are *accessibility/social enhancement, spatial efficiency* and *transport*. Especially by adding NPD Pr2 *Compact Development* (here listed under *accessibility)* and NPD Pr3, *Community Connectivity* (here listed under *special efficiency)* as prerequisites, LEED ND carries the rating system beyond being an exclusively environmental impact assessment tool. By determining the minimum density within walking distance of the project and requiring open access to the surrounding neighborhood, these prerequisites promote land conservation and creation of livable and walkable neighborhoods that allow more daily physical activities. By doing so, LEED ND adds a new socio-economic perspective to LEED’s framework, helping it address previously omitted aspects of sustainability, especially accessibility and social enhancement. However, as mentioned above, the impact of LEED ND is limited compared to other tools such as NC or EBOM.

Compared to LEED, GRI’s core indicators follow a more balanced pattern which addresses each of the three major sectors of sustainability: economy, environment and society. Although GRI CRESS is not a building design guide or a rating system, many of the fields that contain LEED prerequisites are also addressed by GRI core indicators, except *IAQ*, *spatial efficiency* and *transport*. Among the categories addressed by GRI core indicators, *economic efficiency, accessibility/social enhancement, life cycle cost, regional* and *safety and security* are the ones where GRI differs significantly from LEED. Especially indicators for *regional* and *safety and security* address socio-economic aspects of construction including worker safety, contribution to regional development, local hiring, preservation of local communities and cultures and recognition of direct and economic impacts. While GRI brings a more flexible approach in terms of mandatory indicators, its core indicators establish a more balanced relationship among social, economic and environmental aspects of sustainability, by requiring organizations to report on all of these three sectors as much as possible.

Table 5.4 Number of LEED Prerequisites and GRI Core Indicators

Categories	LEED NC	LEED EBOM	LEED ND	GRI CRESS
Accessibility / Social Enhancement			1	13
Acoustic Comfort				
Commissioning / Management	1		1	2
Cultural Preservation				
Daylighting				
Economic Efficiency				5
Energy Efficient Appliances				
Energy Performance	1	2	1	5
Environmentally Preferable Materials	1	1		1
Environmentally Responsive Site Planning	1		5	3
Flexibility and Adaptability				
High Performance HVAC				
High Performance Electric Lighting				
High Performance Building Envelope				
IAQ	2	3		
Information Technology				
Life Cycle Cost				3
Plug Load Management				
Pollution / Waste Production	1	2	1	10
Regional				8
Renewable Energy				
Safety and Security				11
Service Life Planning				
Spatial Efficiency			1	
Stimulating Architecture				
Thermal Comfort				
Transport			1	
Visual Comfort				
Water Efficiency	1	1	1	2
Water Quality / Health				
Grand Total	**8**	**9**	**12**	**63**

The results of the comparative analysis of 16 sets of indicators and the color coded shaded map show that the various sets of indicators developed for the building industry follow similar patterns while they differ significantly from the other four in terms of scope, definition of sustainability, unit of measurement and measurement techniques, and aspects of sustainability they address. Below is a summary of these findings:

1. Most of the indicators or the points made available by the sets designed for the building industry prioritize energy conservation measures either directly by addressing energy efficiency or by guiding ways to improve energy efficiency such as installing high performance HVAC and lighting systems, building retrofits, high performance building envelope with increased insulation and better fenestration.
2. While internationally accepted green building rating systems target energy efficiency by defining certain thresholds for baseline building systems, building codes and guidelines such as ASHRAE, NBI Advance Building Guideline or International Building Guide do this through indicators that deliberately describe the specifics of improving energy related systems such as HVAC, electric equipment, lighting and building envelope.
3. Sets of indicators outside the building industry also address energy efficiency, however not by introducing indicators specific to the energy related systems but by addressing the energy intensity per amount of production, square footage or per person. They also address initiatives established by organizations or bodies of government that aim for energy efficiency.
4. Energy efficiency, environmentally responsible site selection, environmentally preferable materials, pollution/waste prevention and water efficiency constitute the fields where the building industry and other sets coincide. While categories that are specific to the building industry, such as IAQ, commissioning, HVAC, lighting and electrical systems are addressed only by the indicators of the building industry, socio-economic fields including accessibility/social enhancement, economic efficiency, cultural presentation and safety and security are mostly represented by indicators outside the building industry.
5. Some other categories that are also an important component of sustainable building and spatial design are underrepresented in both groups of indicators. These categories are flexibility and adaptability, information technology, service life planning, plug loads and energy efficient appliances. In addition to this, despite its popularity in sustainability discussions, renewable energy is among the underrepresented categories as well, with a percentage of 2.37.
6. Among all other sets of indicators in the building industry, LEED has the greatest potential to address socio-economic aspects of sustainability, especially through the indicators introduced by LEED ND. However, the impact of ND is limited compared to other LEED tools.
7. Among all sets of indicators that are not designed for the building industry, GRI and UN CSD provide the most balanced distribution of indicators by addressing economic, environmental and social aspects of sustainability with a rich number of indicators that provide significant amounts of details for various aspects of sustainability. GPI, however, limits itself to an economic framework by interpreting the externalities of human actions as economic costs. Global 100 provides a more balanced framework but with a very limited number of indicators (11) and strictly defines its boundaries to the corporate business sector.

8. Among all sets of indicators not designed for the building industry, UN CSD and GPI employ a macro scale unit of assessment such as neighborhoods, cities or countries, whereas GRI and Global 100 focus on micro scale assessments limiting their boundaries to individual organizations. However, as a reporting guideline, GRI has the flexibility of being applied to different scales from small firms to NGOs and even cities. Three cities have already reported on sustainability by using the GRI principles: Melburne (AU), Penrith (AU) and Fall River (US).
9. Among all the sets of indicators examined, LEED and GRI follow a similar path in terms of defining the *sine qua non* of the sustainability assessment in their own field through defining prerequisites or core indicators. While LEED's prerequisites mostly remain at the border of environmental sustainability except for LEED ND, GRI requires organizations to report on all three sectors of sustainability.

The above results of the analysis of 16 sets of indicators show that GRI is the best benchmark to study LEED in order to determine which aspects of sustainability are omitted by LEED and to seek possible ways to improve LEED to better address sustainability. One of the most important characteristics of GRI that makes it suitable for this comparison is its ability to address many different aspects of sustainability by providing a rich variety of indicators that cover different topics related to a single aspect. For example, different GRI indicators address health and safety related issues such as those examining the rate of injuries in a workplace, total hours of training on safety issues and health and safety issues covered by trade union agreements.

The scale of assessment of the indicators in GRI is also best fitting to the needs of the building industry, which takes single buildings or neighborhood development projects as their unit of assessment. As a flexible reporting tool that is designed to guide organizations in reporting their sustainability, GRI provides a different vision to the building sector on how each project can be assessed based on their impact not only on the environment but also on the economy and society. In that sense, each project can be though as an organization which has limited lifetime, instead of being permanent. Besides

GRI, this possibility only exists in Global 100. But its limited number of indicators and its inflexible framework designed to compare corporate firms would not satisfy the needs of the building industry.

Last, GRI has industry specific modules that can provide tailored reporting guidelines for different industries. GRI CRESS, which is designed for the construction and real estate sector, is one of them, including eight new indicators that specifically target the needs of the building industry, with indicators such as energy intensity, compliance with international health, management systems and the amount of land remediated or the number of people who are displaced due to construction. For these reasons, GRI was selected to be the benchmark set of indicators to be compared with LEED and to determine possibilities for improving the green building rating systems.

Before comparing these two sets of indicators and providing a deeper analysis of the aspects of sustainability that are addressed by both sets, it is important to gain a deeper view about their frameworks, the philosophy behind them, their scope and the assessment techniques they employ. This will also allow an understanding of why certain aspects are omitted or emphasized in both sets and to see if it is possible to address these fields as well.

5.3 LEED

5.3.1 Origins of LEED

U.S. Green Building Council (USGBC) has been established in 1993 with the major goal of developing a system that will define and measure green buildings. The founding committee was consisted of architects, real estate agents, a building owner, an environmentalist and industry representatives (USGBC, 2009a). The first version of LEED v1 was launched in 1998. Until LEED 2009, LEED has largely addressed new construction commercial buildings. In 2008, Green Building Certification Institute (GBCI) was established as a separate entity from USGBC, in order to manage the certification process and accreditation exams.

USGBC defines LEED as a "document intended to transform the way people practice design, construction, and operations of buildings and is written by the people it is transforming." It is a "voluntary, consensus-based tool which serves as a guideline and assessment mechanism for the design, construction, and operation of high-performance, green buildings and neighborhoods" (USGBC, 2009a, pp. 1,2). This definition assigns LEED an active role of shaping the urban space and the building market. Therefore, LEED promises more than just serving as a passive audit tool that rates sustainability of building systems, but it designates itself as a subject that actively interferes with the transformation of the urban space. This is also parallel with USGBC's mission stated in the *Foundations of LEED*, which is "to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life" (USGBC, 2009a, p. 1).

5.3.2 The Sustainability Approach in LEED

USGBC defines LEED's mission as to "encourage and accelerate global adaption of sustainable and green building and neighborhood development practices". There are three premises that can be derived from this definition:

1. LEED is a global rating system
2. It distinguishes "sustainable" from "green"
3. Its scope includes transformation of neighborhoods as well as building systems.

Responsible use of natural resources, regenerative and restorative strategies (of the ecology), environmental and human health impacts of the building industry and provision of high quality indoor environments are the main concerns that describe the scope of LEED. Although socially responsible building design is not included in this scope, USGBC lists this as the first item of the strategic goals of LEED: "promote the tangible and intangible benefits of green buildings, including environmental, economic, human health, and social benefits over the life cycle of buildings" (USGBC, 2009a, p. 3). This statement not only allow the possibility of developing building rating indicators that will address the socio-economic effects of the buildings, but it also draws the borders of building assessment along with the lifecycle of the building, which may cover a timeline beginning with the extraction of raw materials till the demolition of the building, based on a cradle-to-grave lifecycle approach.

USGBC lists achievement of sustainable cities and communities among the strategic goals of the institution, without deliberatively defining sustainability. Given the generally accepted definition of sustainability, as discussed in the earlier chapters, a sustainable city is expected to promise an economic growth, while protecting the natural resources and enhancing the social structure. Therefore, unless restrictively redefined by the USGBC, designating the achievement of sustainable cities as a goal of LEED allows consideration of job creation, social equity, educational opportunities, human rights issues, cultural preservation, labor processes and community connectivity within the scope of LEED.

The integrated and international structure of sustainability make inclusion of these aspects within the green building rating systems more of a need, than just a choice. The aforementioned environmental crisis in Ghana (Estes et al. 2011) shows that the success of policies towards sustainability is related to the success of regulations bringing environmental regulation in line with the socio-economic needs and consumer preferences. Without regulating the European fish-market and informing the consumers about the lifecycle effects of the fish they buy, in other words, changing the demand structure for the fish that is brought from Africa, the success of the attempts to protect the natural environment of the Ghana region will be limited. In a similar fashion, it is likely that a socio-economically weak urban structure, where manufacturing or building industry is dominated by non-unionized, illicit, cheap labor will undermine the attempts of creating an environmental friendly economic structure where ecological concerns are high and people avoid from environmentally-unfriendly economic activities. One reason for this possibility is the positive relationship between the income and education levels, and the environmental consciousness of people (Shen & Saijo, 2008).

The other reason is the relationship between social equality among different groups of society and environmental degradation. Based on the data collected from more than 1000 different locations all over the world including both urban and rural, Torras and Boyce (1998) find that increased power equality in the society leads to decreased pollution. Their study finds statistical support for their hypothesis that greater equality in the distribution of power among the society leads to lower levels of pollutions. They define power as a function of per capita income, income inequality and non-income determinants. Their hypothesis is based on the assumption that political power is related with income and higher income groups are more likely to benefit with highly polluting activities than the lower ones. Therefore in societies where power is distributed unequally, social group who have higher power will be more likely to support polluting activities, unless counter measures are taken to balance this power relationship. In addition, their study also finds that literacy, in other words educational level, is negatively related with the levels of pollution as well (Torras & Boyce, 1998).

Therefore creation of sustainable urban spaces necessitates a comprehensive approach which regulates not only the end-user effects of urban architecture, but also shapes and improves the socio-economic structure of the urban space, where income inequalities are reduced, educational level of people are increased and power disparities among different groups are reduced in favor of those who are negatively affected from environmental degradation. Studies listed above shows that creation of sustainable urban spaces necessitates development of a global approach which can support sustainable practices in multiple geographies, while regulating the local construction activities. This approach is consistent with LEED's framework which claims to be global rating system that aims at helping build sustainable cities.

5.3.3 The Framework of LEED

In order to understand how LEED addresses sustainability and why it focuses on certain issues while leaving others out it is necessary to look at the framework behind LEED. USGBC states that LEED is a market-driven rating system. LEED not only aims at transforming the building market towards greener practices but also considers the needs of the market (USGBC, 2009a). Credits in LEED are developed and brought together with respect to the needs and potential of the building market. Therefore, the framework behind LEED cannot be considered independent from the demands coming from the building market.

This idea was supported by one of the interviews conducted for this research. Arthur, who is a senior associate principal in a LEED consulting company in New York, has explained that the political structure behind LEED is not independent from the building market, but is a consequence of the needs of the building industry. The current structure of the rating system, he states, is a political choice more than a technical necessity and this political choice was made to serve the immediate needs of the industry. Being someone who has contributed to several stages of LEED's evolution, he mentions two different approaches that LEED could have followed:

1. Result oriented approach based on the end-user results
2. European lifecycle assessment model based on the lifecycle of supply chains

Arthur reported that USGBC has pursued for the first option: it decided to develop a rating system with which a robust, standardized certifications can be provided within the shortest amount of time possible. Therefore, an extended lifecycle perspective was omitted LEED's framework, where the scope is limited to the physical boundaries of the building project. According to him, the borders of this scope end where the required data to achieve the credits are not evident in the final composition of the product. That is, the majority of the credits in LEED are designed in a way that after the certification a third party can verify the validity of the certification by testing existing features of the building.

This approach differs from the European lifecycle approach by leaving the processes that are not evident in the final product out of the certification process. The European approach takes each element of a supply chain into consideration in order to calculate the final impact of a good or a service. Therefore, from extraction to the end-user, impacts that occur during each step of the lifecycle of a good or service is calculated, including transportation of materials, manufacturing, transportation of the workers to their workplace, marketing activities, buildings and other operational activities. The final result is calculated as the summation of all these impacts. Carbon footprint is a good example of this approach, where the carbon production of each element of a lifecycle is summed to give a final result showing how harmful a single product is for the environment.

Nevertheless, as Arthur emphasizes, LEED employs a result-oriented lifecycle approach, compatible with the standards of the American National Standards Institute (ANSI). In this approach the lifecycle impacts of materials and operations are measured only by using the information evident in the final product. The carbon footprint of a building, then, is not calculated through summation of carbon emissions at each level of production and transportation, but it is calculated by looking at estimates of carbon emissions a building will produce over its lifetime. This does not mean that LEED ignores emissions that occur during the production and transportation of materials, on the contrary it forms the whole Materials and Resources section in consideration of emissions; presenting building projects with different ways to reduce their indirect emissions with the use of local products, recycled content and material reuse. But the actual carbon emissions that occur due to the use of these materials are not calculated as they would be in GRI. Another example for this difference is the consideration of use of volatile organic compound (VOC) in building materials. For example, LEED considers whether a surface contains VOC or not, however it does not question whether any VOC was used during the *production* of that surface. These differences between lifecycle assessment approaches are presented in Figure 5.2.

According to Arthur, choice of result-oriented lifecycle approach by USGBC as the basis of LEED's framework might lead to significant areas of sustainability to be ignored, but he added, this was necessary to preserve the intellectual consistence of the rating system. This is also not a total rejection of the lifecycle approach. Indeed LEED does refer to lifecycle assessment in its own documents but, Arthur emphasized, the lifecycle data is considered only if it is evident in the final product. Therefore, unless this very basic principle of LEED is changed, any credit proposed would require collecting data on only those features that are evident in the final product. Whether this can be changed remains as a question to be answered by the political structure behind LEED, mainly the building industry and USGBC. According Arthur, such a change requires scrapping the existing LEED framework and rewriting the entire system. Even though changing this principle is technically possible, it requires the time and resources provided by USGBC and the industry. Arthur said, such change could be possible in 2020 version of LEED, but not prior to that.

As a green building rating system LEED not only rates existing building practices but also guides building projects by introducing a list of best practices. In this way, it becomes an actor in the green building industry, an agent of urban transformation. LEED's point system proposes a list of credits projects can achieve to earn different certification levels (certified, silver, gold or platinum). While certifications help projects get public recognition as green buildings certified by an international third party, the certification levels are also useful as benchmarks for other decision processes in the building market including financial incentives for green buildings and minimum requirements for government buildings. A wide range of incentives and requirements are currently made available by different local governments all over the U.S., including tax credits, density bonuses, grant funding, green building funds, and mandatory regulations to achieve certain credits or certification level for new construction (USGBC, 2009d). A significant number of incentives are provided by local governments for achieving high energy efficiency levels, which make up to 35% of the LEED points available. Therefore the credits provided by LEED guidelines and projects owners' choices of credits to be followed are related to the incentives available in the market and to government requirements.

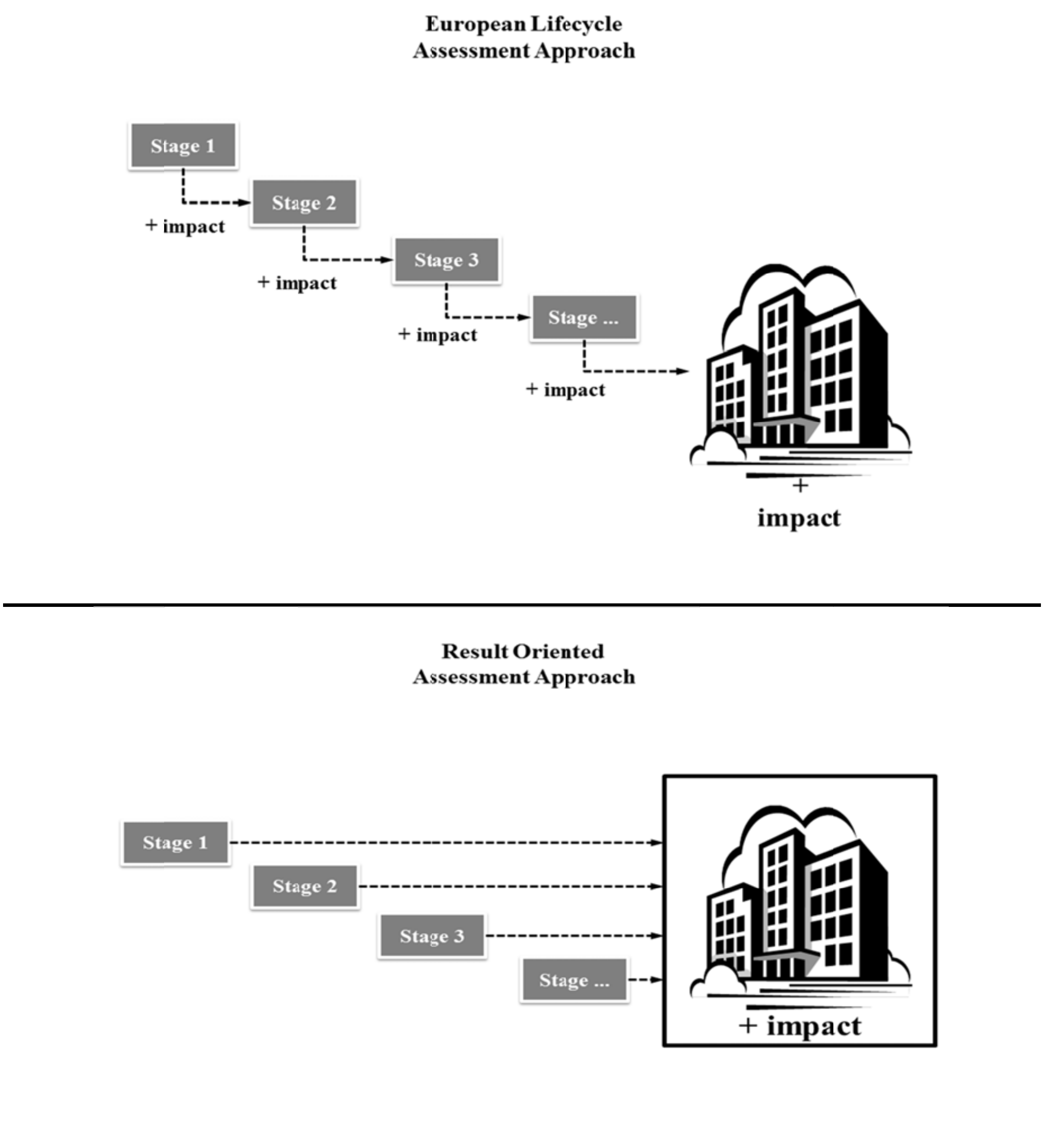

Figure 5.2 Different lifecycle assessment approaches.
Source: *Interviews conducted for this study.*

5.3.4 Weighing the LEED Credits

Credits in LEED 2009 are weighted based on the environmental impact categories of EPA's TRACI, Tool for the Reduction and Assessment of Chemical and other Environmental Impacts. The weightings developed by the National Institute of Standards and Technology (NIST) are also taken into consideration by LEED (USGBC, 2009c).

TRACI is a computer software tool developed by EPA "for the reduction and assessment of chemical and other environmental Impacts, to assist in impact assessment for sustainability metrics, life cycle assessment, industrial eco logy, process design, and pollution prevention" (EPA, 2013). EPA states that "TRACI's impact categories are not comprehensive, but have been selected to represent many of the recognized environmental issues of our time" (EPA, 2003, p. 3). However, unlike EPA, USGBC claims that TRACI is a comprehensive tool, which is readily available as a complement to LEED and suitable for the North American building market (USGBC, 2008). These categories were then weighted by NIST. In a report distributed by the Technology Innovation and Field Services division of EPA (CLU-IN, 2008a), the weighted categories are presented as follows:

1. Greenhouse gas emissions (29%)
2. Fossil fuel depletion (10%)
3. Particulates (9%)
4. Human health-cancer (8%)
5. Water use (8%)
6. Ecotoxicity (7%)
7. Land use (6%)
8. Eutrophication (6%)
9. Human health-non-cancer (5%)
10. Smog formation (4%)

11. Indoor air quality (3%)
12. Acidification (3%)
13. Ozone formation (2%)

Association of these categories to LEED credits and final allocation of points among the credits are described in various documents with slight differences (CLU-IN, 2008a, 2008b; USGBC, 2008, 2009c, 2010). Based on information provided by these documents, the steps of categorizing and weighting LEED credits can be summarized as follows:

1. Building impacts are estimated with a building prototype. Documents issued by USGBC and EPA emphasize that development of scenarios based on building prototypes constitute the origins of the weighting system. Different scenarios can change the weightings. A variety of possible scenarios were reviewed by the LEED Steering Committee for this aim. The prototype was "defined by the characteristics of its location, utility, proximity to mass transit, population density, materials used, and contribution to climate change" (USGBC, 2008).
2. These impacts were associated with the TRACI impact assessment categories that are listed above, by determining which impact category is being affected by each impact.
3. Points are distributed for each credit groups ("activity groups" as LEED calls them) and scores are adjusted within the groups. These "activity groups" represent how the LEED credits are being grouped, where each category represents a section which original LEED documents call as "topic". Those groups/topics are Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), and Indoor Environmental Quality (IEQ). There are also two more groups that allow getting extra points which are Innovation and Design (ID) and Regional Priority (RP) credits. These groups are then associated with related TRACI impact categories to readjust the allocation of points. ,
4. Individual credits are assigned points based of the data on building impacts on environmental and human health.
5. These points are readjusted according to their relationship with the weighted TRACI impact categories and thus final points are issued, which will add up to 100, excluding ID and RP.

Although LEED 2009 Credit Weighting (CLU-IN, 2008b) states that success in green building practices is expected to contribute to solutions to social, economic and environmental problems the weighting process indicates that building impacts on the social and economic aspects of sustainability are not included in the LEED point system, except human health. The TRACI impact categories, which define the boundaries of LEED's point system, limit LEED's focus to the environment and human health. The emphasis on greenhouse gas emissions and fossil fuel depletion (39% in total) is consistent with the current structure of LEED NC and LEED EBOM, where 35% of the points are available under Energy and Atmosphere.

It can be argued that greenhouse gas emissions and fossil fuel depletion affect socio-economic aspect by leading to several outcomes such as increased energy and investment risks, depletion of vital resources for humans and increased political risks due to scarcity of resources. This indeed is an inevitable consequence of the interrelated character of different aspects of sustainability. However these impacts represent an indirect relationship between human actions and outcomes, whereas there might also be direct impacts of buildings on socio-economic aspects which are measurable as well. Those, as summarized in previous chapters, include contributions to the local economy and communities, enhancement of the local labor structure, promotion of a building market which supports labor security and welfare of the workers and direct measures of the life cycle of buildings including the extraction and production of building materials. While exclusion of these aspects align with USGBC's efforts to keep LEED's structure consistent with the boundaries driven by TRACI categories, promotion of economic and social benefits over the life cycle of buildings are among the explicitly defined strategic goals of LEED (USGBC, 2009a).

However, in a 2012 document regarding the LEED 2012, a proposed new version of LEED, USGBC has disclosed that the point weightings will no longer be based on TRACI impact categories, but they will be based on different frameworks including "David Suzuki Foundation, World Resources Institute, 7Group, U.S. EPA, World Business Council for Sustainability, NRDC, Greenpeace, Sierra Club, ReCiPe, Hannover Principles, and Cradle to Cradle" (USGBC, 2012b, p. 2). Without giving further details, USGBC states that commonalities in meta-categories of these frameworks were selected by the LEED Steering Committee with regard to the question: "What do we want LEED buildings to accomplish?" A list of focus areas of these frameworks is given in Table 5.5.

Table 5.5 shows that a majority of the issues addressed by these frameworks falls into the category of environment. However, some frameworks presented in Table 5.5 also include socio-economic issues within their goals or principles, such as building communities (DSF); governance, empowerment of people, harnessing markets, expanding economic opportunities and reducing poverty (WRI); and social fairness (C2C).

Table 5.5 Frameworks and Principles Used in LEED 2012

Institution	Principles
David Suzuki Foundation (DSF)	• Protecting our climate • Transforming the economy • Protecting nature • Reconnecting with nature • Building community
World Resources Institute (WRI)	• Climate Protection: Protect the global climate system help humanity and the natural world adapt to unavoidable climate change. • Governance: Empower people and strengthen institutions to foster environmentally sound and socially equitable decision-making (includes reducing poverty). • Markets & Enterprise: Harness markets and enterprise to expand economic opportunity and protect the environment. • People & Ecosystems: Reverse rapid degradation of ecosystems and assure their capacity to provide humans with needed goods and services.
Hoonover Principles	• Insist on the right of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition. • Recognize interdependence. • Respect relationships between spirit and matter. • Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist. • Create safe objects of long-term value. • Eliminate the concept of waste. • Rely on natural energy flows. • Understand the limitations of design. • Seek constant improvement by the sharing of knowledge.
7Group	• Integrative design
US EPA	Ensure that, • Americans are protected from significant risks to human health and the environment • national efforts to reduce environmental risk are based on the best available scientific information; • federal laws protecting human health and the environment are enforced fairly and effectively; • environmental protection is an integral consideration in U.S. • all parts of society have access to accurate information sufficient to effectively participate in managing human health and environmental risks; • environmental protection contributes to making our communities and ecosystems diverse, sustainable and economically productive; • the United States plays a leadership role in working with other nations to protect the global environment.
World Business Council of Sustainable Development (WBCSD)	• Incorporating the costs of externalities, starting with carbon, ecosystem services and water, into the structure of the marketplace; • Doubling agricultural output without increasing the amount of land or water used; • Halting deforestation and increasing yields from planted forests; • Halving carbon emissions worldwide (based on 2005 levels) by 2050 through a shift to low-carbon energy systems; • Improved demand-side energy efficiency, and providing universal access to low-carbon mobility.
Natural Resources Defense Council (NRDC)	• Curbing Global Warming and Creating the Clean Energy Future • Reviving the World's Oceans • Defending Endangered Wildlife and Wild Places • Protecting Our Health by Preventing Pollution • Ensuring Safe and Sufficient Water • Fostering Sustainable Communities

Table 5.5 Frameworks and Principles Used in 2012 (Continued)

Greenpeace	• Protecting Ancient Forests • Protecting our Oceans • Stopping Global Warming • Preventing building of new nuclear weapons • Promoting chemical security, • Promoting sustainable agriculture.
Sierra Club	• Borderlands Campaign • Chill the Drills! Protect America's Arctic • Ecocentro • Electric Vehicles • Environmental Justice • Environmental Law • Global Population and the Environment • International Climate Campaign • Mission Outdoors • Nuclear Free Campaign • Responsible Trade • Toxics
Pré ReCiPe	• Life cycle Assessment for companies and brands
Cradle to Cradle (C2C)	• Material Health: Value materials as nutrients for safe, continuous cycling • Material Reutilization: Maintain continuous flows of biological and technical nutrients • Renewable Energy: Power all operations with 100% renewable energy • Water Stewardship: Regard water as a precious resource • Social Fairness: Celebrate all people and natural systems

Sources: Club, S. (2013). Sierra Club Programs. 2013, from https://content.sierraclub.org/sierra-club-programs, accessed on September 2013.
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By shifting the basis of LEED's framework from exclusively environment and health oriented impact categories, to a more sophisticated mixture of frameworks that also include socio-economic problems USGBC has implicitly approved LEED's capability to positively shape the socio-economic structure. This change is also stated explicitly in the new impact categories developed by USGBC for LEED v4 by 2013. The last item in these categories, listed below, clearly assigns LEED a role in the social transformation towards increased social equity and community development as well as protection of the environment and human health:

1. Reduce contribution to global climate change,
2. Enhance individual human health, well-being, and vitality,
3. Protect and restore water resources,
4. Protect, enhance, and restore biodiversity and ecosystem services,
5. Promote sustainable and regenerative material resource cycles,
6. Build a greener economy,
7. Enhance community: social equity, environmental justice, and quality of life.

Despite the inclusion of socio-economic concerns within the new impact categories, USGBC does not promise addition of new socioeconomic credits in LEED, in any of its written document. Inclusion of new market sectors, increased technical rigor in content and new credit weightings are the future changes that are mentioned by the USGBC (USGBC, 2012a).

LEED version v4 was launched in 2013, but it was originally scheduled to be launched in 2012. However, in 2012 USGBC announced that the launch of LEED 2012 had been postponed until late June 2013 and that it would be renamed LEED v4. Malin (2012) relates this decision to several concerns from the building industry. According to him, the industry found the changes too fast, excessive, requiring extra refinement, and lacking some of the tools and resources that are needed to achieve the credits.

By the time this research was conducted (July 2013) LEED v4 was at the “beta testing” stage. Although has not officially been launched yet, the proposed credits available for public review on USGBC’s website provide some clues about LEED's future. Some of the new credits proposed for LEED v4 show that USGBC does not rule socioeconomic issues out of LEED’s framework. Some of the proposed credits indicate that inclusion of more socio-economic concerns within LEED's framework is possible. The new credits also challenge the boundaries of LEED that have been mostly limited to the location and the life-time of the building.

Table 5.6 presents the new credits that indicate USGBC’s efforts to provide better coverage of the socioeconomic aspects of building design within LEED’s frameworks. These credits exceed the boundaries of LEED as they were defined in previous versions and suggest a broader life cycle assessment strategy including the extraction of raw materials, manufacturing of the building materials and the socio-economic structure of the built environment.

One of these innovations is the enhancement of the linkage between LEED ND and other LEED guidelines. While the earlier version of LEED ND already addressed several socio-economic issues, including housing and proximity to jobs, walkable streets, compact development, mixed used and community outreach, these concerns were not included within the framework of other guidelines (LEED NC, EBOM). However, with the introduction of LTc1, LEED for Neighborhood Development location, which encourages new projects to be located within LEED ND, a multidirectional connection is set between the individual projects and these above mentioned fields.

Three credits (LTc3 High priority site, SLLc5 Housing and jobs proximity, and NPDc4 Housing types and affordability) all aim at enhancing the socio-economic structure of the neighborhood of the project by creating economic value. LTc3 promotes construction in historic infill areas, Federal Empowerment or Federal Enterprise Community Zones, Federal Renewal Community sites, Weed and Seed Strategy Communities and other pre-defined low-income communities. By doing so LEED creates incentives for economic development and job creation in economically challenged or socially distressed areas. SLLc5 focuses on promoting the existing businesses in the project area while NPDc4 aims at increasing the diversity of income, household and age groups within the project. All of these credits share a similar goal of shaping the socio-economic structure of the neighborhood in order to enhance the local economy, avoid social segregation and reduce disparity in development.

These credits strengthen the economic aspect of LEED, which is not deliberately disclosed through credits in the earlier versions. LEED 2009 and earlier versions establish two types of relationships between green buildings and the economy. The first type is the cost reduction which is a consequence of resource efficiency. LEED presents this as an incentive for pursuing energy and water efficiency credits. The second type is the relationship between project and the economic growth in the projects' vicinity, which is presented by SSc2, Development Density and Community Connectivity, and SSc3, Brownfield Development. These two credits address possible contributions that the project can make to the economic activity in its vicinity and support existing businesses.

While retaining these two types of relationships, with NPDc4 LEED v4 introduces a third type: enhancing socio-economic equity. By promoting housing type and rent diversity LEED v4 aims at establishing local networks between people of higher and the lower income, which can both keep the economy vibrant and help employment opportunities among low income groups. But it also reveals LEED's capability to exceed its previous boundaries and help shape the socio-economic structure of local communities.

Introduction of three new material resources credits in LEED v4, (MRc1, MRc2 and MRc3), brings a significant change to the framework by expanding the life-cycle assessment beyond the spatial and temporal boundaries of the actual project and extending it to include the extraction and production of building materials. In MRc1, Building Lifecycle Impact Reduction, projects that opt for Option 4, "whole-building lifecycle assessment" are rewarded with three points. Option 4 requires consideration of the environmental lifecycle assessment of pre-construction phases and at least a 10% reduction in at least three of the six impact categories listed by the USGBC. These categories address global warming, ozone layer depletion, acidification, eutrophication, formation of tropospheric ozone and depletion of nonrenewable energy resources. Projects pursuing MRc1 Option4 are required to form data sets compliant with ISO 14044, which is an ISO guideline for environmental LCA. Complying with the ISO 14044 necessitates an inventory analysis and an impact assessment based on a cradle-to-grave approach, which addresses impacts on all phases of the supply chain. Therefore, LEED v4 MRc1 promotes a better understanding of the overall effects of a building, not only during and after construction but also during previous stages. However, as it is presented through the impacts listed above and the framework of ISO 14044, MRc1's focus is limited to exclusively environmental effects of the building projects.

While MRc1 expands the boundaries of lifecycle assessment in LEED, MRc2, Building Product Disclosure and Optimization - Environmental Product Declarations, helps create a market for building materials that go through third party screening and disclose their lifecycle impacts through labeling. MRc2 stands as an extended version of LEED 2009 MRc7, certified wood, which required use of FSC labeled wood. By rewarding projects that purchase labeled products by two points, MRc2 shows that LEED can achieve more than just focusing on the environmental end-use effects of building projects and can take a proactive role in the creation of new markets and so shape the economic structure.

Introduction of MRc3, Building Product Disclosure and Optimization - Sourcing of Raw Materials, in LEED v4 is a significant step towards including corporate social responsibility as part of being a green building. With MRc3, LEED addresses the socio-economic lifecycle impact of building materials for the first time and asks projects to use at least 20 different permanently installed products from at least five different manufacturers, who can provide third party verified corporate sustainability reports from their raw material suppliers. USGBC also provides a list of reporting systems that can be used for sustainability reporting, including GRI, U.N. Global Compact and ISO 26000. By doing so, USGBC not only creates a bridge between corporate sustainability reporting procedures and the green building rating process, it also shows that GRI's socio-economic perspective, which is based on a cradle to grave lifecycle process does not contradict the framework of LEED.

Table 5.6 Newly Proposed Credits for LEED v4 that have Socioeconomic Perspectives

Guideline	Credit No	Name	Intent	Change in LEED framework
NC	LTc1	LEED for Neighborhood Development location	To avoid development on inappropriate sites. To reduce vehicles miles traveled (vehicles kilometers traveled). To enhance livability and improve human health by encouraging daily physical activity.	1. Encourages LEED ND applications at the individual building level 2. Promotes the socio-economic measures that are in LEED ND, but not in other guidelines.
NC	LTc3	High priority site	To encourage project location in areas with development constraints and promote the health of the surrounding area.	1. Enhances the physical and the economic structure of the urban setting. 2. Creates continuity in the urban structure 3. Helps development of the areas that are hard to build.
NC	MRc1	Building life-cycle impact reduction	To encourage adaptive reuse and optimize the environmental performance of products and materials.	1. Promotes a broader vision of life cycle assessment 2. Increases the awareness on life cycle concept Carries the boundaries of LEED beyond the construction site.
NC	MRc2	Building product disclosure and optimization - environmental product declarations	To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.	1. Promotes products that go through third party screening and labeling process for environmental issues. 2. Promote innovations in labeling
NC	MRc3	Building product disclosure and optimization - sourcing of raw materials	To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.	1. Promotes CSR reporting for raw material producers. 2. Introduces GRI, OECD, UN Global Compact and ISO 26000 principles into LEED framework. 3. Recognizes the socio-economic impacts as part of being a "green building".
ND	SLLc5	Housing and jobs proximity	To encourage balanced communities with a diversity of uses and employment opportunities.	1. Promotes existing jobs 2. Compares the ratio of existing jobs with the number of dwellings. 3. Explicitly refers to economic development and employment in the LEED framework.
ND	NPDc4	Housing types and affordability	To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.	1. Shapes the social structure by promoting diversity in income, household size and ages. 2. Expands LEEDs framework towards the design of the social structure.

5.4 GRI

The Global Reporting Initiative is an NGO founded in Boston, MA in 1997, which defined its missions as "making sustainability reporting standard practice for all companies and organizations." (GRI, 2013) On its website, GRI states that its framework as a reporting framework aimed at providing metrics and methods for monitoring the reporting sustainability-related impacts of organizations helping improve transparency and accountability.

The foundation of the institution goes back to the Coalition for Environmentally Responsible Economies (CERES) and the Tellus Institute. In the 1990s the concept of sustainability reporting was initiated by the name of the Global Reporting Initiative Project, a department under CERES. In 1998, a multi-stakeholder committee was formed to develop GRI's guidelines. The steering committee adopted the idea of "do more than the environment" as the basic pillar of the reporting guidelines and therefore issues related to economy, society and governance were also included in the reporting framework. In 2002, during the World Summit on Sustainable Development in Johannesburg, GRI was embraced by United Nations Environment Programme (UNEP) and Netherlands was chosen as the country to host it. In 2006, GRI released the third version of its guidelines, G3, which has been used widely in many countries (GRI, 2013).

According to the reporting statistics released by GRI (2011c) in 2011 95 percent of the 250 biggest companies in the world reported their sustainability performance and 80 percent of them used GRI guidelines for their reports. Among 34 countries that host companies with GRI reports, US is the leading country by accounting for 11 percent of the reports issues in 2011. However, these results include a bias: most of these companies have their headquarters in the US, therefore it has the highest percentage of companies with GRI reporting. When normalized with the location of the headquarters, Sweden becomes the leading country in sustainability reporting. The leading three sectors in GRI reporting are financial services, energy and food and beverages. Universities, tobacco and toys are at the end. Among these rankings, construction takes the eighth place and real estate takes eleventh place closer to the top.

There are significant differences between GRI and LEED in terms of their frameworks and assessment approaches. LEED is a “response” oriented rating system. Achieving credits and obtaining points in LEED are mostly associated with exceeding certain thresholds. Unlike LEED, it is harder to categorize GRI indicators regarding to the PSR approach. They can be categorized as “pressure” indicator, since they are designed to help organizations report their pressure on the environment and the socioeconomic structure. However, the content of reports also includes information about measures taken to mitigate effects on environment and enhance socio-economic structure. For these reasons, some GRI indicators contain the features of “response” indicators as well. However, indicators in GRI do not guide users toward better practices as LEED does. They do not define any thresholds for determining whether actions taken by organizations are sustainable; they only determine the topics according to which organizations are required to report their sustainability performance.

Therefore reinterpretation of GRI indicators into LEED credits, especially for socio-economic problems, brings several challenges. The first challenge is the development of a credit language that will not only describe the pressure created by building projects on the environment and socioeconomic structure, but also guides them towards better practices. In other words, GRI indicators have to be transformed from a "pressure" oriented format to a more "response" oriented one.

The second challenge is the development of thresholds to make this transformation possible. In cases where GRI indicators address an organization's responses to existing problems, these responses do determine if an organization is successful in achieving certain goals towards sustainability. While giving a static picture of an organization's prior actions within the reporting period, indicators do not offer a guide for better practices; but they do provide clues to what a good practice could be. However, as a rating system, LEED requires such thresholds. For problems related to the environment and the economy, where quantitative data is prominent in assessments, it is easier to develop measures. For example, GRI EN10, "percentage and total volume of water recycled and reused" can easily be transformed into a response indicator by defining minimum thresholds for water recycled during the construction and occupation of buildings. However, for indicators like HR4, "total number of incidents of discrimination and actions taken," where prevention strategies for unwanted situations are reported, it is harder to define thresholds.

One reason for this hurdle is the problem of transparency and the absence of effective methods to detect these unwanted situations. While consumption of water can be measured through water bills and benchmarks can be developed by comparing water usage per square footage with industry averages, the number of incidents of discriminations that can occur throughout a construction project is hard to detect unless these incidents are recorded through legal claims and reports. For example, Sandy, a sustainability consultant, who was interviewed for this research, stated that for those who are responsible for the collection and submission of LEED documents and other people who are responsible from the LEED certification process, it is hard to detect any incidents of discrimination, since the certification process does not include constant monitoring of the construction process. However, when asked if she has any knowledge of such incidents of discriminations, she replied that her communication with the construction crew is usually prone to such discrimination due to the male dominated working environment of the construction sector. Emphasizing that it might not be described as an absolute act of discrimination, Sandy said that throughout her visits to the construction sites for monitoring and giving training about necessary measures to be taken towards LEED, she has to pay extra attention to keep her voice high and her tone strong, since this is the only way of making sure that her statements are considered in a male dominated environment. This experience exemplifies the hardship of identification, categorization and measurement of some social processes such as discrimination, which becomes an obstacle in developing clear-cut thresholds and response indicators.

Nevertheless, although it is hard to identify some unwanted social processes and develop measures based on the frequency of their occurrences, it is possible to develop measures that will identify the existence of preventive policies related to these processes. For example, LEED SS Pr1, “construction activity pollution prevention”, is a credit that measures the existence of pollution prevention activities such as seeding, mulching, fencing. In order to prove that such policies exist, developers or project owners should supply evidence including erosion control plan, drawings, photos, inspections logs or reports. For credits that will address socio-economic problems that are hard to quantify and develop thresholds, it is still possible to develop similar measures that determine the existence of mechanisms for prevention and monitoring.

CHAPTER 6

WHAT IS MISSING?

6.1 LEED vs. GRI: Differences in Assessment Techniques

The most important difference between LEED and GRI is between their objectives. While LEED is a rating system designed to encourage the construction of greener buildings by providing a list of best practices, GRI is a guideline for organizations to follow when reporting on their sustainability. As a rating system, LEED requires the fulfillment of certain prerequisites and credits and provides specific thresholds to be met. In doing so, it can determine whether or not a project is green. GRI, however, is not a tool for deciding if an organization is sustainable, but is a guiding tool that describes what issues should be reported in a sustainability report and how they should be reported. Unlike LEED, it does not describe best practices by defining certain thresholds for achieving energy and water efficiency, preservation of biodiversity or site selection. Instead it asks organizations to report their achievements in applying these best practices.

LEED and GRI also differ regarding the required process for getting recognized by the related institution. LEED is a volunteer certification process but achieving certification is tied to USGBC's approval and only projects that pass its scrutiny are awarded with certification. A complete process of obtaining a LEED certification has five stages: 1) registering the project; 2) integrating LEED requirements; 3) obtaining technical support; 4) documenting project certification; and 5) receiving certification (AIA, 2007). Registration occurs during the early schematic design period and requires submission of basic information about the project to the USGBC database through their website. As of 2013, the registration fee for USGBC members was $900 and for nonmembers it was $1200. Additional fees apply as the project is built and reviewed by USGBC (USGBC, 2013c). A complete list of registration and certification costs for different LEED certifications is presented in Table 6.1.

Registration is followed by the integration of LEED requirement into the design where scorecards are used and strategies are developed to achieve more than one credit by single design solutions. After the integration process, project teams can ask for technical support from USGBC through a process called “credit interpretation requirements” (CIRs) which are inquiries to learn if a particular design, technology or practice will meet the intent of a credit or a prerequisite. Close to completion, projects submit their documents to the USBGC website to be reviewed by the USGBC committee. Once the review process is complete and corrections have been made that the USGBC committee asked for, documents are sent in for a final review. This final assessment determines if the project will be awarded with the certification. Projects are also given the right to appeal USGBC’s decisions (AIA, 2007). As presented in Table 6.1, project review and appeal processes are subject to additional fees. In addition to the cost of registration and certification, additional costs are likely to occur depending on the degree of private consulting used, costs of extra research and design to meet the credits, costs of commissioning and modeling and finally costs of materials used to meet LEED requirements (LEEDuser, 2013).

Table 6.1 Registration and Certification Fees for LEED

Building Design and Construction fees

Building Design and Construction fees are for single-building projects and apply to all versions of LEED for New Construction, LEED for Core & Shell, LEED for Schools, LEED for Retail: New Construction and LEED for Healthcare.

	Organizational Level or Non-Members	Silver, Gold and Platinum Level Members
Registration	$1,200	**$900**
Precertification Review (optional, LEED CS only)		
Flat fee (per building)	$4,250	**$3,250**
Expedited Review	$10,000	
Combined Review: Design & Construction		
Project gross floor area (excluding parking): less than 50,000 sq ft	$2,750	**$2,250**
Project gross floor area (excluding parking): 50,000-500,000 sq ft	$0.055/sf	**$0.045/sf**
Project gross floor area (excluding parking): more than 500,000 sq ft	$27,500	**$22,500**
Expedited Review	$5,000	
Split Review: Design		
Project gross floor area (excluding parking): less than 50,000 sq ft	$2,250	**$2,000**
Project gross floor area (excluding parking): 50,000-500,000 sq ft	$0.045/sf	**$0.04/sf**
Project gross floor area (excluding parking): more than 500,000 sq ft	$22,500	**$20,000**
Expedited Review	$5,000	
Split Review: Construction		
Project gross floor area (excluding parking): less than 50,000 sq ft	$750	**$500**
Project gross floor area (excluding parking): 50,000-500,000 sq ft	$0.015/sf	**$0.01/sf**
Project gross floor area (excluding parking): more than 500,000 sq ft	$7,500	**$5,000**
Expedited Review	$5,000	
Appeals		
Complex credits	$800/credit	
All other credits	$500/credit	
Expedited Review	+ $500/credit	
Formal Inquiries		
Project CIRs	$220/credit	
LEED Interpretations	CIR fee + $380/credit	**CIR fee + $180/credit**

Neighborhood Development fees

These fees apply to projects using the LEED for Neighborhood Development rating system.

	First 20 acres	Per acre over 20
Registration	$1,500/project	
SLL Prerequisite Review (optional)	$2,250	
Expedited Review	$5,000	
Initial Stage Review	$18,000	**$350/acre**
Expedited Review	$25,000	
Subsequent Stage Review	$10,000	**$350/acre**
Expedited Review	$15,000	
LEED Interpretations		
USGBC Silver, Gold and Platinum Level Members	$180/credit	
Organizational Level or Non-members	$380/credit	
Project CIRs	$220/credit	
Appeals	$500/credit	
Expedited Review	$500	

Source: *USGBC. (2013). Registration and certification fees., from http://www.usgbc.org/leed/certification/fees/overview, accessed on September 2013.*

Unlike LEED, registering sustainability reports to the GRI database and naming them as GRI reports do not require the investigation of reports by a higher GRI authority or payment of any fees to GRI. Reporting using the GRI principles is not only voluntary but is also a much simpler process than LEED certification. For a sustainability report to be named a "GRI sustainability report", organizations prepare their reports according to the guidelines and submit them to the GRI database with a notice of submission and their "reporting level." The three levels of reporting (A, B, C) offered in G3 and G3.1 guidelines indicate how detailed the report is. Reporting organizations have to self-declare the level of their reports. The only review done by the GRI committee is to determine compliance of reports with those self-declared reporting level. But the quality of the reports, their completeness and truth of the information that is being reported is not being audited by the GRI authorities. Those levels of disclosure do not exist in G4, the latest version of the GRI guidelines that was issued in May 2013.

GRI does not require external assurance, but it recommends it. "GRI uses the term 'external assurance' to refer to activities designed to result in published conclusions on the quality of the report and the information contained within it. This includes, but is not limited to, consideration of underlying processes for preparing this information" (GRI, 2011b, p. 59). External assurance has to be conducted by a third party group or individuals who are not associated with the organization and should provide information about whether the report complies with GRI's required reporting principles. If an external assurance service is used, then organizations should declare that in the report. G3 and G3.1 reports that use external assurance also indicate this with a (+) sign that comes after the reporting level (i.e. A+, B+, C+).

The absence of an authority that reviews and approves GRI reports might lead to significant quality differences between reports. A review of various reports selected from the GRI database presents examples of such variance. For example, a report prepared by Is Bank, one of the national banks of Turkey, consolidates a significant portion of the required information at the Indicator Index section as a table at the end of the report and allocates most of the report to promote their annual activities related to sustainability but that does not directly address any of the reporting requirements in the GRI guidelines (Is Bank, 2012). On the other hand, the 2009 report prepared by the Munich Airport (Stadtwerke München GmbH, 2009) presents information in a more complete and balanced way, by deliberately referring to the reporting process, providing a detailed list of stakeholders and describing the identification process of material issues for the report. According to Nicky, who is the CEO of a sustainability reporting consulting business and one of the interviewees in this study, this variation among reports is not desirable for those who uses the information provided by these reports, but does not pose a major problem. This is because sustainability reporting is a process and its real value derives from the opportunity it creates for organizations to realize how they affect sustainability and to identify organizational processes that were not being tracked before. Many organizations, she says, find out that there are many operational processes for which no data has been collected or no data analysis has been conducted. Thus, the effects of these processes on sustainability are an unknown for these organizations. Sustainability reporting is the first step to identify these processes and to develop assessment tools to measure their impacts; so it also becomes significant tools of institutional training on sustainability.

Despite the differences in their approaches toward assessment and public recognition, the results of the comparative analysis of different sets of indicators, presented in Chapter 4, shows that LEED systems and GRI have many similarities in terms of the issues they address (Table 6.2). Both LEED and GRI focus on commissioning /management, energy performance, environmentally responsible site planning, pollution/waste production, regional, renewable energy and water efficiency. Among different LEED systems, only LEED ND focuses on accessibility / social enhancement, which is a distinct category of GRI that distinguishes the reporting tool from green building rating systems. Environmentally preferable materials, IAQ, renewable energy, stimulating architecture, transportation, and water quality/health are the categories LEED emphasizes while GRI has only a few or no similar indicators. Cultural preservation and spatial efficiency are two categories that are addressed only by LEED ND. Economic efficiency, life cycle cost, and safety and security categories that are addressed only by the GRI indicators. It should be noted that there are no clear-cut distinctions between these categories but the number of indicators displayed under these categories indicate only the number of indicators that directly address issues represented by these categories. However, there might be other indicators that indirectly address these categories, although they are placed in another category. For example, many of the credits listed in the section Material and Resources (MR) employ an approach that encourages builders to consider the life cycle of the whole building by reusing building materials, using recycled content or using rapidly renewable materials. However, they do not directly address the life cycle costs of the building by requiring a documentation of the life cycle phases of the building, total amount of the materials used during the life cycle of the building or preparation of a report listing the impacts of the building throughout its life cycle. GRI credits EN1, EN2 and PR1, on the other hand, require organizations to list the total amount of products used in different stages of the life cycle of products or services, or to identify the health and safety impacts of these products and services at each phase of their life cycle. This approach is different from LEED's MR section in the sense that deconstruction of the whole process of production or service delivery into its phases of life cycle is required, whereas LEED MR addresses only the life cycle issues that are evident at the final product, without having to go through the deconstruction process.

Table 6.2 Comparison of the Allocation of Indicators in LEED Systems and GRI

Categories / Code, Guidelines, Rating Systems	**LEED NC**	**LEED EBOM**	**LEED ND**	**GRI Cress**	**LEED NC**	**LEED EBOM**	**LEED ND**	**GRI CRESS**
Accessibility / Social Enhancement			10.91	24.14				
Acoustic Comfort								
Commissioning / Management	1.82	8.18	6.36	2.30				
Cultural Preservation			1.82					
Daylighting	1.82	0.91	0.91					
Economic Efficiency		0.91		6.90				
Energy Efficient Appliances								
Energy Performance	20.00	19.09	4.55	6.90				
Environmentally Preferable Materials	9.09	5.45	0.91	1.15				
Environmentally Responsive Site Planning	12.73	8.18	22.73	6.90				
Flexibility and Adaptability								
High Performance HVAC								
High Performance Electric Lighting		0.91						
High Performance Building Envelope								
IAQ	9.09	4.55						
Information Technology								
LCC				3.45				
Plug Load Management								
Pollution / Waste Production	3.64	4.55	2.73	13.79				
Regional	5.45	3.64	3.64	10.34				
Renewable Energy	8.18	6.36	2.73					
Safety and Security				18.39				
Service Life Planning								
Spatial Efficiency			5.45					
Stimulating Architecture	5.45	4.55	5.45					
Thermal Comfort	2.73	0.91						
Transport	10.91	13.64	27.27	1.15				
Visual Comfort								
Water Efficiency	9.09	12.73	1.82	4.60				
Water Quality / Health		5.45	2.73					
Accessibility / Social Enhancement	100.00	100.00	100.00	100.00	N/A	N/A	N/A	N/A

One of the big differences between LEED credits and GRI indicators is the assessment methods they employ. As a rating system, LEED aims at assessing the compliance of a building project with certain principles of sustainability that are defined by USGBC such as reduction of energy and water use, increase in the amount of recycled materials and renewable materials, improvement of indoor environmental quality, etc. Therefore, the majority of LEED credits employ the “response” type of approach in grading, which measures the success of solutions developed by building project owners or designers to mitigate the negative effects of buildings on the environment and human health. Examples for "response" type approach are LEED NC WE Pr1, which requires reduction of water consumption by 20 percent compared to the baseline calculated for the building, EA Cr3, which requires assignment of an commissioning agent at the early stages of design and LEED ND NPD Pr2, which requires building high dwellings per acre residential units or high floor-area ratio for nonresidential units. It should be noted that many of these credits, such as those that calculate water or energy efficiency, have characteristics of the “pressure” type measurement approach as well. This is because in many cases the effectiveness of the response (i.e. energy reduction) is measured by calculating the actual or estimated impact of the building on the environment and human health (i.e. total energy consumption, total carbon emission, estimated water use). But the final results presented by these credits do not provide the information about the pressure of the buildings on the environment, but tells whether certain levels could mitigate this pressure. Therefore, it is more appropriate to categorize them “response” type indicators.

As a reporting guideline, GRI includes many indicators that employ “pressure” and “state” type approaches in addition to “response” types. For example, GRI EN3 is an indicator that requires organizations to report their direct energy use by primary sources, which eventually documents the pressure of the organization on the environment through CO2 emissions and depletion of resources. In a similar manner, EN8 requires reporting the total amount of water withdrawal for business operations and EN9 requires documentation of the water resources that are affected by withdrawal of water. GRI also has several indicators that employ the “state” approach. These indicators mostly address the current state of an organization's economic structure, its labor force and the current state of human rights related issues in the organization such as the total financial assistance received from the government (EC4), state of total workforce (LA1), ratios of standard entry level wages compared to local minimum wages (EC5) and number of substantiated complaints regarding breaches of customer privacy and loss of customer data (PR8).

Another difference between LEED credits and GRI indicators is the assessment method. A majority of LEED credits employ assessment methods that have the characteristics of end-user approach or the life cycle approach, or both. Credits and prerequisites addressing use of energy and water, refrigerant management, waste management, heat island effect or light pollution are all centered on the impacts created by the end-user. But, as Arthur stated, when he was interviewed this study, LEED also includes credits with a life cycle perspective, as long as the measurements can be done without going beyond the boundaries of the final product. Many LEED credits are prepared in respect to a life cycle vision but do not address each and every process specifically that contributes to the final product. For example, the use of certified wood is a life cycle-oriented measure that aims at supporting sustainable forestry practices by creating a demand through the commodity chain of the building. It is possible to prove the use of certified wood by purchasing documents and the specific labeling of the wood purchased. However, a similar life cycle assessment process is not applied to all materials that are used in a building project, specifically in the early phases of life cycle such as the extraction of materials.

As mentioned above, many indicators in GRI address different life cycle phases of the goods and services provided and these indicators also require organizations to identify each of these phases. GRI also includes several indicators that address changes that might occur in the life cycle of different parts of society or policies that target such changes. These indicators employ a socioeconomic perspective by looking at changes in the living quality of workers, compliance with human rights principles by the organization and by its suppliers, compensation levels and benefits for workers, product responsibility and development of policies that target improvement in these issues. Differing from the end-user impact approach, these indicators do not provide quantitative information about the impacts of the organizational activities but they do give information about the ways that an organization manages these impacts.

6.2 A Socio-Economic Extension for Green Building Rating Systems

Buildings are living entities. As opposed to the static structure of building plans or engineering schemas once built, buildings change the surrounding environment and they are changed by it. While a building plan or a site plan represents an image of an actual reality, an instance of it as captured by photography, buildings make the reality. Buildings, that use the same plans, same materials and even the same design concepts may differ in their effects on the economy, environment and society, depending on how building materials are produced, delivered or used, how construction workers were compensated, how the building is welcomed by the community and the building's ability to communicate with its users.

Conventional thinking considers buildings to be deliverables designed to meet the Owner's Program Requirements (OPR), static entities that will serve for a certain number of years to shelter and then be demolished. However, conceptualization of buildings as living entities opens up an opportunity to reconsider a vast array of processes that are entangled with the construction, service and demolition of buildings. Conceptualizing building as living entities also allows recognition of the continuous and bi-directional relationship between users and buildings, where the other changes each party during the time of occupation. These processes that occur during the lifetime of a building can be investigated under four categories: 1) a building's footprint on the environment; 2) a building's contributions to the local and global economies; 3) a building's effects on the socio-cultural structure of its region; 4) the potential of a building to increase the life-quality of its users.

Each of these processes covers a timespan starting from the design stage for the building to the removal of the demolition debris, tracing back to both direct and indirect changes that the building is responsible for. For example, the carbon footprint of a building is not limited to only the carbon emissions that occur during the construction and service life of the building but the carbon that is emitted during the extraction and transportation of the building materials, transportation of the construction workers, demolition of the building and the cleaning of debris. Similarly, contributions of a building to the economy are not only limited to the jobs created through construction but also include benefits to the employees, magnitude the local businesses triggered by the construction and the increase in tax base both at the building site and in other regions through the commodity and service supply chains.

Many studies have examined the effects of buildings on the socioeconomic and environmental structure throughout their life cycles. Studies focus on the life cycle effects of building including: actual energy consumption of buildings, embodied energy in building materials, pollutant discharge (Gehin, Zwolinski, & Brissaud, 2009; S. Guy & Farmer, 2001; Komnitsas, 2011; Liu, 2010; Meryman, 2005; O'Sullivan, 2004; Thiers & Peuportier, 2012; Yung & Chan, 2011), seismic damage costs (Hong, Lee, & Hong, 2010), equipment efficiency (Xiao & Wang, 2009), building life cycle information management (Gursel, Sariyildiz, Akin, & Stouffs, 2009; Vanlande, Nicolle, & Cruz, 2008), indoor air quality (Loftness, Hakkinen, Adan, & Nevalainen, 2007), investment and operation and maintenance costs (Menassa, 2011; Wang, Chang, & Nunn, 2010). Of all the issues in studies on building life cycles, environmental and security related topics constitute a significant portion of the research on building life cycle and life cycle assessment (LCA). Many of these studies narrow their focus to particulars aspect of the whole building process, such as energy use, waste production or the economic life cycle of buildings. A more comprehensive approach that can investigate the relationships among these components is mostly left out. Despite the extensive amount of research on the LCA of buildings, their effects on the economy and society throughout their life cycle, and their ability to improve the life quality of their users require more attention from researchers.

Several studies address this gap. For example Li's (2006) study reintroduces the term "attached environmental burden" in order to develop an integrated impact assessment model, which would consider not only a building's local effects at a given time but also its effects on the surrounding infrastructure throughout the stages of construction, service and demolition. Assefa et al. (2007) tries to link the relationships between the environmental footprint of a building and its social effects through the concept of "internal environmental impact" which refers to the way people within a building are affected by their "surrounding conditions" including technical aspects of their building, its indoor air quality or their vicinity to a source of nuisance. Haapio, & Viitaniemi's (2008) study states that life cycle assessment tools in the current building market either provide information about the environmental life cycle of the buildings or guide better life cycle practices to help the environment but most of them do not introduce measures that can address the socioeconomic effects of buildings throughout their life cycles.

Research on developing environmental life cycle analysis methods for the building industry provides a variety of tools for understanding and managing the multidimensional relationship between buildings and the environment. Green building rating systems are the most visible, comprehensive and functional results of this effort, which not only measure the success of building projects in attaining sustainability but also create market incentives for greener projects. But both previous studies and the comparative analysis of different sets of indicators in this study show that those green building tools mostly lack socioeconomic indicators that can address sustainability in a more comprehensive and complete manner. Although they provide strong tools that can provide information about the life cycle impacts of buildings on the environment, they miss the chance to map their socioeconomic effects including the amount of economic value the building projects create, changes in local infrastructural facilities, contributions to the local employment, educational opportunities provided or new local businesses created. However, it is possible to create assessment tools to measure changes related to these socioeconomic issues by using similar techniques to the ones that are employed by environmental LCA tools. The environmental footprint approach, for example, which measures the carbon emissions and waste production of a building beyond its service life, can be modified to develop a LCA technique that will assess the socioeconomic footprint of buildings.

Although the building industry functions like a hub, allocating different resources and forming linkages among various economic, social and environmental structures, existing green building rating systems cannot map and manage all of these effects of the building industry. The absence of widely accepted assessment tools that can measure and guide all three aspects of sustainability necessitates a discussion of the possibility of introducing socioeconomic indicators into the existing green building rating systems.

Such a discussion should seek ways that these new indicators can be added without compromising the basic requirements of the existing systems, but can be introduced as an extension, or an additional package, by giving additional certification options that will indicate that the building is built with consideration to the socio-economic responsibilities, as well as environmental ones. The end result of this effort could be a new certification, which would allow users to distinguish themselves by indicating that they occupy a "fairly built" building, in a similar manner to what supporters of the "fair trade" movement do.

In order to explore the possibilities of expanding LEED to include a new dimension that would include stronger measures of social and economic issues, this researcher has developed a system that identifies the topics that frequently appear in the academic literature on buildings and sustainability, but rarely are addressed by the building industry. The details of the methods of analysis used are discussed in Section 3.4. The results of this analysis are presented in Table 6.3 under the "academia" column. The differences between the scores obtained through research on the green building market (see Chapter 4) and the scores obtained through research on the existing literature are presented in the last column of Table 6.3. These differences can also be seen in the graph in Figure 6.1. Negative signs indicate those categories that receive more attention in the literature than by the green building industry and positive signs indicate vice versa. Economic efficiency is the category where the difference between the literature and the market is the greatest. This is because a significant portion of studies, even the ones that address environmental issues directly, also refer to the economic benefits of implementing sustainability measures in building design or to topics that effect economic efficiency. Studies on energy efficiency also pay attention to the economic aspects of improving energy performance. Nevertheless, the sets of indicators in the green building market provide few or no indicators about the economic efficiency of buildings. Although rating systems such as LEED employ a vision that links resource efficiency to economic benefits and encourage developers to assess potential cost savings the results are not presented through LEED credits. A LEED credit that says the building has passed the 30 percent energy efficiency threshold does not necessarily give information about the economic gains of this saving. These gains can vary depending on the location of the building, energy sources, utility companies, the electricity peak demands and the current rates in the energy market.

Table 6.3 Comparison of Scores from Market and Academia for Indicator Categories

Categories / Code, Guidelines, Rating Systems	Market	Academia	Difference
Accessibility / Social Enhancement	1.18	5.60	-4.42
Acoustic Comfort	1.25	0.29	0.97
Commissioning / Management	5.01	4.56	0.45
Cultural Preservation	0.22	3.45	-3.23
Daylighting	3.09	0.75	2.34
Economic Efficiency	0.60	10.34	-9.74
Energy Efficient Appliances	0.43	3.77	-3.34
Energy Performance	12.44	9.19	3.24
Environmentally Preferable Materials	4.30	2.84	1.46
Environmentally Responsive Site Planning	9.09	2.23	6.86
Flexibility and Adaptability	0.47	0.29	0.18
High Performance HVAC	8.28	7.54	0.74
High Performance Electric Lighting	5.07	4.60	0.47
High Performance Building Envelope	6.73	5.03	1.70
IAQ	6.09	3.05	3.03
Information Technology	0.61	0.68	-0.07
LCC	1.28	5.10	-3.81
Plug Load Management	0.59	1.87	-1.28
Pollution / Waste Production	4.06	5.85	-1.79
Regional	1.06	4.09	-3.03
Renewable Energy	3.07	2.01	1.06
Safety and Security	2.71	0.83	1.88
Servise Life Planning	2.09	4.42	-2.33
Spatial Efficiency	1.46	0.57	0.89
Stimulating Arch.	1.56	1.65	-0.10
Thermal Comfort	0.85	1.94	-1.09
Transport	6.40	1.72	4.67
Visual Comfort	1.16	0.47	0.69
Water Efficiency	7.62	2.01	5.61
Water Quality / Health	1.24	3.27	-2.02
Grand Total	**100.00**	**100.00**	**0**

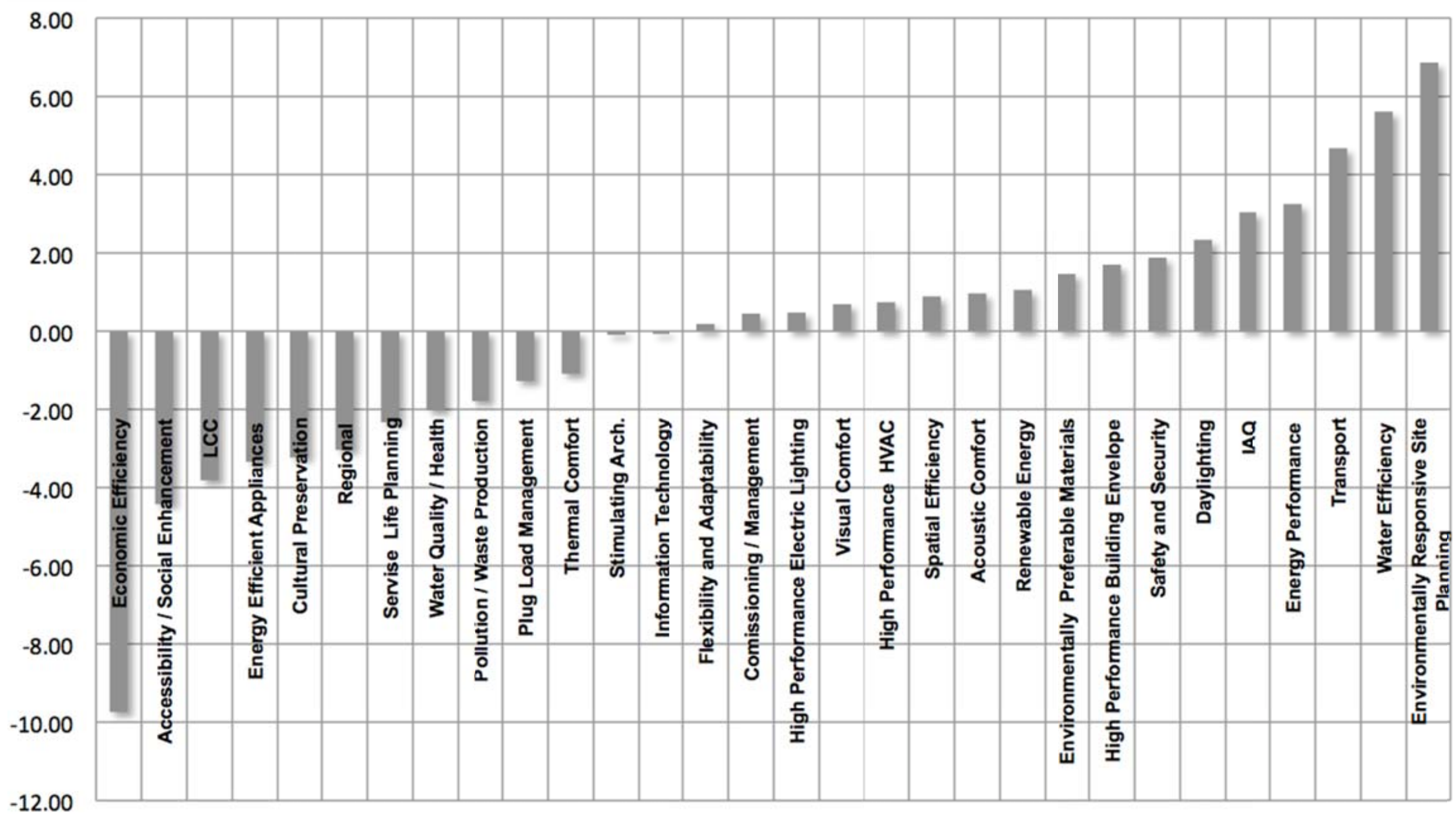

Figure 6.1 Deviation of market from academia in addressing sustainability.
Source: *Findings from this study.*

Environmental site planning, water efficiency, transport, energy performance and IAQ are the five categories that receive significantly more attention from the green building market compared to the literature. It should be noted that these categories also match the major sections of green building rating systems like LEED and BREEAM.

Accessibility/social enhancement is another category that gets significantly more attention in the literature than in the green building market. This category includes several socioeconomic indicators and keywords, which mainly address labor practices, human rights issues, training opportunities for workers, product responsibility and protection of the local communities. Although its deviance from the market stays below economic efficiency, this category represents the major difference between the literature and the green building industry. This is because, despite the absence of indicators showing economic losses or contributions resulting from building projects, the economic efficiency is still partially represented indirectly through several indicators that measure resource efficiency. But accessibility and social enhancement are not represented by any green building indicators even partially, except a small amount number of indicators provided by LEED ND and WBDG. Even these few indicators do not focus on labor processes, human rights issues or workers' training. They do not provide information about the extent of new employment created, total amount of social benefits provided, unionization status of the construction workers, training opportunities provided, measures taken to prevent child labor in the supply chain of the building materials, etc.

Since this researcher investigated the opportunities for expanding boundaries of the green building rating systems and questioned including the aspects of sustainability that are currently not being represented in the green building market, this study focuses on those categories that get less attention form the green building market and more attention from research on sustainability and buildings. These categories are presented in Table 6.4, by filtering the categories with a (-) sign from Table 6.3. The last column of Table 6.4 shows the filtered categories where GRI presents related indicators. Among the filtered categories, only six are addressed by GRI and among those accessibility/social enhancement is being addressed most.

Table 6.4 Comparison of Differences between the Literature and the Green Building Market with the GRI Categories

Categories	Deviation	Market	Academia	GRI
Accessibility / Social Enhancement	-4.42	1.18	5.60	**26.58**
Cultural Preservation	-3.23	0.22	3.45	0.00
Economic Efficiency	-9.74	0.60	10.34	**7.59**
Energy Efficient Appliances	-3.34	0.43	3.77	0.00
Information Technology	-0.07	0.61	0.68	0.00
LCC	-3.81	1.28	5.10	**3.80**
Plug Load Management	-1.28	0.59	1.87	0.00
Pollution / Waste Management	-1.79	4.06	5.85	**12.66**
Regional	-3.18	0.91	4.09	**10.13**
Service Life Planning	-2.33	2.09	4.42	0.00
Stimulating Arch.	-0.10	1.56	1.65	0.00
Thermal Comfort	-1.09	0.85	1.94	0.00
Water Quality / Health	-2.02	1.24	3.27	**1.27**

Source: *Findings from this study.*

The GRI indicators that fall in the category of accessibility / social enhancement have the potential to make significant contributions to the framework of the green building rating systems by bringing a socioeconomic perspective to the green building industry for two reasons:

1- The green building market does not address most of the issues included in this category.
2- Among the categories that get more attention from the literature than from the green building market, accessibility / social enhancement has the most number of GRI indicators.

Therefore, this study takes a closer look at some of the indicators that fall in accessibility / social enhancement category in order to understand the advantages and disadvantages of increasing the aspects of sustainability that is addressed by LEED. GRI indicators that fall under accessibility / social enhancement are presented in Table 6.5. The topics addressed by these indicators can be summarized as labor processes, educational opportunities for the workforce, labor structure of the organization, human rights perspective of the organization, community protection, and product responsibility / customer. Building industry includes many practices and business processes where actions related to these topics become important. As a labor-intensive sector, the conditions of workers and the structure of the labor force can affect the efficiency of work as well as contributions to the local economy by determining the resilience of workforce to socioeconomic risks. The human rights perspective of organizations that finance and manage the construction processes can be a key element in determining compliance with the human rights principles within the whole supply chain of a building. Being at the top of this supply chain, by employing and disclosing such principles, construction companies can create a butterfly effect within the whole lifecycle of the building industry including the processes of supply and transfer of building materials. Community protection, which is also addressed by LEED ND, is a very important factor that can mitigate the negative effects of a building on its environment as well as on the social structure. By limiting the effects of a building project on its surrounding communities, the economic activities and the cultural capital of a region can be protected, preventing any unwanted migration, loss of jobs or proliferation of less sustainable economic activities resulting from these changes. Preservation of communities is a very challenging situation for the green building projects, especially if the increased quality of buildings attracts high-income people leading to the gentrification of regions with high numbers of green buildings. Finally, product responsibility and customer protection is another important topic that relates to the public image of the green building industry. As green buildings provide an opportunity to reduce the pressures on ecology and resources, their success is strictly bound to market demand. If they fail to satisfy certain levels of thermal comfort, glare effect, indoor air quality or noise prevention above the standards, building developers would be likely to choose conventional buildings over green buildings, especially because they usually come with a premium cost at least in the short term.

While all of these factors significantly affect the success of buildings in meeting the requirements of social and economic sustainability, the time and resources allocated for this research allowed focusing on only a select number of them. This also gives a chance for a deeper investigation of each indicator rather than providing a general view about the applicability of many indicators. The basic aim of this study was to discuss whether indicators addressing aspects of sustainability outside the boundaries of ecological and technical concerns could be part of the green building industry. A deep examination of several indicators from the category of accessibility / social enhancement is sufficient to fulfill this aim.

For two reasons, this researcher chose to focus on labor processes and the human rights perspective. First their capacity to affect large numbers of people with small policy changes. With 5.5 million employed in the building sector, constituting 3.8 percent of the total number of employed people in the US (Bureau of Labor Statistics, 2011), improvements in the labor processes such as compensation, benefits, prevention of discrimination at the work place and freedom of association can lead to improvements in the living conditions of a significant portion of the population. Also the green building sector can be a pioneer for the implementation of these improvements in other sectors as well. With the inclusion of a human rights perspective that relates to supply chains, the building sector can create a domino effect by leading other suppliers to implement the same changes in their commodity chain.

The second reason for choosing these two topics is to challenge the building industry into implementing them. During the interviews conducted in the early stages of this research, several interviewees stated that the implementation of measures related to labor processes and human rights issues are difficult because both the availability of data is problematic and the building industry would not welcome such an addition to the green building rating systems. Arthur, who is a LEED consultant and an interviewee for this study stated that many human rights issues are related to the supply chain of building materials, which cannot be assessed by the project team unless there are labels that provide information about how they built. He also said that measures that address socioeconomic issues, such as unionization rights, cannot be applied in all locations, since the right to collective bargaining is not required everywhere. Jamie's view, who is also a LEED consultant at the same company with Arthur, supports his statement that consistency in expectations from construction is a key issue in the building industry and if different agents in different locations cannot provide the same socioeconomic benefits to its workforce, this can violate the principle of consistency in the implementation of green building measures. According to her, no one in the industry would say "providing better benefits for workers is a bad thing" but what the industry would prioritize is the quality of the labor, not the workforce. If better benefits would lead to better labor efficiency, then the industry would consider this. Hally stated that even though these topics are important, they are beyond what LEED can achieve now. According to her, LEED cannot collect data about existing processes, such as post-occupancy efficiencies, user habits. She believes that LEED should be even more specific instead of expanding. During two independent interviews, Alex and Roger, who were team members of a LEED registered project, both said that labor processes and human rights are political and ethical issues, for which developing measures and collecting data is hard and should stay outside the boundaries of a green building rating system. These insiders' views from the green building industry show that it is a very challenging task to include new socioeconomic indicators in the building industry, especially those that will address workers benefits and human rights. Therefore, examining this possibility gives an important opportunity to analyze the limits of green building industry in fully addressing sustainability.

Table 6.6 gives a list of the selected GRI indicators to be examined. While nine of these indicators are selected from accessibility / social enhancement, there is one exceptional addition that was originally listed under the category safety and security. This exception is CRE6, "percentage of the organization operating in verified compliance with an internationally recognized health and safety management system" which is an additional indicator defined by GRI for its Construction and Real Estate Supplement. Although safety and security is among the categories represented more by the market and therefore is outside the indicators that were filtered to be examined, CRE6 provides information that can be significant for labor processes and human rights. Especially for the construction sector, which has one of the highest injury and fatality rates, implementation of international health and safety standards is a crucial part of achieving sustainability standards in the labor processes, along with benefits, compensation and other workers' rights. For this reason, CRE6 is also included in the analysis of this research.

Table 6.5 GRI Indicators that Fall Under "Accessibility/Social Enhancement"

	Code	Name
Labor Processes	**EC3**	Coverage of the organization's defined benefit plan obligations.
	EC5	Range of ratios of standard entry level wage compared to local minimum wage at significant locations of operation.
	HR4	Total number of incidents of discrimination and actions taken.
	HR5	Operations identified in which the right to exercise freedom of association and collective bargaining may be at significant risk, and actions taken to support these rights.
	HR6	Operations identified as having significant risk for incidents of child labor, and measures taken to contribute to the elimination of child labor.
	HR7	Operations identified as having significant risk for incidents of forced or compulsory labor, and measures to contribute to the elimination of
Educational Opportunities to the Workforce	**LA10**	Average hours of training per year per employee by employee category.
	LA11	Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings.
	LA12	Percentage of employees receiving regular performance and career development reviews.
	HR8	Percentage of security personnel trained in the organization's policies or procedures concerning aspects of human rights that are relevant to operations.
Labor Structure	**LA13**	Composition of governance bodies and breakdown of employees per category according to gender, age group, minority group membership, and other indicators of diversity
	LA14	Ratio of basic salary of men to women by employee category.
Human Rights Perspective	**HR1**	Percentage and total number of significant investment agreements that include human rights clauses or that have undergone human rights screening.
	HR2	Percentage of significant suppliers and contractors that have undergone screening on human rights and actions taken.
	HR3	Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained.
Community Protection	**HR9**	Total number of incidents of violations involving rights of indigenous people and actions taken.
Product Responsibility and Customer Satisfaction	**PR3**	Type of product and service information required by procedures, and percentage of significant products and services subject to such information requirements.
	PR4	Total number of incidents of non-compliance with regulations and voluntary codes concerning product and service information and labeling, by type of outcomes.
	PR5	Practices related to customer satisfaction, including results of surveys measuring customer satisfaction.
	PR6	Programs for adherence to laws, standards, and voluntary codes related to marketing communications, including advertising, promotion, and sponsorship.
	PR7	Total number of incidents of non-compliance with regulations and voluntary codes concerning marketing communications, including advertising, promotion, and sponsorship by type of outcomes.

Source: *Findings from this study.*

Table 6.6 Selected GRI Indicators to Be Examined

Category	Indicator Code	Indicator Name
Labor Processes	EC3	Coverage of the organization's defined benefit plan obligations.
	EC5	Range of ratios of standard entry level wage compared to local minimum wage at significant locations of operation.
	HR5	Operations identified in which the right to exercise freedom of association and collective bargaining may be at significant risk, and actions taken to support these rights.
	HR4	Total number of incidents of discrimination and actions taken.
	HR6	Operations identified as having significant risk for incidents of child labor, and measures taken to contribute to the elimination of child labor.
	HR7	Operations identified as having significant risk for incidents of forced or compulsory labor, and measures to contribute to the elimination of
	CRE6	Percentage of the organization operating in verified compliance with an internationally recognized health and safety management system.
Human Rights	HR1	Percentage and total number of significant investment agreements that include human rights clauses or that have undergone human rights screening.
	HR2	Percentage of significant suppliers and contractors that have undergone screening on human rights and actions taken.
	HR3	Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained.

Source: *Findings from this study*.

6.3 Addressing Social Structure

As is evident in the research presented in previous sections that the green building industry and rating systems like LEED are missing many sustainability indicators essential for monitoring and managing social processes and economic performance. For many people from the industry it is still a question if green building rating systems should include these indicators within their frameworks. Interviews conducted for this study showed that there are two types of opinions in the green building community about how LEED should respond to the need for including socioeconomic aspects of sustainability. One opinion claims that as a green building rating system, LEED should not be responsible for addressing socioeconomic issues, but has to focus closely on environmental and human health impacts of buildings. But according to findings presented in section 4.3, regarding the framework of LEED and USGBC's trajectory for future updates, USGBC does not share this opinion. Attaining social and economic sustainability is actually among LEED's goals as they are defined in its framework document. Especially, inclusion of new M&R credits in LEED v4 that follow a broader life cycle assessment approach and promote use of suppliers with sustainability reports are signs of a strategy to expand LEED's perspective beyond the boundaries of end-user impact assessment and include more socioeconomic measures in addition to the environmental and human health perspective.

According to the second opinion, LEED already supports the social and economic sustainability by providing green, healthier living spaces and creating new markets. Several interviewees in this study (Jamie, Sandy, Carrie, Roger) believe that the provision of better indoor environmental quality, increased comfort in office environments and more green spaces are LEED's social achievements. Therefore it should not be considered as a solely an environmental assessment tool but credit should be given to the indirect social benefits of creating better living and working environments.

Although the social benefits of improving indoor environmental quality of working spaces and providing greener urban areas are undeniable, the impacts of these improvements are debatable. Although LEED raises the standards for a healthy built environment, it is hard to consider these improvements social achievements unless they are enjoyed by a significant portion of the population and give an equal chance of access to different groups. For this reason, it is important to develop measures that will assess accessibility to the innovations brought by the green building industry and promoting strategies that allow more people enjoy the benefits of living or working in a green building.

Data presented in the *Public LEED Project Directory*, which was retrieved from USGBC's website in April 2013, shows that the total number and the total area of LEED projects differ significantly among states (Figure 6.2). Hosting 6082 registered LEED projects with a total gross area of 1.26 million square feet. California is the leader among the other states. It is followed by Texas, New York and Florida respectively. New York, which hosts three of the case studies that were examined in this research, has 2762 projects registered with LEED, with a total gross area of 533 million square feet. At the time the data was retrieved, 632 of these projects held a certification with an average of 41 points earned from LEED credits.

While the total number and area of LEED projects is an important indicator showing in which locations the green building industry is stronger, normalization of these numbers with the total population gives a better insight into accessibility to the benefits of green buildings. As can be seen in Figure 6.3, distribution of the number and total area of LEED registered projects does not follow a similar pattern if the population of each state normalizes them. The total LEED certified building area per person is seven times larger in the District of Columbia (DC) than in any other state in the US. The primary reason for this difference is DC's unique position as an urban district, without rural or suburban population, hosting a significant number of federal and nonprofit buildings, including USGBC headquarters. Due to the absence of rural and suburban populations, statistics numbers provided by DC can be misleading, but Figure 6.4 shows that even after eliminating DC, the states still vary significantly in terms of LEED certified building area per person.

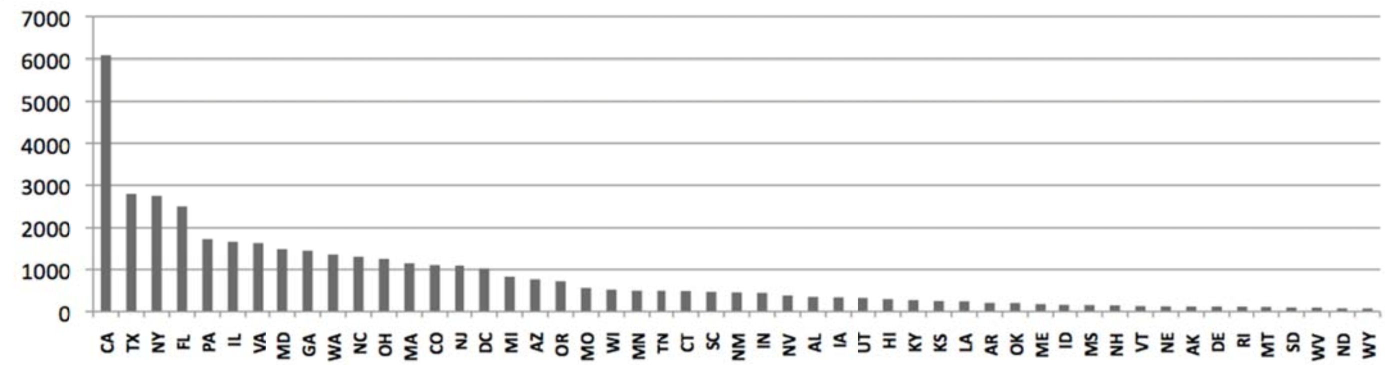

Figure 6.2 Number of LEED registered projects per state.
Source: *LEED Project Directory, www.usgbc.org, accessed on September 2013*

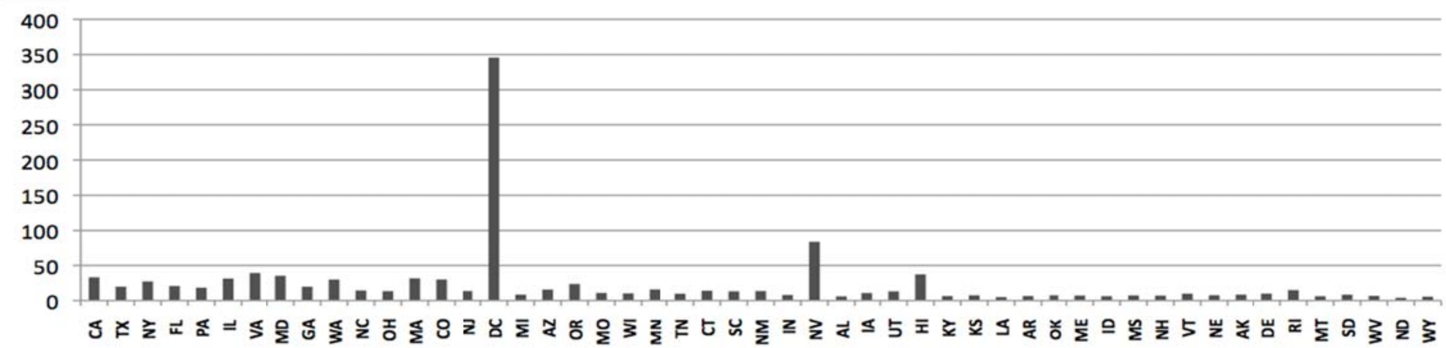

Figure 6.3 Total area of LEED registered projects per person (square foot).
Source: *LEED Project Directory, www.usgbc.org, accessed on September 2013*

In addition to its unique geographical and administrative position, another reason for large LEED certified area per person in DC is the laws and regulations that promote LEED certification in government buildings. Thanks to the minimum limits created by two executive orders, E.O. 13423 and E.O. 13514(US Federal Government, 2007, 2009), signed by the G. W. Bush and the Obama administrations respectively, federal buildings in the US have adopted mandatory measures for better energy efficiency and environmental management systems. Along with these executive orders, the Energy Independence and Security Act of 2007, enacted by the 110th US Congress, required the General Services Administration (GSA) to recommend a third-party building rating system to be used by all federal agencies and GSA suggested LEED as the certification system to be used (GSA, 2013). In 2013, 34 million square feet of LEED certified building space in DC was in federal government buildings only, accounting for 16 percent of the total certified space in DC. With the addition of local and state government buildings, educational buildings and non-profits, this number goes up to 71.7 million square feet, making up 33 percent of the total certified space.

Washington DC's leading position in the total area of green building per person indicates the significance of government regulations for making the benefits of green buildings available for more people. However, this information alone is not enough to describe the profile of people who have access to these spaces. Given that the majority of green building space is allocated by either government authorities or profit-oriented organizations (77%), it is expected that a significant portion of the people who can use green buildings in Washington DC are either government or private employees. Unfortunately, the quality of data provided by USGBC does not allow to do further assumptions about the profile of people who use these spaces, including their jobs, income level, age, etc. For example, according to the LEED Project Directory, for 34 percent of the total area of green buildings registered in DC, the “project type” field was left blank and 30 percent of the registered space is identified as either “commercial” or “commercial retail” without any further specification. With the absence of these data, it is not possible to answer questions such as “Are most of the jobs that are in green spaces are corporate middle class jobs?” or “Given the current structure of the LEED certification process, do people who work in smaller businesses also have a chance to work in a green building?”

Developing strategies that can increase accessibility to the benefits of green buildings by all segments of the population requires identifying where these projects are located, their ability to serve urban areas with dense populations and the socioeconomic characteristics of the populations they serve. For this aim, I developed a preliminary analysis to help clarify if the location and amount of green spaces built are related to the density and/or median income of their locations. By doing so I tried to answer two questions: “Are most of the green buildings located in densely populated areas?” and “Are green building spaces more available for people with higher income, than lower ones?”

In order to answer these questions, regressions analysis were run for the three models that were described in Section 4.6. The results (Table 6.7) for Model3 shows that when measured together, the variations in the median income and population density can account for 4.6 percent of the variation in the total area of LEED registered buildings. The direction of this relationship is positive and it is statistically significant, meaning that increase in both variables also lead to increases in the amount of LEED certified projects in a region. However, 4.6 percent is a low percentage to explain the variations, indicating that there are other variables that affect the amount of LEED projects that are registered within a particular zip code. Comparison of the ANOVA tables (Table 6.8) shows that the residual sum of squares of Model3 is lower than that of both Model1 and Model2, therefore income and population density together can account for the change in total area registered better than the individual variables. The p-values in comparisons also show that the differences among these models are statistically significant.

According to the results of Model 1 and Model 2, when variables are examined individually, population density can account for a higher portion (3.8%) of the variance in the total area registered than income levels (1.2%). This difference can be seen through the maps presented in Figure 6.4 and Figure 6.5 as well. The first map, which compares the distribution of total area of LEED registered projects with population density, shows that LEED projects follow a similar pattern with degree of urban density: clusters form around the urban areas of New York, Buffalo, Rochester, Syracuse and Albany. However, while most of these projects are located within close proximity of urban areas, they are not necessarily located in the heart of the cities, or in the densest areas. The dark green spots on the map with little or no LEED registered building area are where the green building market did not grow significantly, despite high population density. These locations also show that although LEED certification provides healthier and more environmentally friendly working areas, these features do not necessarily become more available as the population increases. In other words, in some locations, these features are less accessible to the population than they are in other locations.

Accessibility to the benefits of green buildings could be related to income levels due to the increased building values and higher rents. But, both the regression analysis and the map presented in Figure 6.5 shows that this argument is not totally valid within the New York State area either. Although median income and the total area of LEED registered buildings are positively correlated, the relationship between the two is too weak to make conclusions such as LEED projects are built in relatively wealthier districts. The map in figure 6.6 also supports this finding, by showing that LEED projects are mostly located in the boundaries of or in close proximity to urban areas where income is comparatively higher than in rural areas. But many suburban areas with higher levels of median income still have few or no registered projects. Given the content of the data, which does not include LEED for Homes, this is not a surprising result because most of darker areas with higher income levels are residential suburban districts that surround the cities.

The analysis of the distribution of LEED registered projects within New York State provides some information about where those projects are concentrated and their relationship to median income and population density; showing that most of the projects are located close to the dense urban areas but the amount of registered space does not increase with density significantly. This is also true for the relationship between area of LEED projects and median income. Nevertheless, the analysis also shows that there must be other variables, not yet identified, that can account for the difference in total area of registration. One problem that occurred during this analysis, which also affects the ability to explain variation, is the absence of variables to measure other differences between urban and nonurban areas such as amount of trade, local GDP, employment levels, percentage of residential areas, total space of office buildings, and type of businesses involved.

For this reason, a second set of analyses was conducted, this time focusing on variations within the NYC area. In order to understand how the urban environment affects the location and size of LEED projects. The results, presented in Tables 6.9 and 6.10, show that population density is not significant in explaining variation in the total area of LEED registered projects when the analysis is conducted within NYC. The direction of this relationship is negative and is not statistically significant. This is an important piece of information indicating that while more LEED projects are built within or close to urban areas, by forming clusters that can be seen in maps in Figure 6.4 and 6.5, population density loses its significance within these clusters.

However, contrary to the findings on population density, the ability of median income in explaining where and how many LEED projects are being built increases, if the analysis is conducted within the city borders. While at the scale of New York State, median income can explain only 1.2 percent of the variation, within the borders of NYC, accounts for 5.5 percent of the variation, with a p-value lower than 0.001, showing that the results are statistically significant. This relationship is also evident in Figure 6.6 through the regression line with a positive slope, meaning the area of LEED registered projects increases as income level increases in the NYC area. The map in Figure 6.9 also provides evidence to support this argument; showing that the area of LEED registered projects within the darker areas is larger, where the median income is above $100,000. But a significant number of these projects are located in Manhattan, which has a unique characteristic of being an urban area with one of the highest concentrations of high-rise office space within a narrow area. This makes New York City an attractive region for many new construction projects and a lucrative market for the green building industry as well. While this unique feature may be important for attracting LEED registered building projects to the city, the consequences are still the same; a large portion of the LEED projects are gathered in an urban area with high income levels.

As a final step, the maps showing the population density and the median income were combined to identify those zip codes with low income and high population density (Figure 6.10). The light green areas of the map in Figure 6.10 indicate the zip codes where median income is below $50,000 and the population density is above 50,000 people per square mile. These areas are highlighted to see if locations with larger populations but less purchasing power receive equal attention from decision makers in the green market industry or if these areas are being ignored. The results show that dense areas with less income are not totally ignored by the green building industry, but they also receive much less attention from the industry than the other areas. In most of the highlighted green areas, the total amount of LEED registered area stays below 292,000 square feet, usually even below 100,000, while in Manhattan this number can be as high as 24 million square feet. One exception is the area defined by the zip code 10027, where Columbia University is located. Despite its median income of $35,129, it has nine LEED registered projects with a total area of 733,417 square feet and five of these projects have certification. Most of these projects are, however, university owned buildings, including a new library, laboratories and other unspecified college buildings, which are located within the campus area and serving faculty, students and staff. Therefore, it is hard to claim that these projects serve for the entire local community, especially the disadvantaged, mostly African American community of the neighborhood, unless they are students or employees of the university.

Table 6.7 Multiple Regression Models: Gross Square Foot of LEED Project in NY State, 2013 n = 2332

	Model 1 (R^2=0.012)			**Model 2 (R^2=0.038)**			**Model 3 (R^2=0.046)**		
Variables	Par. Est.	β	Sig.	Par. Est.	β	Sig.	Par. Est.	β	Sig.
Median Income	3.49	0.111	**<0.001**				2.86	0.0905	**<0.001**
Population Density				14.197	0.197	**<0.001**	13.5	0.187	**<0.001**

Note: Bold values indicate $p < .050$. Par. Est. = Parameter Estimate, β = Standardized Estimate, Sig. = Significance Level.
Source: *LEED Project Directory, www.usgbc.org, accessed on September 2013*

Table 6.8 Analysis of Variance Table for Models on NY State

	RSS	**P-Value**		**RSS**	**P-Value**
Model1	3.48E+15		**Model2**	3.39E+15	
Model3	3.36E+15	0.000	**Model3**	3.36E+15	0.000

Source: *LEED Project Directory, www.usgbc.org, accessed on September 2013.*

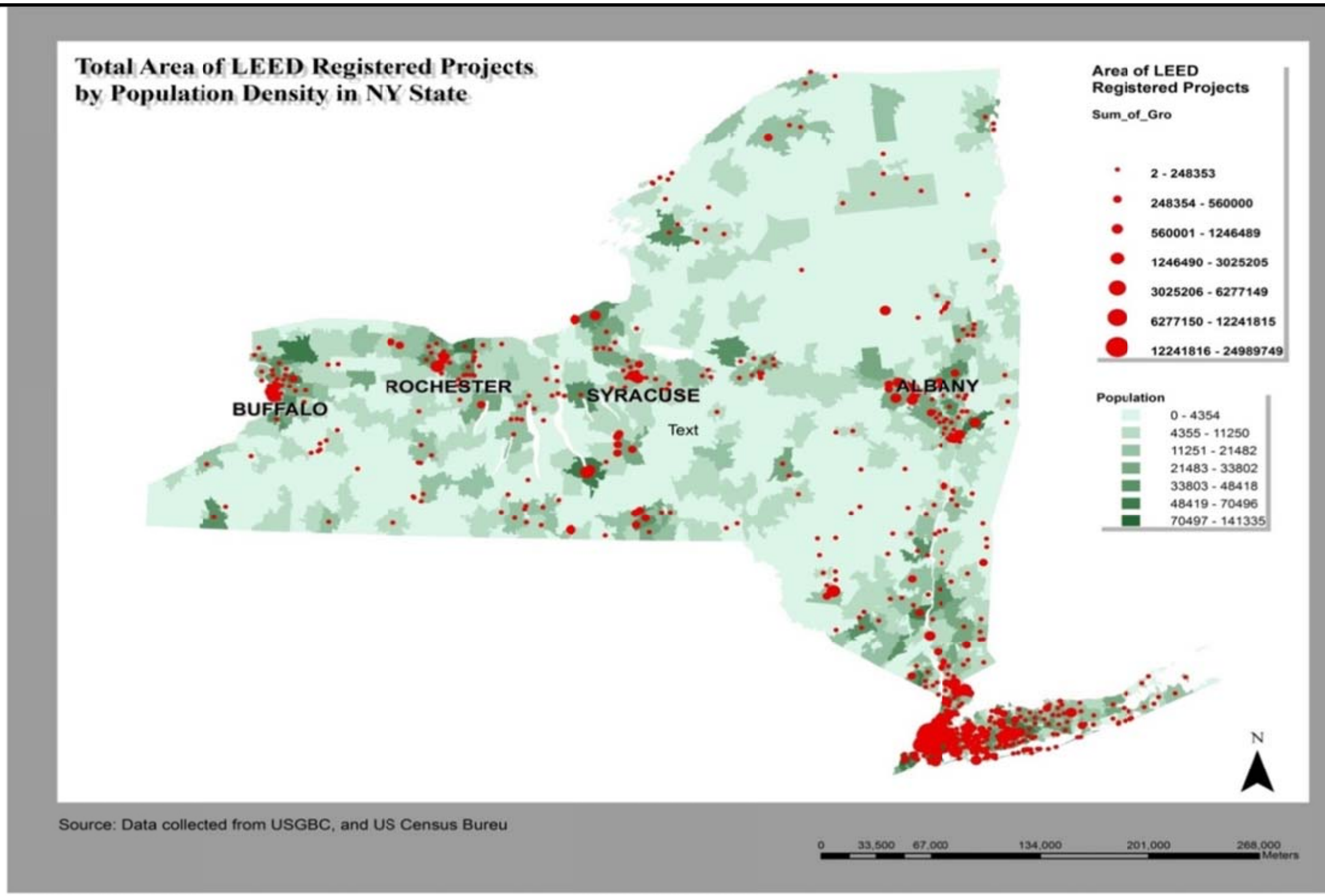

Figure 6.4 Total area of LEED registered projects in NY State and the population density.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

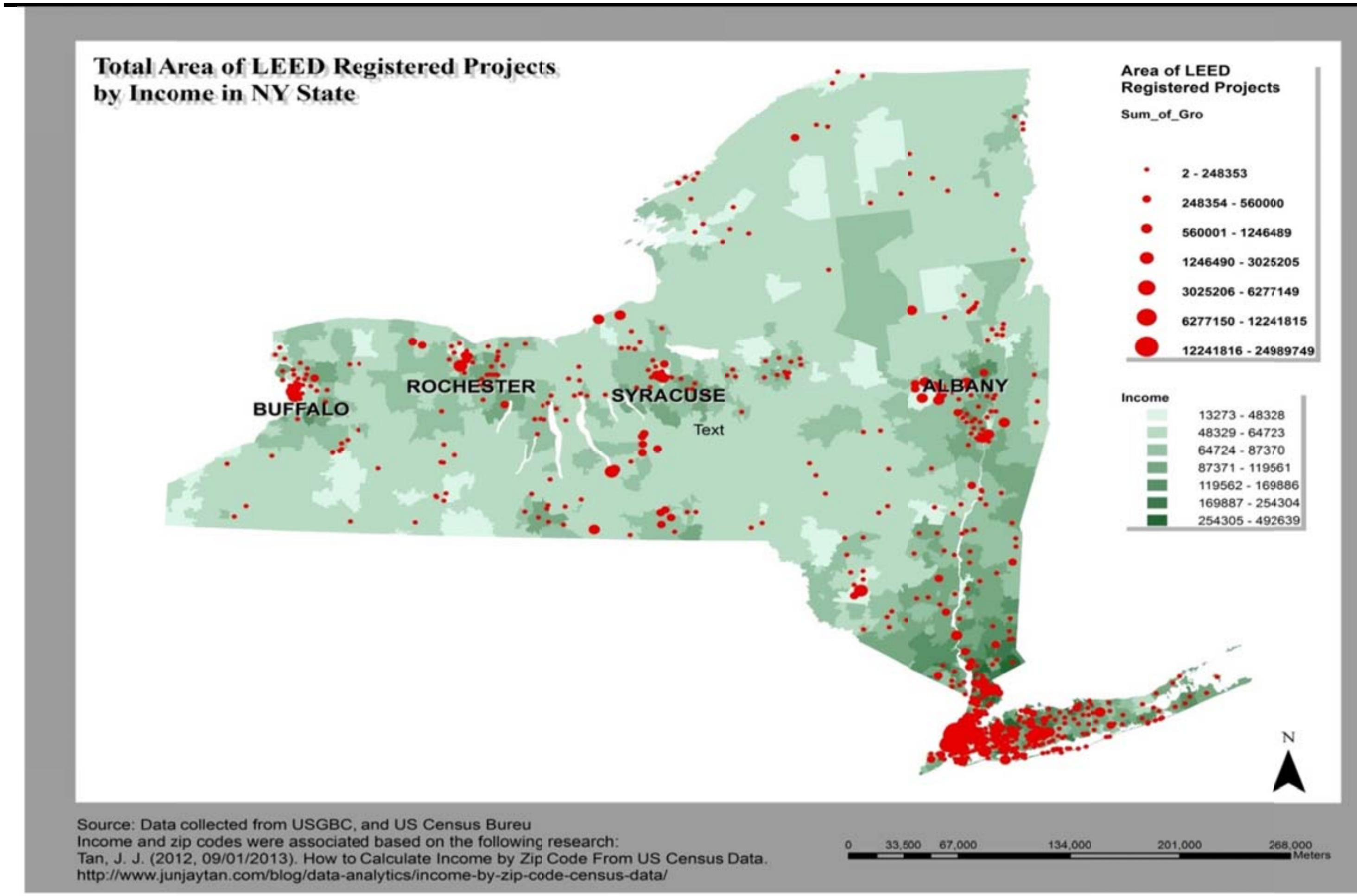

Figure 6.5 Total area of LEED registered projects in NY State and the median income.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

Table 6.9 Multiple Regression Models: Gross Square Foot of LEED Project in NYC , 2013 n = 2332

	Model 1 (R^2=0.055)			**Model 2 (R^2=0.005)**			**Model 3 (R^2=0.055)**		
	Par. Est.	β	Sig.	Par. Est.	β	Sig.	Par. Est.	β	Sig.
Median Income	17.6	0.237	**<0.001**				17.175	0.228	**<0.001**
Population Density				-0.075	0.197	0.254	-3.411	0.0267	0.687

Note: Bold values indicate $p < .050$. Par. Est. = Parameter Estimate, β = Standardized Estimate, Sig. = Significance Level.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

Table 6.10 Analysis of Variance Table for Models on NYC

	RSS	**P-Value**		**RSS**	**P-Value**
Model1	217.35		**Model2**	228.69	
Model3	217.2	<0.001	**Model3**	217.2	0.687

Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

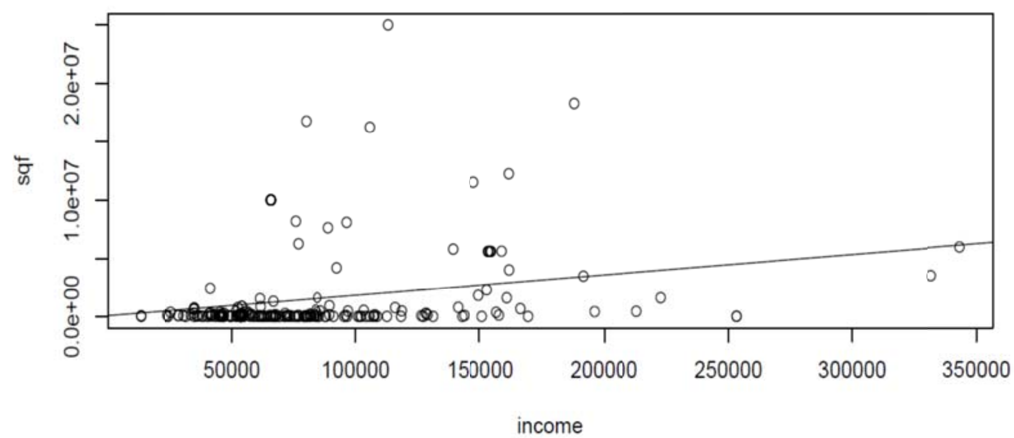

Figure 6.6 The regression line of total area of LEED registered projects and income in NYC.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

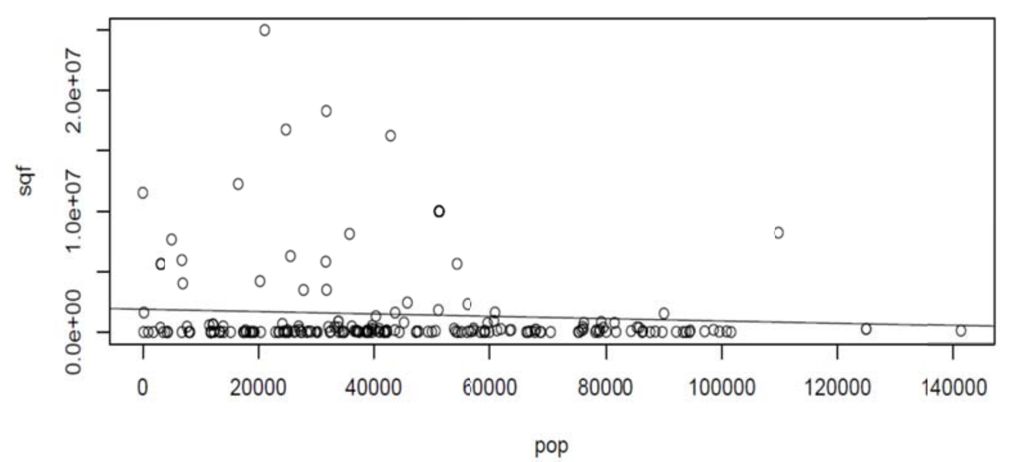

Figure 6.7 The regression line of total area of LEED registered projects and population density in NYC.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

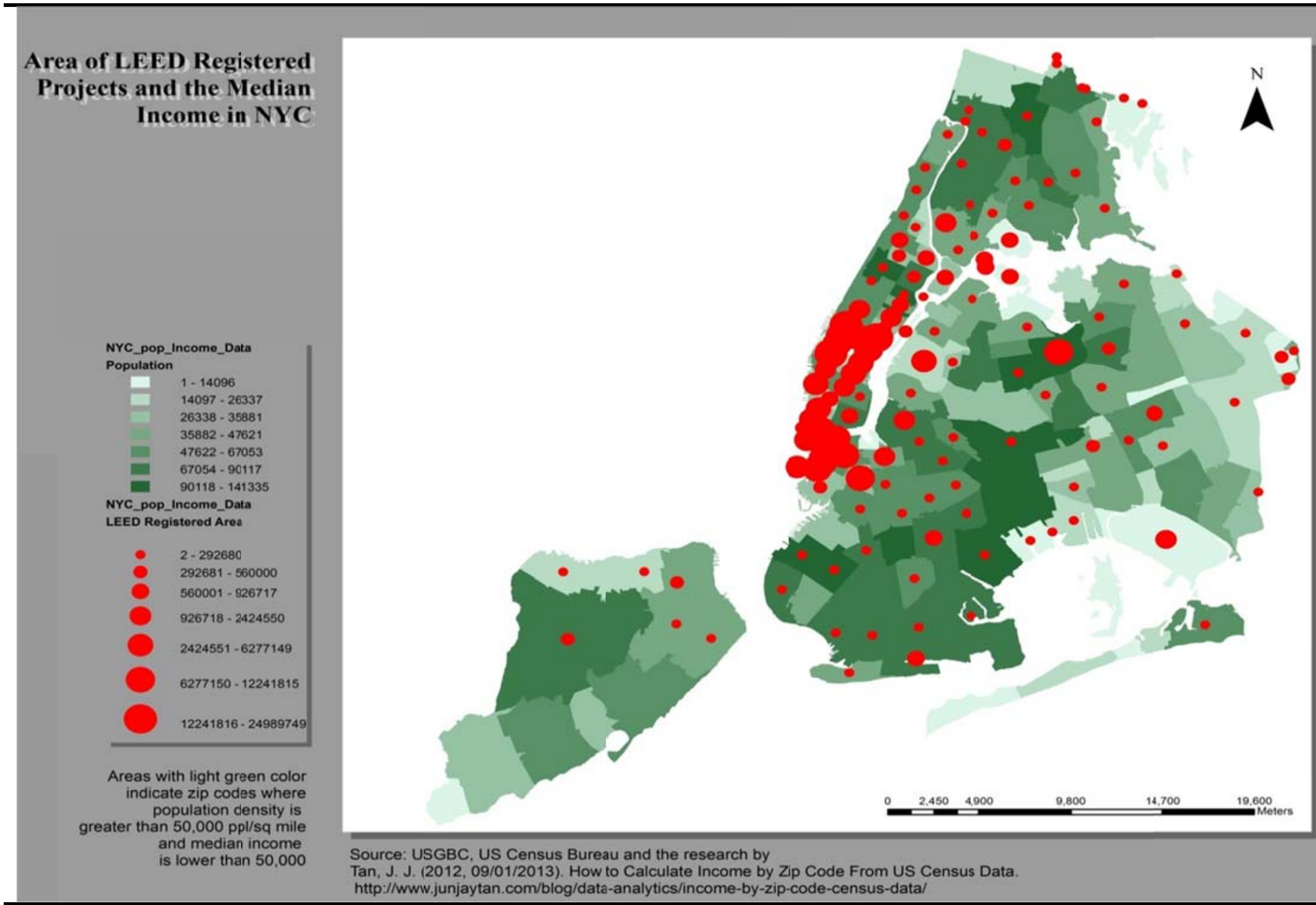

Figure 6.8 Total area of LEED registered projects in NYC and the population density.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

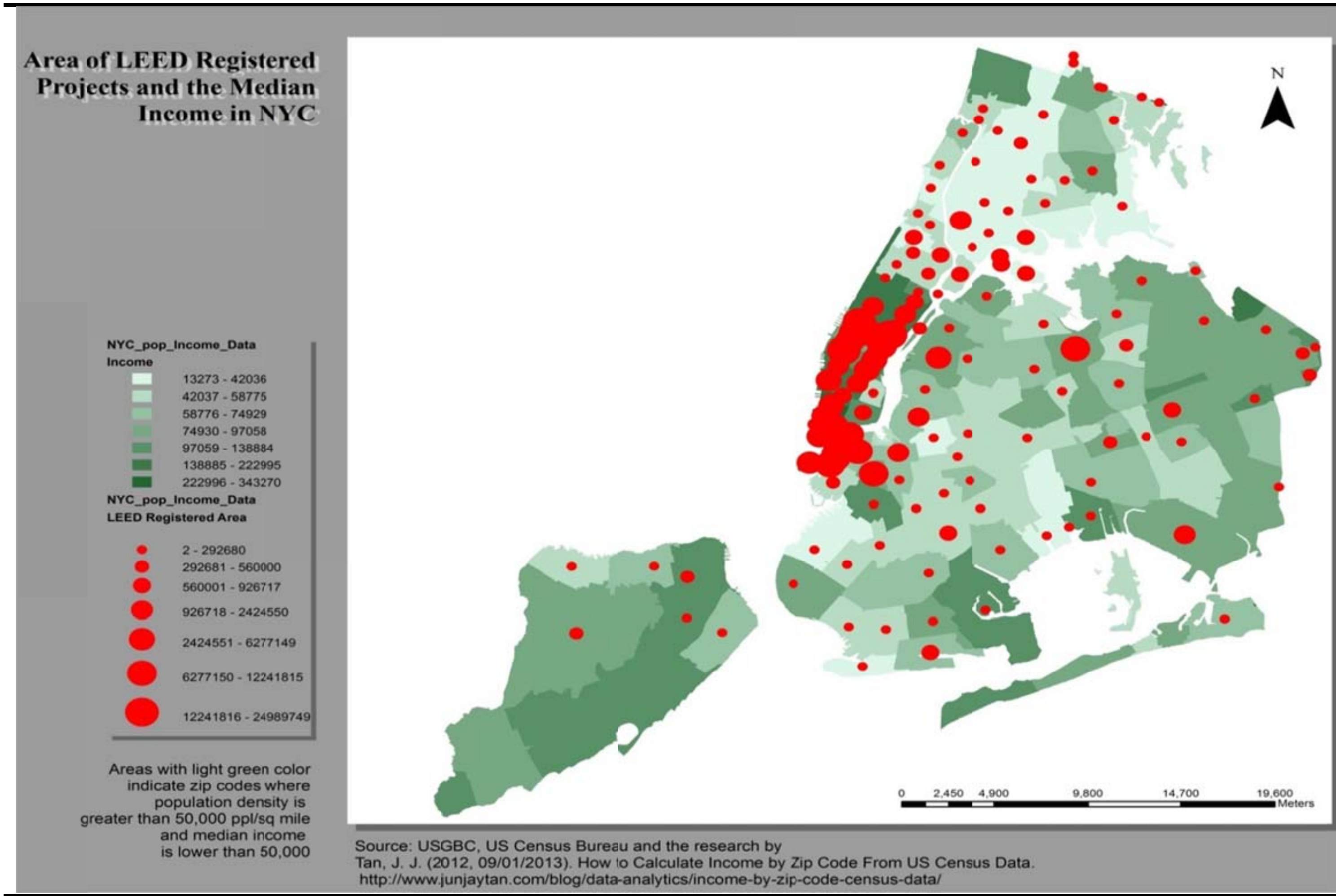

Figure 6.9 Total area of LEED registered projects in NYC State and the median income.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

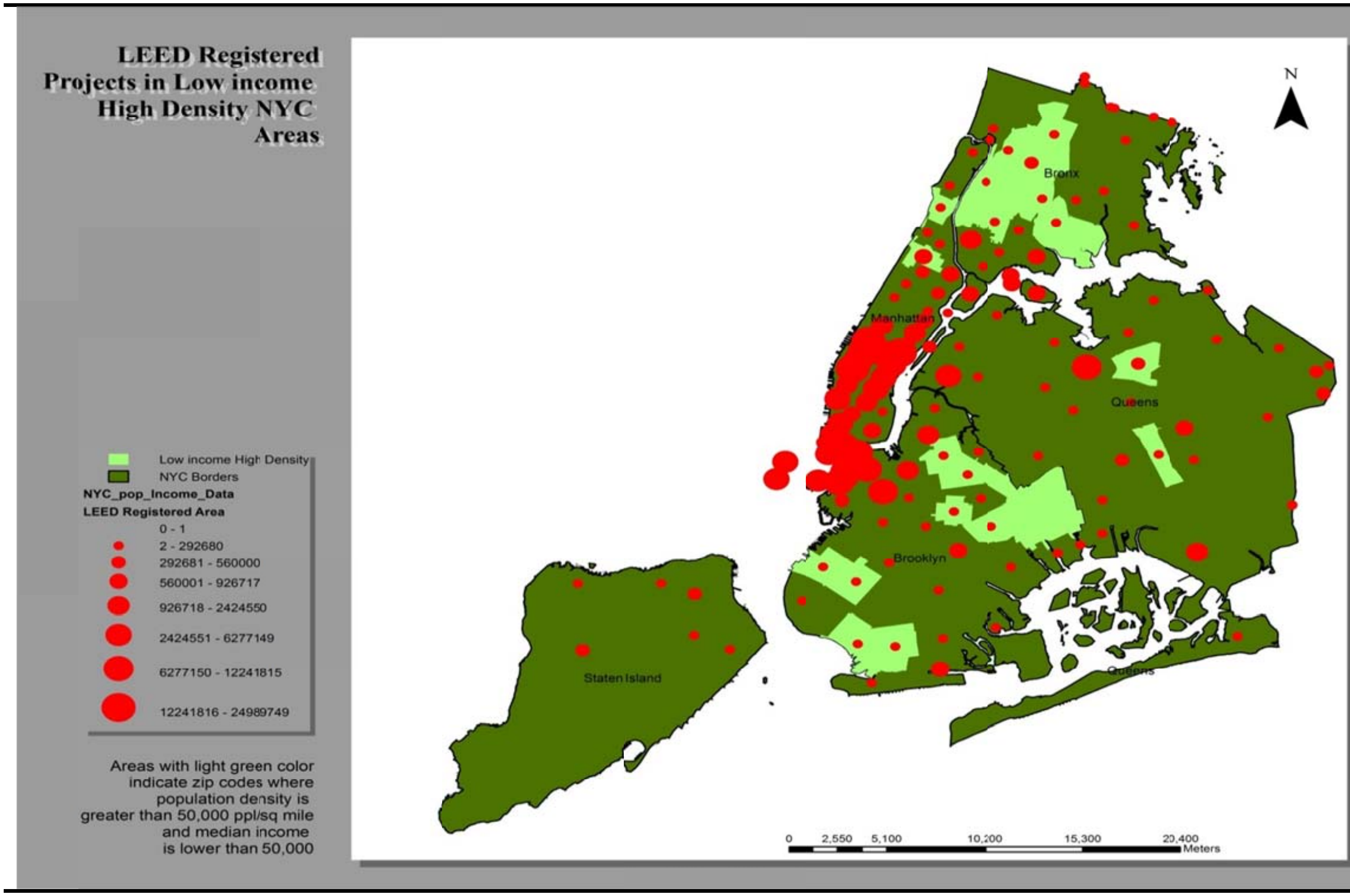

Figure 6.10 Number of LEED Registered Projects in low income high population density areas in NYC.
Source: *LEED Projects Directory, retrieved from www.usgbc.org, accessed in 2013*

The results of this research are not conclusive but they provide important clues for understanding the potential impacts of LEED on the socioeconomic structure. While it is true that LEED indirectly contributes to social wellbeing and economic efficiency by creating livable spaces, new jobs and increased economic value, are not sufficient to claim that LEED or other green building rating systems thoroughly address the socioeconomic aspects of sustainability. One problem that might occur regarding these aspects is the concentration of the green buildings in locations with high income, reducing its accessibility by lower income groups or smaller businesses. Several interviewees from a LEED consulting company in Manhattan stated that one of the biggest challenges of LEED for building developers and owners is the complexity of the documentation and the review processes. The complexity of these processes, which usually requires a team of consultants and engineers, in addition to the registration and certification fees, makes LEED harder for smaller businesses or owners of small buildings to apply for or receive LEED certification. This leads to the risk of limiting the benefits of green buildings to those who work in companies (mostly corporate) that are knowledgeable, determined enough to get certification and have enough funds; or those who live in certified multifamily housing with a premium on rent.

To address these issues and overcome the problems that limit LEED's accessibility to greater populations, further research is needed to identify the market patterns that lead developers to build in certain areas and to create incentive mechanisms to increase the amount of LEED certified areas in locations with low income and high population density. The introduction of new credits, similar to those that encourage brown field development, is an important tool for achieving this goal. It is also important for USGBC to provide more detailed data, maybe by recording types of businesses and building uses more specifically along with other data that will help identify user profiles of the buildings. Currently, only a small portion of the data collected by USGBC is publicly available. Even the public project directly, which was used for this research, is not available with the same amount of data anymore through USGBC's new website. Public disclosure of non-confidential data by USGBC on LEED projects would not only help future research about the green building market, but it would increase the transparency of the institution, which is one of the major principles of sustainability.

In addition to increasing accessibility to green building areas, there are many other ways for LEED to positively affect the socioeconomic structure. The GRI indicators which were selected in this study as candidates for introduction to the green building industry provides an idea about this potential, since they address labor processes, human rights, educational opportunities and community enhancement. Several interviewees stated that that they were not familiar with possible socioeconomic improvements that can be delivered by LEED because they usually do not focus on these aspects of construction and design. Most of their responsibilities during the LEED certification processes do not require engaging with construction workers or supervising the construction process. Therefore, they do not have opportunities to make judgments about the quality of the work environment, condition of workers or their compensation levels. Many of the interviewees however do have some information about the needs of the neighborhoods in which the projects are built because they occasionally have to hold meetings with community representatives as a requirement of the integrated design process. This can also be helpful for them in meeting the requirements of zoning regulations and other local rules. But the interviews reveal that a gap still exists between the environmental benefits of green buildings and the socioeconomic consequences of certification both at the conceptual and the practical levels. Despite the consciousness about the possible impacts of the projects on their neighborhoods, the long-term socioeconomic impacts of the buildings remain unknown in many cases, given the absence of indicators to assess and manage them. The economic value and employment that will be created, contribution to the wellbeing of the local work force, improvements in the social assets of the communities or the risks of gentrification are among these impacts yet to be measured and managed during the green building certification process.

CHAPTER 7

EXPANDING LEED: POSSIBILITIES

Each of the selected GRI indicators was examined in detail to determine if they are suitable for being a LEED credit. For this purpose pilot credit requirements of LEED and the criteria presented in section 4.7 were used as guidelines. The results of this analysis are presented in this chapter.

7.1 Identification of Possibilities

Previous research has shown that as a green building rating system, LEED has moved further significantly in the last decade, from being a resource conservation and pollution prevention centered rating tool towards being a more comprehensive assessment system of covering a larger scope of topics including community enhancement, responsible site selection, promotion of sustainability reporting suppliers and many others, tailored to be applied on a variety of building types. Despite this improvement in the scope and scale, comparison of the literature on sustainability in the building industry with the existing 12 sets of indicators from the building industry showed that there are still significant number of fields that remains unaddressed by these sets, although they are covered by the literature. As shown in Chapter 6, table 6.1, ten of these indicators have been chosen to be examined, listed in two major categories: labor issues and human rights.

7.2 Labor Processes

Among the selected GRI indicators, seven were grouped under Labor Processes (Table 7.1), based on their intents which are all centered on the benefits, rights and working conditions of the labor force. This section addresses each of the labor process related credit in turn.

7.2.1 EC3: Coverage of the organization's defined benefit plan obligations.

GRI EC3, Coverage of the organization's defined benefit plan obligations is intended to assessing an organization's ability to provide good benefits to their employees and to maintain their workforce. It focuses on the types of benefit plans and asks organizations to disclose if they provide defined benefit (DB) plans or other types. GRI distinguishes defined benefit plans from other types by the long-term obligation that employers have to meet in order to guarantee employees' access to a retirement plan and the quality of the benefits.

EC3 is a "response" type indicator. It assesses an organization's ability to create positive impacts on socioeconomic structure of society by improving working conditions. The assessment method can be categorized under lifecycle since developers do not regulate defined benefit plans directly through the developer but by secondary or tertiary actors who are contractors, subcontractors or unions. Investigation of retirement plans, liabilities to employees, percentage of salary contributed and participation rates are the main tools of the indicators. The finance or accounting departments of contractors or the contracts between the developers and the contractors are possible sources for data collection for this indicator.

According to the IRS, DB plans have the advantage of providing predictable and significant benefits in a relatively short period of time. These are the plans to which employers can contribute and deduct more than under other plans (IRS, 2013a). One of the biggest differences of DB plans and other plans is their independence from asset returns, which protects the beneficiaries from economic fluctuations and give them the ability to predict their post-retirement financial situation. However, DB plans have some disadvantages of being the costliest and most administratively complex plan. There is also the risk of being exposed to an excise tax if the minimum contribution requirement is not met.

The second type of plan, which is the defined contribution (DC) plan, provides benefits for each individual based on the amount that is collected in each participant's account. Unlike defined benefit plans, benefits are not always independent from asset returns if the plan is a profit-sharing plan but the investment earnings of the plan is effective on the retirement returns. Therefore defined contribution plans do not guarantee the amount of benefits to be received after retirement. Currently, plans that follow the 401(k) requirements are the most popular type of DC plans in the U.S. These plans do not require contributions from employers while allowing employees to make unlimited contributions, which will be deductible from their income tax.

According to a report issued by the Utah State Legislature (USL, 2007), DB plans receive better benefit returns than DC plans mostly because of the mismanagement of the investment options by individual participants. Although DC plans provide the opportunity for higher gains under careful investment management, historically DC plans tend to provide 1 to 2% lower returns than DB plans and the returns are not as stable as under DB plans.

The report also points out several long-term risks of DC plans for both the work force and employers. One of these risks is the absence of the aggregation of “mortality risk” in DC plans, which allows allocation of risk of mortality of contributors among all the participants, hence providing a lifetime benefit for all. In DC, the “mortality risk” is bared individually by the contributors, which means that each beneficiary has to define an expected lifetime. If this lifetime period is exceeded there are no more payments and the participant has to find other sources of funding for his or her retirement.

Preference for DB over DC plans is a major shift of responsibility from employers to employees in terms of saving and managing their funds for retirement. Since employers are no longer responsible for the end result -- that is the quality and continuity of retirement benefits -- no incentives are placed on employers to help employees manage their retirement benefits effectively. With the absence of necessary financial knowledge and institutional experience, employees who have DC plans rely either on their own financial skills or on third parties’ willingness to provide them the maximum benefits with minimum cost. This puts the employees in a more vulnerable situation compared to the secure environment of DB plans.

DC plans also come with higher management and investment cost, which are placed on the employees. USL’s report shows that DC plans in retail mutual funds have investment fees ranging between 0.75% and 1.25% on average whereas DB plans have only 0.25% combined total administrative and investment costs.

One of the possible determinants of the type of benefit plan is continuity of work. In sectors or positions where loyalty of the employees is important, it is expected that the employers will be more willing to offer a defined benefit plan whereas in sectors or positions where flexibility is more common and the turnover rate is high employers are likely to prefer defined contribution plans. Data released by the BLS shows that construction has one of the highest annual turnover rates with an average of five years approximately 73%, along with the leisure and hospitality sector. In 2012, the annual turnover rate for the construction industry (67.5%) was almost twice as high as the average for all sectors (37.1%) (Bureau of Labor Statistics, 2013). The low level of defined benefit plans in the construction industry may be related to these high turnover rates.

However, rate of having defined benefit plans in an industry also change together with the unionization rates. The BLS report shows that in 2011 67% of all unionized workers had defined benefit plans whereas this number was only 13% for nonunion workers. In the construction industry the similarity between unionization rate (14%) and the percentage of workers holding defined benefit plans (16%) indicates that unionization of workers may be the main reason for the existing prevalence of defined benefit plans, despite the high turnover rates and the low level of defined benefits across all industries.

Although defined benefit plans provide higher retirement benefits and a more secure retirement period, given the temporary character of work and the high turnover rates in construction, it is not realistic to expect employers to provide defined benefit plans for the majority of construction workers, unless there is an increase in the unionization rate. For this reason, the language of a LEED credit that would address benefit plans for employees requires extra attention. Translating the GRI EC3 into LEED's language require some modifications in the structure of the indicator. If the credit asks project owners directly to prefer contractors that provide defined benefit plans for relatively larger number of employees this can be discriminatory for workers who do not have DB plans. In other words such a credit could hurt workers without DB plans instead of helping them because the project owners would avoid hiring workers with DC plans. Since 84% of the workforce in construction does not have a DB plan, the requirements of such a credit would also be very hard to achieve unless number of workers DB plans increase significantly.

However, a credit that would encourage contributions to the retirement benefits of employees can still have positive effects on the quality of retirement of employees and the sustainability of the workforce in the long run. Such a credit could reward projects owners who choose contractors who provide contributions to the retirement plan of employees above certain limits or that include clauses in contract agreements that ensure additional contributions to the retirement plan during the time of the project, or who choose contractors that provide defined benefit plans for their workers. In this way, the credit would address workers with different types of benefit plans by either supporting already existing defined benefit plans or encouraging additional contributions to those who have define contribution plans.

A comparison of GRI EC3 using the checklist presented in Chapter 4 shows that a modified version of EC3 would not conflict with pilot credit requirements or the foundations of LEED. Table 7.1 provides a filled out version of the table 4.8 presenting data regarding GRI EC3.

Table 7.1 GRI EC3 Pilot Credit Analysis

Title:	Coverage of the organization's defined benefit plan obligations.	
Intent:	Assessing the ability of the project to provide good benefits for its employees and to maintain the workforce	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Type of benefit, percentage of salary contributed by employer
2. Are the resources clearly defined?	Y	Finance or accounting departments should have the information required by this Indicator.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	IAS 19 Employee Benefits
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	Y	Benchmarks are defined by IRS, data is available, similar examples exist.
2. Does the credit support the intent?	Y	Contributing to retirement benefits and encouraging employees to contribute more help create a more stable workforce and encourage existing employees to stay within the industry.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	The credit enhances the labor force and the socio-economic structure in general.
4. Does the credit support market innovation?	P	It does not bring direct innovation to the job or labor market but it supports multiple different sectors that are related to retirement plans, including insurance and finance.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	Y	Documentation of the requirements does not bring any significant extra cost. Although matching employee contributions incur initial costs, these are deductible from taxes as described in IRS publication 560.

*Y: Yes, N: No, P: Partially

GRI EC3 clearly defines the submittals that can be used to identify the benefit plans provided to workers. The indicator points to finance or accounting departments of organizations as the source of the necessary information. This information includes:

- type of benefit plan(s)
- source of funding if it is DB,
- the estimated value of liabilities and the estimated ability of funding to meet them,
- strategies to fully cover the liabilities,
- percentage of salary contributed by employee or employer,
- level of participation in retirement plans (participation in mandatory or voluntary schemes, regional or country-based schemes, or those with financial impact).
- instructions related to calculation and consolidation techniques methods in consideration with different jurisdictions.

As a reporting guideline for organizations, GRI addresses various aspects of the provision of retirement benefits including the source of funding and funding strategies. However, for a LEED credit that would aim at enhancing retirement benefits should have a narrower scope. It can only address the contributions that occur during the construction period. It this sense, among the types of information listed above, only the type of the plans and the percentage of salary contributed by employers are relevant. In order to address cases where DC plans apply, this information can be rephrased to disclose the maximum amount of an employee’s contribution that is being matched by the employer as a simple indicator of the employer’s support of retirement benefits for its workers.

Since the credit does not require any technical specification but addresses labor processes, it is applicable to all types of projects and rating systems. In addition to submittals, the resources are clearly defined as well. GRI gives International Accounting

Standards (IAS) 19 on Employee Benefits as the reference standard. This can also be used by the guest experts to audit projects performance in meeting the requirements of the credit.

Three conditions can affect the achievability of the credit: Existence of benchmarks, availability of the necessary data and ability of organizations to meet the proposed criteria. Benchmarks can be derived from national or local regulations as well as averages of contribution rates in the market. Publication 560 issued by the Internal Revenue Service is one source for deriving such benchmarks (IRS, 2013b). The document defines minimum and maximum limits for contributions to retirement plans by small business owners addressing both DB and DC plans. The credit language can be designed in a two-tiered way where any contributions to employees' retirement plans throughout the design and construction period would be rewarded with a certain number of points. Additional points could be awarded for projects where the maximum contribution rate allowed by the IRS or other regional regulations is offered to employees. Requests for Qualifications (RFQ) for projects could include clauses ensuring contribution matching by contractors towards the retirement plans of workers engaged with the project, limited to the design and construction period of the project. For example, while the presence of such a clause would be awarded with certain points, if the employees have 401(k) plans, then a 3% contribution rate, which is the highest rate defined by IRS, could be awarded with extra points.

Documents investigated in relation to the Project 4 and interviews with the managers of LEED projects in this study indicate that inclusion of such clauses in RFQs is possible. The RFQ for Project 4 in this study is an example for how building projects can encourage contractors to take certain measures that enhance the local workforce. The RFQ clearly states that applicants should be businesses that are registered with the NJ Department of Treasury, the Division of Revenue and "the contractor or subcontractor should agree to make good faith efforts to employ minority and women workers consistent with the applicable county employment goals established in accordance with N.J.A.C. 17:27-5.2 or a binding determination of the applicable county employment goals determined by the Division, pursuant N.J.A.C. 17:27-5.2."

Compliance with the employment goals of N.J.A.C. 17:27 requires writing bidding documents and contracts in a way that leads contractors and subcontractors to select the required proportion women and minorities. The required percentages are listed in NJ State's website for each county. This requirement shows that it is possible to include specific measures in bidding documents and contracts for the projects that aim at enhancing social conditions. These measures can encourage contributions to retirement benefits as well as giving work opportunities to women and minorities.

The credit does not require any measures that are uncommon in the construction sector, nor does it need supply of any rare material or information that is hard to collect. Therefore, once necessary language is clearly construction through giving references to related standards, it is possible to achieve the credit by including necessary clauses in RFQ and ensuring that the (sub)contractors follow these requirements.

Although (additional) contributions to employees' retirement plans can incur initial costs that may discourage contractors or subcontractors from meeting the requirement for this credit, these costs can be reduced thanks to the IRS's regulations that allow some of these contributions to be tax deductible (IRS, 2013b). Previous studies show that approximately 60% of employers in the U.S. already match the contributions of their employees within certain limits. When the amount of matching is increased to 100%, participation to DC plans increases up to 26% (Even & Macpherson, 2004). Even and Macpherson draw from previous studies to point out two possible reasons for employers willingness to match: (1) matching helps companies satisfy non-discrimination rules enforced by the IRS; and (2) workers who benefit from matching are more likely to be loyal, use fewer sick days and receive higher performance ratings. For these reasons, supporting and encouraging contributions to retirement funds would not only benefit employees, but would also provide advantages to employers, bringing possible solutions to the incentive problems discussed in the previous chapter. Therefore, a credit that rewards improvements in retirement funds would not have to challenge the needs of the industry or the structure of the market.

The intent of GRI EC3 is to provide information about an organization's ability to provide good benefits to its employees and to maintain its workforce. With respect to green building rating processes, this intent can be rephrased: "assessing the ability of the project to provide good benefits for employees and to maintain the workforce." Here "employees" refer to those who work for the project only and the workforce refers to the workforce of the construction industry or workforce of subcontractors. Employers' contributions to the retirement benefits of employees increase the resilience of the workforce while also creating a more "worry-free" working environment by reducing the stress that can emerge from unpredictability of the future. For this reason, this credit can help create a better working environment for the entire design and construction team while encouraging them stay in the industry, thus maintaining the workforce.

7.2.2 EC5: Range of ratios of standard entry-level wage by gender compared to local minimum wage at significant locations of operation.

GRI EC5 is an indicator guiding an organization to disclose its contribution to the economic wellbeing of its employees. It also aims at providing information about the competitiveness of an organization's wages. GRI states that "offering wages above the minimum can be one factor in building strong community relations, employee royalty and strengthening an organization's social license to operate" (GRI, 2011b). By requiring organizations to report their entry level wages as a percentage of local minimum wages for both genders, the indicator also aims at wage gaps between women and men in the organization.

EC5 is "response" type indicator. It assesses the response of the organization to the existing wage level and its attempt to improve the socio-economic conditions of employees by regulating wage levels. It can be categorized as a lifecycle indicator since the project or owner or development does not usually pay wages directly to workers. However, the indicator assesses the processes that occur within the temporal and special boundaries of the construction project. Therefore it can also be considered an end-user impact indicator. Possible assessment tools that can be used for the construction industry are described below.

Providing entry level wages to employees above the federal or local minimum wages can improve the living quality of employees with the lowest earnings and strengthen lowest wage earners economically. For communities where construction workers constitute a significant portion of residents, this can also help local economies revive and increase the resources allocated for these neighborhoods by increasing the purchasing power of residents.

However, increasing entry level wages is likely to face significant opposition, especially from labor intensive industries such as construction, due to expected effects on the overall cost of construction. Examples of such opposition can also be found in the discussions about prevailing wages. But a recent study (Mahalia, 2008) shows that, opposed to the common belief, prevailing wages do not necessarily increase construction costs. Mahalia argues that labor costs usually make up only one fourth of total construction costs, including overhead, reducing the overall effect of any increase in hourly wage to 25%. Additionally, incremental costs due to prevailing wages might be offset by increased efficiency and decreased construction time. Mahalia also states that the laws regulating the prevailing wage help reduce injuries and fatalities by encouraging the training and retention of workers while increasing the tax revenues of the states where they are applied.

Despite the findings of Mahalia's study, development of an indicator that would encourage developers still presents several challenges. One is the incentive mechanism and the tendency of developers to choose indicators that bring the maximum number of points with minimum cost. Several interviews conducted with the employees of the sustainably design consulting firm in Manhattan stated that this tendency is the primary criterion of project owners and is the designer's strategy in choosing which LEED credits will be pursued. Therefore, a credit that guarantees minimum pay for employees should also promise some benefits for developers and/or building owners that would compensate for the cost. Unlike the contributions to retirement benefits that can be provided through tax deductions in GRI EC3, it is harder to provide similar direct benefits from setting a minimum wage level.

Research conducted by the Center for Urban Innovation (Vitullo-Martin & Cohen, 2011) shows that increasing costs of labor can force developers to change their investment decisions. Martin and Cohen's study on decreasing use of unionized construction labor in the NY, NJ and CT region shows that the price premium of union workers can lead developers to choose nonunion workers, even in high-rise construction, despite the well trained and highly skilled character of union workers. They present Northside Piers as an example, a luxury tower in Brooklyn, built by Toll Brothers and L+M Development Partners, where the tower built by union workers cost $365 per square foot, while the other tower built by non-union workers cost $280. Martin and Cohen argue that this price difference can offset the money lost in delays in construction, sales and renting, or other financing costs. Therefore, especially in times of economic downturn, these premiums might harm union workers by encouraging developers to choose nonunion workers. In a similar fashion, the same tendencies might force developers or building owners to opt out this credit and choose other, reducing the usefulness of it.

GRI addresses a possible increase in the competitiveness of organizational wages and the loyalty of workers as a solution to this incentive problem. However validity of these arguments for the construction sector is yet to be shown. GRI defines the "entry level wage" as "the full-time wage offered to an employee in the lowest employment category" excluding intern and apprentice wages (GRI, 2011b). By the time this research had been conducted, there was no data available showing average entry level wages for the construction industry. An alternative strategy is to look at the lowest possible hourly rates that can be earned in the construction industry. For this aim, hourly wages of the first 10 percentile of the lowest paid occupation is expected to represent the possible lowest entry level wages. According to t2010 data provided by Bureau of Labor Statistics (BLS) construction laborers and helpers earn the lowest median annual wage with $28,410 among other occupations listed in construction sector (Bureau of Labor Statistics, 2012b). The basic tasks in construction process are done by these workers, which mostly require physical labor. Forty % of these workers are helpers and construction trades with the lowest average annual pay -- $26,360 -- while 20% of construction laborers earn a slightly a higher wage of $29,280 per year.

GRI does not clearly define either the competitiveness of organizations' wages or the loyalty of workers. However, loyalty of workers can be traced through turnover rate data provided by BLS. If higher entry level wages lead to higher levels of loyalty, then a negative relationship between annual turnover rates in the construction industry and level of entry level wages is expected.

There is no data showing the entry level wages specifically. However, estimates are possible by using data provided by the Bureau of Labor Statistics. Table 7.2 provides a list of hourly wages estimated to be the lowest entry level wages in the construction industry. For states where data is available helpers' wages are taken; for those states where data is not available for helpers wages for construction laborers are taken. For states where the mandatory minimum wage is below $7.5, which is the hourly wage required by the federal law, the federal wage is used for comparison. The data shows that the lowest 10th percentile of a mixture of lowest paid occupations (laborers and helpers) receives a national average hourly wage of $9.05, which is 24% higher than the federal minimum wage. The comparison shows that entry level wages are 20% higher than the local minimum wages on average, with a standard deviation of 15%. Only in Alaska, Colorado, Connecticut, Rhode Island and the District of Columbia are the wages more than 35% above the minimum wage.

Nevertheless, minimum wages are not always a good source of information for the ability of a wage level to satisfy the basic living conditions of employees and their families. Two indicators that have been developed for this aim are the poverty wage and the living wage. These indicators show the wage required to support employees in different locations and with different family sizes. *The Living Wage Calculator* , developed by the Massachusetts Institute of Technology (MIT, 2013), provides information about the minimum living wage and the minimum poverty wage for each county within the US, in comparison with typical wages. The calculation is based on the data collected in different locations showing the necessary expenses of different family sizes for food, child care, medical, housing, transportation and other, also taking taxes into account. The tool also compares typical wages with living wages. MIT states that typical wages "reflect May 2010 State-Level Area Occupational Employment and Wage Estimates produced by the U.S. Department of Labor" (MIT, 2013), therefore they are higher than entry level wages.

Table 7.3 gives information about living wages in certain locations (MIT, 2013), including those where entry level wages are more than 35% above the minimum wage. The data shows that even in places where entry level wages are more than 35% above the minimum wage, typical wages barely exceed the living wage level, except in Juneau City, Alaska and Chicago, Illinois. In Juneau City typical wages are 35% and in Chicago 26% above the living wage. However, in Denver, Colorado, although entry level wages are more than 35% above minimum wages, typical wages remain 10% below living wages. Table 7.3 also shows that in many cities including New York, San Francisco, Washington D.C., Austin, Boston, Dallas and Montgomery, typical wages remain below the living wages.

This data indicates that comparing minimum wages with entry level wages might not give sufficient information about the ability of wages to meet the basic needs of the employees. Even in cases where entry level wages are significantly above the minimum wage, wages on average often fall short of meeting basic living standards. For this reason, the language of the indicator could be modified in order to compare entry level wages with living wages. A green building credit that addresses this issue could require that the lowest wage paid during the project be at least equal to the local living wage. According to the interviews conducted in this study with project managers and the director of a research center, it is technically possible to include such clauses in contracts with general contractors and subcontractors. But, its acceptance by contractors and project owners remains a question of incentive. Therefore, the relationship between the entry level wages and employee loyalty gains significance as a possible incentive mechanism.

There are two reasons to question the validity of this relationship. One is the broken linkage between the bearer of the costs and the beneficiary. Even if a linkage can be proven to exist between entry level wages and loyalty of workers, the ultimate costs will be borne by developers or building owners. However, they will not benefit from the loyalty of workers; those who benefit will be the subcontractor firms or the unions. Therefore, increased loyalty of workers can be an incentive only if the cost of increasing entry level wages is borne by the subcontractors without changing the final cost, which is a highly unlikely scenario. Otherwise, there is an incentive problem where the benefits of paying higher wages cannot be enjoyed by those who pay the wages.

Table 7.2 Comparison of the Estimated Lowest Hourly Wages for Entry Level Positions in Construction Industry with Federal and State Minimum Wages

State or other jurisdiction for 2013	Minimum Wage ($)[i]	First 10% Hourly Wage ($)[ii]	Ratio of the difference between to wages to the min wage
Federal (FLSA)	**7.25**	**9.05**[iii]	0.20
Alabama	0	8.01	0.07
Alaska	7.75	12.69	0.70
Arizona	7.8	9.81	0.33
Arkansas	6.25	8.12	0.08
California	8	8.64	0.17
Colorado	7.78	10.29	0.39
Connecticut	8.25	10.67	0.41
Delaware	7.25	8.53	0.14
Florida	7.79	8.43	0.15
Georgia	5.15	7.79	0.04
Hawaii	7.25	9.69	0.29
Idaho	7.25	7.76	0.03
Illinois	8.25	9.36	0.26
Indiana	7.25	8.07	0.08
Iowa	7.25	9.87	0.32
Kansas	7.25	7.88	0.05
Kentucky	7.25	9.03	0.20
Louisiana	0	8.77	0.17
Maine	7.5	8.31	0.11
Maryland	7.25	8.65	0.15
Massachusetts	8	9.69	0.31
Michigan	7.4	8.86	0.18
Minnesota	5.25 - 6.15	8.35	0.11
Mississippi*	0	8.70	0.16
Missouri	7.35	9.44	0.26
Montana	4.00 - 7.80	10.15	0.30
Nebraska	7.25	7.65	0.02
Nevada	7.25 - 8.25	8.55	0.04
New Hampshire	7.25	9.83	0.31
New Jersey	7.25	9.68	0.29
New Mexico	7.5	8.02	0.07
New York	7.25	7.79	0.04
North Carolina	7.25	8.25	0.10
North Dakota	7.25	8.12	0.08
Ohio	7.85	8.56	0.17
Oklahoma	2.00 - 7.25	7.87	0.05
Oregon	8.95	9.06	0.20
Pennsylvania	7.25	8.08	0.08
Rhode Island*	7.75	11.69	0.57
South Carolina	0	9.76	0.30
South Dakota*	7.25	9.68	0.29
Tennessee	0	7.98	0.06
Texas	7.25	8.77	0.17
Utah	7.25	9.55	0.27

Table 7.2: Comparison of the Estimated Lowest Hourly Wages for Entry Level Positions in Construction Industry with Federal and State Minimum Wages (Continued)

State or other jurisdiction for 2013	Minimum Wage ($)[iv]	First 10% Hourly Wage[v]	% difference of construction entry level wage from national minimum wage
Vermont	8.6	10.00	0.32
Virginia	7.25	8.90	0.16
Washington	9.19	11.45	0.32
West Virginia	7.25	8.91	0.05
Wisconsin	7.25	10.74	0.08
Wyoming*	5.15	9.63	0.28
District of Columbia*	8.25	12.75	0.67
Guam*	7.25	7.75	0.03
Puerto Rico	5.08 - 7.25	7.58	0.32
U.S. Virgin Islands	4.30 - 7.25	no data	no data

*For these states data for "helpers and construction trades are not available, therefore construction laborers' data were used.

[i] Source: U.S. Department of Labor

[ii] "Minnesota sets a lower rate for enterprises with annual receipts of less than $500,000 ($4.90, January 1, 1998-January 1, 2005). The dollar amount prior to September 1, 1997 was $362,500 ($4.00 - January 1, 1991-January 1, 1997); Montana sets a lower rate for businesses with gross annual sales of $110,000 or less ($4.00 - January 1, 1992-January 1, 2005); Ohio sets a lower rate for employers with gross annual sales from $150,000 to $500,000 ($3.35 - January 1, 1991-January 1, 2005) and for employers with gross annual sales under $150,000 ($2.50 - January 1, 1991-January 1, 2005); Oklahoma sets a lower rate for employers of fewer than 10 full-time employees at any one location and for those with annual gross sales of less than $100,000 ($2.00, January 1, 1991-January 1, 2005); and the U.S. Virgin Islands sets a lower rate for businesses with gross annual receipts of less than $150,000 ($4.30, January 1, 1991-January 1, 2005)."
Source: U.S. Bureau of Labor Statistics

[iii] Mean of the first 10% of wages in 53 U.S. states and jurisdictional districts.

[iv] Source: U.S. Department of Labor

[v] "Minnesota sets a lower rate for enterprises with annual receipts of less than $500,000 ($4.90, January 1, 1998-January 1, 2005). The dollar amount prior to September 1, 1997 was $362,500 ($4.00 - January 1, 1991-January 1, 1997); Montana sets a lower rate for businesses with gross annual sales of $110,000 or less ($4.00 - January 1, 1992-January 1, 2005); Ohio sets a lower rate for employers with gross annual sales from $150,000 to $500,000 ($3.35 - January 1, 1991-January 1, 2005) and for employers with gross annual sales under $150,000 ($2.50 - January 1, 1991-January 1, 2005); Oklahoma sets a lower rate for employers of fewer than 10 full-time employees at any one location and for those with annual gross sales of less than $100,000 ($2.00, January 1, 1991-January 1, 2005); and the U.S. Virgin Islands sets a lower rate for businesses with gross annual receipts of less than $150,000 ($4.30, January 1, 1991-January 1, 2005)."
Source: U.S. Bureau of Labor Statistics

Table 7.3 Typical Hourly Wages in Construction versus Living Wages in Selected Locations

Locations	State Minimum wage	Poverty Wage for one adult supporting one child	Living Wage for one adult supporting one child	Typical hourly wages for construction	Typical Hourly Wages / Living Wages
Austin, Texas	7.25	7.00	17.67	15.35	0.87
Boston, Massachusetts	8.00	7.00	25.96	24.55	0.95
Chicago, Illinois	8.00	7.00	20.86	26.24	1.26
Dallas, Texas	7.25	.00	19.13	15.35	0.80
Denver, Colorado	7.25	.00	20.95	18.89	0.90
Hartford, Connecticut	8.25	7.00	22.67	24.09	1.06
Juneau City, Alaska	7.75	8.00	21.22	28.68	1.35
Montgomery, Alabama	7.25	7.00	18.01	15.26	0.85
New York, New York	7.25	7.00	24.69	23.99	0.97
Newark, New Jersey	7.25	7.00	22.12	25.56	1.16
Providence, Rhode Island	7.40	7.00	20.64	21.36	1.03
Sacramento, California	8.00	7.00	20.73	23.55	1.14
San Francisco, California	8.00	7.00	26.03	23.55	0.90
Washington, District of Columbia	8.25	7.00	26.37	24.37	0.92

Source: *MIT. (2013). Living Wage Calculator. 2013, from http://livingwage.mit.edu/counties, accessed on September 2013*

The second problem is the availability of sufficient data to support the argument that higher entry level wages lead to higher loyalty rates. Comprehensive data for such an analysis do not exist for the construction sector. Data provided by BLS on median weekly earnings and turnover rates can be used to examine possible correlations between these two variables. However, the range of the data is limited to 12 years -- between 2001 and 2012.

Table 7.4 presents the number of employees, median weekly wages and turnover rates in the construction industry in the time period between 2000 and 2012.

If higher entry level wages increase the loyalty of workers, then the same relationship should be valid for other wages as well. Therefore, there should be relationship between median wages and separation rates, which can be presented with the equation

$$y = \beta_1 + \beta_2 x \qquad 7.1$$

where y is the rate of annual separation and x is the median weekly wages. It is expected that β_2, the correlation coefficient of x, will be a negative number since the rate of separation should decrease as the wages increase. The correlation analysis presented in Table 7.5 shows a negative relationship between median wages and annual turnover rate, with a correlation coefficient of -0.4. With an R^2 equal to 0.22, the model shows that 22 percent of the variation that occurs in separation rates can be explained by variation in median weekly wages. But, with a p-value of 0.11 this relationship is not statistically significant and therefore requires repetition of the same analysis with a larger data set and possibly with the inclusion of more variables.

Table 7.4 Employment, Median Wages and Turnover Rate for the Construction Industry.

Year	Men Employment (000)	Women Employment (000)	Total Employment (000)	Median Weekly Earnings (Men)	Median Weekly Earnings (Women)	Median Weekly Earnings (both sexes)	Annual Turnover Rate	% of Women in Workforce	% of Men in Workforce	Ratio of Earnings (W/M)
2000	5720	132	5852	581	517	580	no data	0.02	0.98	0.89
2001	5911	142	6053	597	502	595	3.8	0.02	0.98	0.84
2002	5829	146	5974	590	523	589	3.2	0.02	0.98	0.89
2003	5831	141	5973	602	497	599	2.6	0.02	0.98	0.83
2004	6109	123	6232	606	504	604	3.0	0.02	0.98	0.83
2005	6663	163	6826	606	480	604	2.7	0.02	0.98	0.79
2006	6995	172	7166	621	533	619	4.5	0.02	0.98	0.86
2007	7071	156	7227	648	573	646	3.0	0.02	0.98	0.88
2008	6293	139	6432	688	747	688	3.1	0.02	0.98	1.09
2009	5154	113	5267	719	673	718	2.2	0.02	0.98	0.94
2010	4918	102	5020	710	646	709	3.4	0.02	0.98	0.91
2011	4937	95	5031	718	612	717	2.6	0.02	0.98	0.85
2012	5004	98	5102	741	723	740	2.1	0.02	0.98	0.98

Source: *Bureau of Labor Statistics. (2012). Construction and Extraction Occupations. Washington, DC Bureau of Labor Statistics.*

Table 7.5 Correlation Analysis for Weekly Wages and Turnover Rate

r	- 0.47822			
r^2	0.228694			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	6.645622	2.115043	3.142074	0.010
Median Weekly Earnings (both sexes)	-0.00556	0.003231	-1.72193	0.115

The correlation analysis shows that with the given data, it is not possible to demonstrate a statistically significant relationship between median wages and annual turnover rates. Although this does not disprove that higher entry level wages can lead to higher loyalty of construction workers, it shows that further research is needed to indicate such relationship.

Another goal of GRI EC5 is to address the wage gap between women and men. This is a very important problem for many industries but contrary to the other sectors the construction sector has a very low or no wage gap (Rampell, 2011). In 2012, the median wage of women was 98% of the median wage for men. One reason for this can be the significantly low ratio of women in the total working force. Table 5.7 shows that for the last 11 years, women have constituted only 2% of the workforce in the construction sector. Due to this low ratio, higher wages for women will have little effect on the total cost of projects, which makes it easier for employers to equalize wages. Based on the data presented in Table 7.4, Figure 7.1 shows that over the last decade the wage gap has shrunk even more as the ratio of women's wages to men's wages followed an upward trend in the U.S.

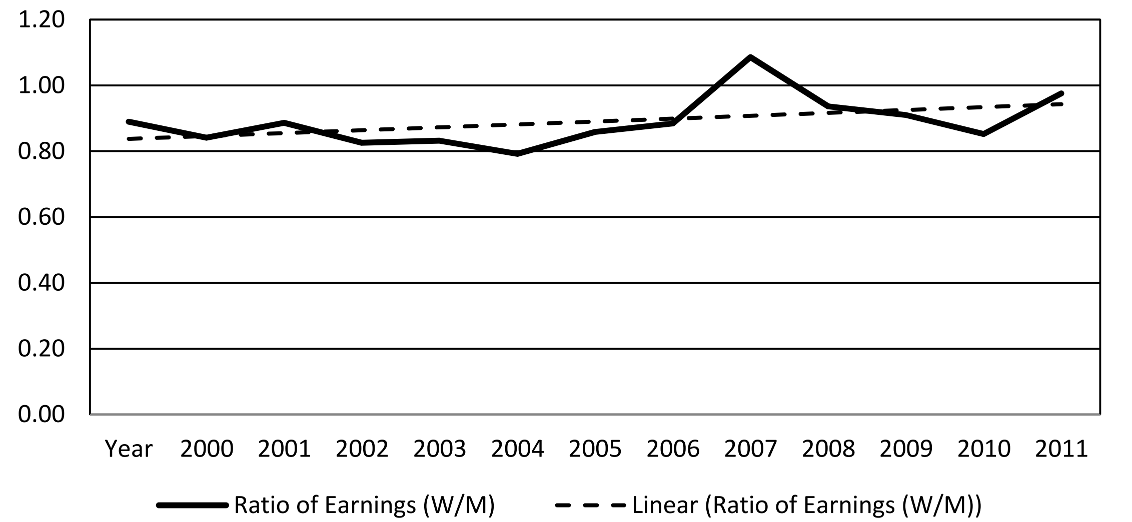

Figure 7.1 Ratio of Earnings (Women/Men).
Source: *Bureau of Labor Statistics. (2012). Construction and Extraction Occupations. Washington, DC Bureau of Labor Statistics*.

These findings show that GRI EC5 has several problems for adoption in LEED in terms language, incentive mechanisms and relevance of some its goals in the construction industry. However, the structure of the indicator does not contradict the requirements of LEED in terms of LEED's framework. Data required for the indicator is accessible and the structure of the indicator is suitable to be a pilot credit (Table 7.6). Data on minimum wages and living wages for all locations the US are available from different sources. Compliance with these benchmarks can be traced through contracts between developers and contractors. The credit also satisfies most of the requirements of a pilot credit but the above listed problems in demonstrating that the credit supports its intent for the construction sector makes it really hard to be applied into LEED.

Table 7.6 GRI EC5 Pilot Credit Analysis

Title:		Range of ratios of standard entry level wage by gender compared to local minimum wage at significant locations of operation.
Intent:		Demonstrating the contributions to the economic well-being of employees, the competitiveness of wages, ability to build strong community relations, employee loyalty, and strengthening organization's social license to operate
Impact categories addressed:		None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Proportion of the workforce that is compensated based on wages subject to minimum wage rules, comparison of local min wage and entry level wage by gender,
2. Are the resources clearly defined?	Y	Payroll department of the organization or finance, treasury, or accounting departments. Pertinent legislation in each country/region of operation may also provide information for this Indicator
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW), 1979.
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	Y	Minimum wage level can be fixed in the contracts. Living wages can be used as benchmarks. Technically the credit is achievable, however there problems with the incentive mechanism.
2. Does the credit support the intent?	P	Data collected from BLS indicates that more research is needed to prove that the credit supports the intent.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	The credit enhances the labor force and the socio-economic structure in general by increasing living standards, purchasing power and supporting higher skills.
4. Does the credit support market innovation?	P	The credit does not bring direct innovation to the job or labor.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Further research is needed to match the costs and benefits, hence decrease the effects of credit on construction costs..

*Y: Yes, N: No, P: Partially

7.2.3 HR4: Total Number of Incidents of Discrimination and Actions Taken

HR4 is an indicator developed to assess an organization's ability to comply with ILO Core Conventions 100, 111 and other international conventions against discrimination. In CRESS, GRI emphasizes that there is a risk of gender discrimination in the construction sector. Therefore, additional clauses are added in the construction version of GRI HR4 highlighting the significance of monitoring and preventing such discrimination through policies, training, awareness and grievance mechanisms.

The indicator is a "state" indicator that aims at disclosing the state of the organization in preventing discrimination in the workplace, but it can also be a response indicator if additional measures introduced that will guide organizations to develop prevention mechanisms against discrimination. HR4 requires identification of incidents of discrimination according to race, color, sex, religion, political opinion, national extraction, or social origin; review of the incident; and a report on the remediation plan prepared and implemented including the results of remediation. The reports should be based on legal actions taken and complaints registered, which can be obtained from the reporting organization's legal and compliance departments.

According to ILO (2003), from rural places to plazas, discrimination can occur in any type of workplace in many different forms, including age, gender, race, ethnicity, health status or political opinion. Giving equal opportunities in access to education, training and resources such as financial credits are listed as possible strategies for eliminating discrimination. Setting up and running businesses, activities in the workplace, hiring, payment, provision of benefits, promotions and lay-offs are all processes where discrimination can occur.

While direct discrimination can occur due to laws and regulations that limit or promote certain groups' access to resources, ILO emphasizes differences between educational opportunities, especially those that result from socio-cultural differences as the most significant form of indirect discrimination. Therefore creation of equal opportunities to develop skills, knowledge and competencies are listed as major forms of the fight against indirect discrimination (ILO, 2003).

In ILO Convention 111 lists preventive measures against discrimination that the member states of convention are responsible for undertaking. These measures can be reinterpreted at the scale of individual organizations and summarized as follows:

1- Seek cooperation of employers' and workers' organizations and other appropriate bodies in promoting policies against discrimination. In the construction sector, this necessitates evidence of communication between developers, contractors and unions indicating awareness of the problem and agreement on development of anti-discrimination policies.
2- Provide educational programs that ensure the acceptance and application of preventive measures.
3- Modify any administrative instructions or practices that are inconsistent with the policy. For the construction sector, this can also include termination of contracts where contractors violate these principles.
4- Monitor the application and teaching of anti-discriminatory policies through guidance and vocational training.
5- Issue annual reports on the application of these policies, actions taken and results secured by these actions.

Several studies show the significance of the discrimination problem in the construction industry. Early research conducted by the Maryland State Advisory Committee (U.S. Commission on Civil Rights. Maryland Advisory Committee, 1974) provides findings indicating that racial discrimination has been a significant issue in the construction industry. Among the allegations cited in the report are racial discrimination in hiring in favor of white workers by both union and non-union trades, discrimination in training opportunities allocation of tasks in way that well paid high profile jobs will be done by non-immigrant white workers.

One of the stories transmitted in the report illustrates possible forms of indirect discrimination. William Burke, an African American former electrician states that "Most of the black apprentices were assigned work outside of Baltimore. They were jobs that were inaccessible unless you had an automobile… and the majority of us… could not afford an automobile" (U.S. Commission on Civil Rights. Maryland Advisory Committee, 1974, p. 11).

Roughly 25 years later after this report was published, Sutherland (2000) stated that significant progress had been made in the advancement of women and minorities in the construction industry. According to her, legal regulations at federal and local levels and federal efforts to employ minorities and women are the main reasons for this achievement. Especially with the launching of the Office of Federal Contract Compliance Programs (OFCCP) large federal construction projects started promoting the employment of women and minorities increase at a national level.

A limited number of studies focus on recent incidents of discrimination in the construction industry. Data released by the U.S. Equal Employment Opportunity Commission (EEO, 2008, 2012) and the Bureau of Labor Statistics (BLS, 2008) indicate that discrimination based on race and gender is still a problem in the US and there is still an unequal distribution of positions and tasks among different races and ethnicity in the construction industry. According to the EEO report (EEO, 2012) 33509 discrimination cases resulted in EEO charges based on race in the US. 30351 charges were issued for gender discrimination, 22855 charges for age and 26408 charges were issued for discrimination based on disabilities. These numbers show that despite the improvements since the issuance of Title VII of the Civil Rights Act in 1964, discrimination on different bias is still an issue in the workplace for many sectors.

Table 7.7 presents tasks and positions in the construction industry by gender and race/ethnicity. The first two rows of the table present figures on overall employment and employment within the construction industry by gender, race and ethnicity. Comparison of these numbers with the allocation of tasks shows that the white population is overrepresented in better positions, while the portion of employment of minorities increases as the quality of positions decreases.

The data show that the Hispanic/Latino population is overrepresented in the construction industry by 11.22%, compared to overall employment distribution. Although only 65% of the total workforce in construction consists of white employees, on the executive/senior level officials' and managers' position this ratio jumps to 92%. However, at the bottom of skill set, such as among laborers, the ratio of white employees decreases as the ratio of Blacks and Hispanic/Latinos increases. Although Hispanic/Latinos make up 25% of the total workforce in construction, their representation in the laborer category is 45%. This disparity is evident in the Black population at a lower rate. However, unlike race and ethnicity, distribution of tasks and positions by gender does not show similar signs of discrimination. Allocation of tasks by gender is mostly parallel with the proportion of men and women employed in the construction industry. Especially for higher paying positions such as executives and professionals, the ratio of women is either the same or higher than the ratio of women in the workforce.

Data presented in Table 5.10 shows that employment status does not show significant signs of discrimination against women the construction sector. This might be due to the lower representation of women in the construction and because of the physical requirements of many positions in the industry that allow employment of women only in office jobs, which mostly better paying positions requiring higher levels of education. But it should be noted that this does not necessarily mean that indirect discrimination towards women, such as "mobbing", does not exist in the workplace. As mentioned by the interviewee Sandy in this study, the male dominated environment of the construction industry is still be prone to various forms of discrimination that are hard to detect or to quantify.

Table 7.7 Employment Status in the Construction Industry by Race and Ethnicity (%)

	White	**Black or African**	**Asian**	**Hispanic or Latino**	**Men (+16)**	**Women (+16)**
Overall National Employment Status*	81.95	10.97	4.76	14.00	53.30	46.70
Total Employment in Construction	65.34	6.49	1.25	25.22	89.45	10.55
Executive/Senior Level Officials & Managers	92.23	1.28	1.10	4.62	89.12	10.88
First/Mid Level Officials & Managers	85.34	2.70	1.39	9.44	89.16	10.84
Professionals	83.59	4.02	3.70	7.42	80.84	19.16
Technicians	74.59	6.89	2.14	14.77	92.93	7.07
Sales Workers	85.11	5.32	1.58	6.9	64.59	35.41
Office & Clerical Workers	78.62	6.11	2.35	11.25	24.73	75.27
Craft Workers	64.06	6.00	0.97	27.16	98.20	1.80
Operatives	59.93	9.60	0.73	27.58	96.56	3.44
Laborers	42.83	9.17	0.7	45.56	95.71	4.29
Service Workers	61.05	9.12	1.08	26.30	76.91	23.10

*Overall employment status represents the percentage of employed in the US among the civilian noninsitutional population.

Sources: *BLS. (2008). Labor Force Characteristics by Race and Ethnicity, 2008. Washington D.C.: Bureau of Labor Statistics.*

EEO. (2008). National Aggregate Report by NAICS-2 Code: 23 - Construction. Washington, D.C.: The U.S. Equal Employment Opportunity Commission.

Nevertheless, unlike gender, disparity between by race and ethnicity is more evident, as shown in Table 7.8. Despite previous efforts and achievements reported by Sutherland (2000), the data show that better positions with higher skill sets are occupied mostly by white workers, and minorities, especially Hispanic/Latinos are employed in lower paying positions requiring less skill. While this does not necessarily indicate discrimination since education and skill sets are a significant factor in the allocation of tasks, it is also not possible to claim that anti-discriminatory policies have achieved a fair allocation of positions in the construction industry. Due to this disparity, discrimination, which may be a partial explanation for this disparity in addition to differences in skills, still needs extra attention in the construction industry.

The RFQ for Project 4, which was investigated for this research, includes clear clauses that address discrimination and require anti-discriminatory policies during the selection of workers. Under the Mandatory Equal Employment Opportunity Language section of the RFQ, the developers of Project 4 state that:

> "The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affection of sexual orientation, gender, identity or expression, disability, nationality or sex… the contractor will take affirmative action to ensure that such applicants are recruited and employed and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex."

The document also requires contractors to post notices provided by the Public Agency Compliance Officer describing the provisions of this non-discriminatory clause. The notices must be in conspicuous places to be easily seen by applicants and employees. Communication between labor unions and contractors are also regulated by the RFQ document by asking contractors to send a notice to unions informing them about the commitment to anti-discriminatory policies. In order to show compliance with these principles, the contractors are asked to provide a letter of Federal Affirmative Action Plan Approval, a Certificate of Employee Information Report and Employee Information Report Form AA302. The RFQ, however, does not refer to any vocational training or education programs that would address discrimination and present anti-discriminatory principles in the work place.

The RFQ document for Project 4 shows data required to be used in GRI HR4 were available and these data can also be used if the credit were reinterpreted for LEED. While the characteristics of the problem of discrimination do not allow development of thresholds for the allocation of points, it is possible to develop preventive measures which will require evidence of developers' or contractors' efforts in preventing incidents of discrimination and creating awareness in the workplace about this issue.

Despite the limited number of studies on discrimination in the construction industry, the data presented above shows that the gap in the distribution of tasks and positions between different races and ethnicities provide enough evidence to consider discrimination as a possible ongoing problem in the construction industry. My interview with Sandy also reveals that despite the disappearance of the gender gap in the allocation of tasks and positions, indirect forms of gender discrimination can still be a problem in the male dominated environment of the construction industry.

As evident in the RFQ issued for Project 4, it is possible to develop preventive measures against discrimination in the construction industry. Although it is hard to develop quantifiable measures for a credit that would address discrimination, it is possible to develop measures that will check the existence of such preventive policies. In addition, evidence of a reporting mechanism in the organizations (among contractors, design firms, etc.) and a report covering the construction period can be added as extra measures to the credit. Reports do not only provide information about the pressure of organizations on the environment and the socio-economic structure; they also function as tools of self-recognition and institutional education for the reporting organizations. These reports can be enhanced by surveys that will aim at collecting anonymous information about possible cases of discrimination, which would also raise awareness about workplace discrimination while teaching possible ways to prevent it.

Table 7.8 shows that GRI HR4 meets the basic requirements of being a pilot credit. It does not contradict the basic framework of LEED; it complies with the future development path of LEED; it does not incur significant costs; and the data that is required for the credit can be collected through legal, compliance, and human resources departments of developer firms, contractors and design firms.

Table 7.8 GRI HR4 Pilot Credit Analysis

Title:	Total number of incidents of discrimination and actions taken.	
Intent:	To assess the ability to comply with ILO Core Conventions 100 & 111 against discrimination	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	

Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Preventive anti-discriminatory measures taken by organizations, reports on number of discrimination cases, proof of surveys and other educational policies.
2. Are the resources clearly defined?	Y	Reporting organization's legal, compliance, and human resources departments, RFQs and contracts, surveys and other documents related to anti-discriminatory actions.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	Declaration on the Elimination of All Forms of Intolerance and of Discrimination based on Religion or Belief, UN General Assembly Resolution 36/55 of 26 November 1981, ILO Convention 100 & 111; Title VII of the Civil Rights Act in 1964 ILO Convention 100 & 111, Title VII of the Civil Rights Act in 1964
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	Y	Anti-discriminatory clauses can be included in contracts and RFQs, proof of anti-discriminatory policies can be provided, surveys can be conducted. No contradiction with the regular workflow of the construction industry.
2. Does the credit support the intent?	Y	Providing proof for anti-discriminatory mechanisms and educational actions on discrimination help increase awareness and reduce cases of discrimination.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Reduction of cases of discrimination not only improve the working conditions of minorities and women, but it also establishes confidence in labor markets, thus enhancing the economic structure.
4. Does the credit support market innovation?	Y	The credit may promote development of better mechanisms to prevent and detect discrimination, educational activities and maybe independent audit mechanisms which may well contribute new values to the labor market.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	Y	Research shows that some of the measures are already required by ILO conventions and being taken by the project. With the current technology surveys are no longer expensive tools.

*Y: Yes, N: No, P: Partially

In the US, implementation of anti-discriminatory policies in the workplace is already required by Title VII of the Civil Rights Act of 1964. Additionally, for countries that have signed the ILO Convention 100 and 111, discrimination is an issue that has to be addressed at the national level. Achieving a modified version of GRI HR4 is not expected to bring significant extra costs for construction projects. With current online technologies surveys in organization do not bring extra costs either. Inclusion of anti-discriminatory measures in international green building rating systems, such as LEED, can raise international awareness on this issue while enhancing confidence in labor markets. Eliminating conditions that prevent minorities' access to better tasks and training opportunities can also increase productivity in the long run by increasing the quality of the workforce. Including HR4 into LEED or other green building rating systems does not pose incentive problems but actually provides an opportunity for firms to achieve extra credits for actions that they are likely already taking.

7.2.4 HR5: Operations Identified in Which the Right to Exercise Freedom of Association and Collective Bargaining may be at Significant Risk, and Actions Taken to Support These Rights.

GRI defines the intent of HR5 is to reveal actions that the reporting organization has undertaken to determine whether opportunities exist for workers to exercise their rights to freedom of association and collective bargaining and to reveal actions that support these rights. It requires the identification of operations and suppliers in which freedom of association and collective bargaining can be at risk and proof of support for these rights by the organizations. GRI presents the UN Universal Declaration of Human Rights and International Labor Organization (ILO) Core Conventions 87 and 98 as the basis for this measure, which regulate the right to freedom of association.

HR5 is a "response" indicator because it assesses the proactive response of the developers or project owners to improve the socio-economic state of employees and to enhance communication between employers and employees. It can be categorized under lifecycle because it assesses the processes that exceed the temporal and spatial borders of the construction.

Possible applications of HR5 in LEED include support of Freedom of association and the right to collective bargaining throughout the construction process and screening suppliers' policies about these rights. Two points need to be considered when HR5 is reinterpreted for the green building industry. First, tracing back to suppliers to identify their policies towards these rights requires a lifecycle approach that does not currently exist in LEED. As mentioned before, LEED adopts a lifecycle approach that is evident in the finished product only. Therefore processes that cannot be measured by collecting samples from the finished product -- the actual building -- are not considered within the lifecycle approach of LEED. For this reason, even if supplier firms do show extra effort t in supporting the freedom of association and collective bargaining rights, it is not possible to represent these efforts with LEED credits given the current framework of LEED. However, if a paradigm shift occurs to adopt a European lifecycle approach will that traces back to all the suppliers and if the necessary documentation can be provided from these suppliers, then HR5 can be applied to include the processes of both construction and the production of materials.

The second issue is that unionization and/or rights to collective bargaining mostly occur prior to and independently from the construction process. Due to the temporary character of building projects, measures supporting unionization of workers or collective bargaining rights cannot require project owners allow or help unionization of employees who are in the construction and design team. But what these measures can require is a construction and design team from unionized workers who have collective bargaining rights. Contracts between developers and contractors or subcontractors, or RFQs, can be used as assessment tools for this credit. Additionally, documents revealing contractors' legal compliance with the rules and human resource departments are potential resources for this credit. The related section of ILO Declaration states that

> All workers and all employers have the right to freely form and join groups for the support and advancement of their occupational interests. This basic human right goes together with freedom of expression and is the basis of democratic representation and governance. People need to be able to exercise their right to influence work-related matters that directly concern them. In other words, their voice needs to be heard and taken into account (ILO, 2003, p. 9).

Four basic principles that are listed by ILO to ensure freedom of association and the right to collective bargaining:

1. Legal basis that will guarantee the enforcement of these rights
2. A tripartite institutional framework between the employers' and workers' organizations;
3. Prevention of discrimination against who wish to exercise their rights to;
4. "Acceptance by employers' and workers' organizations as partners for solving joint problems and dealing with mutual challenges." (ILO, 2003, p. 10)

ILO Core Convention No.87 defines the principle of freedom of association as the means for improving conditions of labor and establishing peace. The convention states that both workers and employers should have the right to establish organizations, join and manage them with their free will. ILO Core Convention 98 requires protection against acts of anti-union discrimination in support of the right to organize and to pursue collective bargaining.

The Ethical Trading Initiative (ETI) states that for those who accept ILO conventions, these rights should be available for all workers except the police and armed forces. ILO conventions allow workers to choose and join the organization that represents their interests best without any repression or interruption. Employers cannot prevent workers from joining union or being reached by the representatives of a union. In other words, representatives of unions should have sufficient access to the workplace where they can communicate with the workers freely and promote union activities (ETI, 2005).

In reference to ILO's documents, ETI defines the freedom of association and the right to collective bargaining as a "reflection of human dignity" (ETI, 2005, p. 1). It emphasizes that these rights not only secure the economic condition of workers but also improve civil liberties including security and protect against discrimination, interference and harassment.

Rosenfield's study (2006) shows that unionization leads to increases in both worker and managerial wages while reducing the pay gap within organizations. However, according to his research, unionization leads to significant increases in workers' wages while only small increases are associated with unionization and managerial wages; therefore it helps reduce the pay gap.

The major criticism of employing union workers in the construction sector is that unionization leads to lower productivity and higher construction costs. For example, Martin and Cohen's report (2011) on the conditions of unionization in New York State argues that restrictive measures in collective bargaining documents can limit their positive effects by strictly defining work responsibilities and decreasing flexibility at work. In many cases, they argue, workers whose duties are strictly defined by unions cannot be assigned other tasks. This leads to overstaffing of several tasks, while some other tasks remain incomplete for long time periods, although there are workers with enough skills to complete them. Their report claims that many of these inefficiencies could be avoided if responsibilities of construction workers could be defined in a more flexible way by the unions. The authors argue that these practices increase the cost differential between union and nonunion work between 20 and 30%, which they claim is intolerable to developers, hence creating the tendency to avoid union workers. In order to decrease this premium to a more tolerable level, 10% for example, they suggest removing some of the restrictive measures from collective bargaining agreements, including restrictions on choice of equipment, technology and methods and abolishing contractual requirements for temporary services.

However, several studies show that collective bargaining not only provides benefits to workers but can also improve average productivity in the construction industry. Allen (1984) argues that unionized workers are expected to be more productive because unions can provide job training to their members which ca single worker cannot afforded. He also states that unions require certain skill sets to be a member. Therefore, employers, especially those who are in need of construction workers immediately, have more chance of finding skilled workers if they hire from union hiring halls instead of employing nonunion workers. His empirical study also demonstrates that unionized workers have approximately 20% higher productivity levels. His findings suggest that better training programs, changes in occupational mix, reduction in recruiting and screening costs for contractors and greater managerial ability are the main reasons for this increase (Allen, 1984).

Braun (2011) argues that productivity, firm profits and firm output increase if sector-level bargaining takes place, as opposed to firm level bargaining. Braun states that sector-level bargaining increases average skill among all firms by setting up higher wage levels, creating a barrier for those who cannot afford higher wages, hence eliminating firms with lower productivity. The same process of elimination also allows higher mark-ups by leading to higher profitability and output rates for the whole industry.

These studies show that including an indicator in favor of unionization of construction workers, or employing union workers, or encouraging collective bargaining of construction workers does not contradict employers benefits. If established properly by removing some restrictions over working procedures that are established by collective bargaining documents, use of union workers can improve productivity and the quality of projects in the long run.

Another hesitation about the development of credits that would support unionization rights and collective bargaining in LEED is the applicability of the credit universally. Arthur, one of the interviewees who works as a LEED consultant, stated that collective bargaining is not legal in several states in the US and also in many other countries, which is an obstacle in developing such a credit.

In the US, collective bargaining for the private sector is defined by the 1935 National Labor Relations Act, which is also known as the Wagner Act. Section 7 of the act secures the right to organize and bargain collectively for private workers. Section 8(f) of the act, which is designed specifically for the construction sector, allows companies to sign union-securitization acts before any employee has been hired (NLRB, 1935). By doing this the law provides the flexibility which is needed in the construction sector where work is temporary and makes it possible for developers to add union membership as a conditions in their contracts as a condition of agreement.

Unlike the private sector, collective bargaining is not allowed in the public sector in all US states. In seven states (Arizona, Georgia, Mississippi, North Carolina, South Carolina, Texas, Virginia) collective bargaining is outlawed for public sector workers. Nine states have no laws about collective bargaining but collective bargaining is allowed. Eleven states have collective bargaining rules but agency fees are prohibited. The remaining 23 states have both collective bargaining laws and allow agency fees (Freeman & Han, 2012). As Arthur claimed, prohibition of collection bargaining in several states may create complications by reducing the universality of a related credit. However, it is possible to design two-tiered credit language whereby encouraging union membership can be separated from encouraging collective bargaining with the allocation of points distinguished and defining a level of flexibility that complies with local regulations. Freeman and Han's (2012) findings show that even in locations where collective bargaining is not allowed, union membership still leads to higher earnings for public sector employees including teachers, police and firefighters. Therefore, development of credits to encourage union membership can still help improve employees' working conditions even where collective bargaining is not legal.

Despite his hesitation, Arthur believes that development of credits about union membership is possible if the requirement is kept within the temporal and geographical borders of the project. In other words, he does not oppose inclusion of clauses in contracts with contractors that ensure hiring from union hiring halls. Mark, who is the associate vice president for facilities management of a state university, agrees that such credits are possible. Especially, he said, if the state has specific requirements for the recruitment of minorities or women; then it becomes a necessity to hire from particular unions since they have better access to these employee groups. For the student complex project he manages, such clauses that regulate the hiring process already exist in the RFQ documents.

Table 7.9 summarizes HR5's fulfillment of the requirements for being a pilot credit. Analysis shows that HR5 is compatible with the criteria for developing a new pilot credit. The data needed to develop effective measures can be obtained from local laws, regulations and the contractors' legal, compliance and human resources departments. The credit addresses the social rights, the economic c and working conditions of workers while also helping developers improve the overall efficiency of their projects in the long run. By enhancing socio-economic, the credit aligns with the foundations of LEED and responds to the increasing attention toward the socio-economic aspects of sustainability as dictated in LEED v4. The documents investigated for this research indicate that these issues are neither directly nor indirectly addressed in the LEED certification processes. There are no documents submitted to GBCI regarding the freedom of association or bargaining rights, or the working conditions of workers. However, documents collected regarding Project D show that it is possible to produce and collect such documents and use them as a means of measurement.

Table 7.9 GRI HR5 Pilot Credit Analysis

Title:	Operations and significant suppliers identified in which the right to exercise freedom of association or Collective bargaining may be violated or at significant risk, and actions taken to support these rights..	
Intent:	To reveal actions that the project owners have taken to evaluate whether opportunities exist for workers to exercise their rights to freedom of association and collective bargaining	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Disclosure of any measures taken by the organization intended to support rights to freedom of association and collective bargaining.
2. Are the resources clearly defined?	Y	Reporting organization's legal, compliance, and human resources departments.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	ILO Convention 87, 'Freedom of Association and Protection of the Right to Organize Convention', 1948. ILO Convention 98, 'Right to Organize and Collective Bargaining Convention', 1949 United Nations Universal Declaration of Human Rights, 1948. International Covenant on Economic, Social and Cultural Rights, 1966.
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	Y	Requirements can be included in contracts and RFQ to hire a minimum amount of union workers and workers with collective bargaining rights, where local laws and regulations allow.
2. Does the credit support the intent?	Y	Including minimum number of unionized workers support unionization and the right to collective bargaining.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Unionization and collective bargaining help workers' living conditions improve, while also improving the productivity of constructions industry through better skills and education.
4. Does the credit support market innovation?	Y	The credit improves labor market by enhancing organized labor and helping increase the skill sets. It also gives way to new opportunities to create better unionization practices.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	Y	Current research shows that if flexibility is increased in collective bargaining agreements unionization can lead to better productivity and higher profits.

*Y: Yes, N: No, P: Partially

7.2.5 HR6 and HR7 Operations Identified as Having Significant Risk for Incidents of Child Labor/Compulsory Labor, and Measures Taken to Contribute to the Elimination of Child Labor/Compulsory Labor

GRI HR6 and HR7 are both pressure and response indicators focusing on the elimination of child and compulsory labor. Both indicators consist of three parts: (1) identification of operations considered to have significant risks of incidents of child, forced or compulsory labor; (2) reporting operations considered to have significant risks of incidents of child, forced or compulsory labor; and (3) reporting measures taken to eliminate those risks.

7.2.5.1 Child Labor, Both indicators are based on several ILO conventions, principles and UN declarations. ILO Conventions 138 and 182 are the two major reference documents of HR6, which focuses on child labor. The 1989 United Nations Convention on the Rights of the Child states that people under 18 years of age need special care and protection that adults do not. ILO Convention 138 (ILO, 1973) sets the minimum admission to employment or work at the age of completion of compulsory or minimum 15. For those jobs that are likely to jeopardize the health, safety or morals of young persons the minimum working age is at least 18 years. Convention 182 (ILO, 1999) bans the worst forms of child labor (here child refers to all people below 18), including all forms of slavery, human trafficking, serfdom, compulsory labor, prostitution, illicit activities and work that is likely to harm the health, safety or morals of children. Article 3.a and 3.d of this convention, slavery, compulsory work and jobs with hazardous working environment are parts that are related to the construction industry. Hazardous work environments are especially significant in the construction industry since mining of many important building materials has the risk of including child labor if the products are supplied from developing and underdeveloped countries where regulations on child labor is weak.

According to ILO (Diallo, Hagemann, Etienne, Gurbuzer, & Mehran, 2010) in 2008 the number of children employed was approximately 215 million worldwide. This was equal to 13.6% of all children. More than half of these, 115 million, were employed in hazardous work while 52,895 under the age of 14. The proportion of child labor is higher in the Asian and Pacific countries (96.4 million in total) than in the rest of the world. These numbers show that child labor is still a vital problem of social sustainability. However, thanks to policies developed by UN, ILO and UNICEF there has been a noticeable decrease in these numbers. According to the same ILO report, child employment decreased by 1.3 percent between 2004 and 2008. Better performance was achieved in girls' employment by 3%. Data show that 67.5% of all child labor consists of unpaid family workers whereas only 21.4% of them receive some sort of payment.

Child labor can lead to significant injuries while also negatively affecting children's mental, emotional, psychological, moral and spiritual development. For those who are under 18, exposure to chemicals and other harmful substances can cause irreversible damage to the body, including respiratory illnesses, spinal injury and other forms of deformations (ILC, 2002).

According to ILO's categorizations, mining and construction, ISCO-88 915-931, is a designated hazardous occupation. Although the amount of child labor employed in the construction sector is relatively low (1.5% of all the child labor), this sector poses the most hazardous forms of work. Research conducted in 1997 reveals that 25% of work related illness and injuries among working children occur in the construction industry, making it the leading industry in work related illnesses and injuries (ILC, 2002). Unlike other industries, children in the construction industry have to live on construction sites and have to switch between construction sites frequently, which prevents them from attending school. Child labor in construction can even be a problem in developed countries. In New Zealand construction sector has the highest second injury rate among adolescence whereas in Italy approximately 40,000 children are employed in this sector.

Consideration child labor in the construction sector should not be limited to direct employment of children. Child labor is also associated with the production and distribution of many materials supplied for construction in the form of manufacturing or mining activities. Studies show that in both Latin America and Sub Saharan Africa use of child labor in mining is a significant problem. According to research in Guatemala, Madagascar and the United Republic of Tanzania children are used in breaking rocks, washing and sieving, setting explosives and carrying loads (ILC, 2002).

7.2.5.2 Compulsory/Forced Labor, ILO Convention 29 abolishes any form of compulsory labor including labor that is exacted as tax, excluding cases of compulsory military service, civic obligations, court decisions, cases of emergencies and minor communal services (ILO, 1930). Convention 105 also bans any form of forced or compulsory labor as a means of political coercion, economic mobilization, labor discipline, punishment for participating in strikes or social, racial, national or religious discrimination (ILO, 1957). While these two conventions constitute the basis of the indicator, GRI also refers to UN decisions against slavery and slave trade.

Compulsory and forced labor as a concept emerged with the worldwide abolition of slavery with the UN Slavery Convention in 1927. With the illegalization of slavery, hidden forms of compulsory labor emerged. More explicit forms occur as compulsory participation in public works such as portering, construction, maintenance and servicing military camps, mostly guided by state organizations as in Myanmar (Burma). But compulsory labor also exists in implicit forms. One example is mandatory forced labor in remote areas. As described in the 2004 report issued by the National Research Council, despite abolition of serfdom (NRC, 2004), agricultural workers in many remote areas still work compulsorily to pay their debts. Another form of implicit compulsory labor is human trafficking, which has increased with globalization. This type of compulsory labor occurs in domestic labor, prostitution and sweatshop production. Unlike the other forms, this form is more prominent in developed countries. The severity of the problem increases as the effectiveness of laws against conspiracy decreases and more laws exist that criminalize the victims.

Although child labor or compulsory/forced seems like a distant problem for the green building industry, it needs to be considered for two reasons. First the international character of the rating systems, such as LEED, requires promotion of universal sustainability measures; therefore even though these forms of labor might not be a significant problem in developed countries, in the rest of the world there is no guarantee that green buildings are not being built by the use of these forms of labor. Second even where these forms of labor are abolished and under strict control, green building projects may still use products produced by these forms of labor.

The failure of Nevsun, a Canadian originated mining company, in monitoring and preventing the use of compulsory labor in its production sites in Eritrea is one example of how unwanted types of labor can penetrate the supply chains of green construction projects. A report issued by Human Rights Watch (HRW) (2013) revealed that despite the high risk of forced labor managed by the National Service Program of the Eritrean government, Nevsun has not developed human rights safety measures and employed Segen, a government owned construction company that uses forced labor for infrastructural construction. HRW's investigations revealed that forced labor was used during construction and that many workers were threatened under inhumane conditions. Although the company later tried to switch to another construction firm, under the Eritrean government's pressure it was forced to use Segen once more for its 2012 mining project.

The Nevsun example illustrates how forced labor can be directly used in construction projects and also indirectly through the supply chains of building materials. Gold, zing, potash and silver are the major minerals produced in Eritrea; they are also significant raw materials used in the production of building materials. Therefore, even though unwanted forms of labor are unlikely to be used during the production of green buildings, in a globalized economy it is more likely to find it embedded in the building materials.

The two biggest challenges in developing green building credits to address child, compulsory or forced labor are the hidden character of these unwanted forms of labor and the limitations posed by the lifecycle approach in LEED. As is evident in the case of Apple Inc., where use of 106 children in 11 factories was revealed in different countries

(Garside, 2013), inclusion of unwanted forms of labor is possible even for products widely used and under public scrutiny. In the absence of constant monitoring and product labeling based on social sustainability measures, it may be impossible to trace back to the source of materials and get information about their production process.

Arthur stated in his interview that due to these difficulties, USGBC has chosen to limit its lifecycle framework to the construction site and the construction period. For this reason he said, “Involvement of child labor in the construction site can be a concern for LEED, but use of child labor in the construction of lighting fixtures cannot in the current framework.” Nevertheless, as mentioned earlier, the introduction of Mrc3 in LEED v4, USGBC shows that LEED is no longer bound by the framework that Arthur referred to MRc3 encourages LEED users to trace back to the sources of materials including the extraction of raw materials and to provide evidence that supply processes comply with corporate responsibility principles, which also outlaw the use of unwanted forms of labor.

The biggest hurdle in developing green building credits to address unwanted forms of labor is the difficulty of documenting the absence of these types of labor both during construction and in the supply chain of building materials. Since use of child, compulsory or forced labor is a hidden action, a third party audit, certification or labeling is needed to identify products and construction projects that are child/compulsory/forced labor-free. For green building projects that are built where use of unwanted forms of labor are not under strong governmental scrutiny, reports from third party audit firms can a form of evidence. Investigation of the documents submitted to USGBC by Project1, Project 2 and Project3 showed that third party reports are frequently used as a form of evidence for achieving LEED credits. For example, for Project1, a third party closure report was submitted to document the site remediation activities undertaken to comply with the requirements of LEED credit SSCr3, Brownfield Redevelopment. The report testified that cleaning activities had taken place on site and provided information about the amount of soil that was excavated, the installation of vapor barriers, the importation of top soil and other details. Another third party report was submitted for SSpr1, Construction Activity Pollution Prevention, including a weekly soil erosion and sedimentation control log. In addition to reports, third party approved plans related to several construction processes were also among the submitted documents such as a Construction Indoor Air Quality Management Plan, which was submitted in relation to IEQcr3.1, Construction IAQ Management Plan During Construction. This plan defines the precautionary actions to be taken for securing a healthy working environment for workers by minimizing construction related air pollution.

While absence of unwanted forms of labor on the construction site can be certified by third party audits and reports, labeling can be used to address the same problem in the supply chains of building materials. Certification and labeling processes already exist for certain products to monitor the existence of such labor. Use of FSC certified products, which is already being promoted by LEED, is a way to demonstrate the absence of unwanted types of labor in the production of wood products. FSC Standard (2006) clearly states that certification is also evidence that there is no "violation of the International Labor Office (ILO) Fundamental Principles and Rights at Work in the FMU". These principles include freedom of association and the right to collective bargaining, the elimination of forced and compulsory labor, the abolition of child labor, and the elimination of discrimination in the workplace.

However, labels and certifications that monitor ILO standards for building materials are uncommon. Fair Trade certification for food products and gold mining and GoodWave certification for rugs are other examples where ILO standards are monitored. However more certification tools are needed to monitor the compatibility of building materials with ILO standards. The introduction of GRI HR6 and HR7 into LEED requires such certification tools. As evident in FSC experience, such credits can also function as significant incentives that could spur the development of such tools. FSC has issued a statement claiming that LEED credits that promoted FSC certified wood have stimulated the development of a certified wood market (FSC, 2012). It is possible to develop similar certifications for other building materials with a credit like HR6 and HR7.

Analysis of HR6 and HR7 (Table 7.10) shows that both indicators meet the requirements to be a LEED pilot credit. Two issues that may be problematic are the achievability of the credits and being cost, time and effort effective. The credit is achievable mostly through third party audits, certification or labeling. The underdeveloped character of the market of labelling and holistic sustainability at the level of products may create challenges for achieving these credits. However the problem existed for certified wood as well, which has nonetheless been promoted LEED MRc7, Certified Wood. Additionally, as already proposed in MRc3 of LEED v4, use of products from companies with GRI reporting can be a strategy to overcome this problem. An additional clause in MRc3 promoting the use of products that disclose on HR6 and HR7 in their GRI reports can be substitute for an individual credit that would require third party certification until a reliable market emerges for this purpose.

Another challenge is the additional cost that might be incurred from the third party certification process. Several interviews related to Project 4 indicate that costs associated with the LEED certification process are the biggest challenge that prevents people from seeking certain credits. Especially during the selection of credits to be achieved, extra cost becomes the major criterion. Unlike previous indicators that have been discussed, eliminating unwanted forms of labor does not lead to direct or indirect cost reductions. Nor does it increase quality of construction or efficiency. However, once the credits are issued, it is likely that avoidance of these credits would create a negative impression of the branding of the projects for their failure to prove the absence of such types of labor. This risk on the intangible assets of the developers and construction firms can act as an incentive for achieving the credits. Nevertheless, as Mary, the senior vice president of a LEED consulting firm in Manhattan, reported in her interview, the introduction of new credits in LEED is strictly dependent on the approval of the building industry. In that sense, the binding structure of HR6 and HR7 for the construction firms and the social indictment that could be created of projects that do not achieve these credits could be the basis for strong objections to the credits from the building industry. Other objections are likely to refer to the difficulties of collecting data documenting the absence of unwanted labor in projects in developing countries and for building materials produced in these countries.

Table 7.10 GRI HR6 and HR7 Pilot Credit Analysis

Title:	Operations and significant suppliers identified as having significant risk for incidents of unwanted types (child/compulsory/forced) of labor, and measures taken to contribute to the effective abolition of them.	
Intent:	To measure the presence and effective implementation of policies against unwanted types of labor	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Identification of the operations considered to have significant risk for incidents of unwanted types of labor and measures taken to ensure compliance with related ILO conventions by all stages of lifecycle.
2. Are the resources clearly defined?	Y	Reporting organization's legal, compliance, and human resources departments.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	ILO Convention 29, 105, 138, 182; ILO Declaration on Fundamental Principles and Rights at Work, 86th Session, 1998; UN Universal Declaration of Human Rights, 1948, League of Nations (later UN) Slavery Convention, 1927; ILO Declaration on Fundamental Principles and Rights at Work, 86th Session, 1998.
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	P	Absence of third party certification and labeling for nonexistence of unwanted labor in construction processes and supply chain is an important hurdle. However, previous experiences such as FSC shows that it is not a sufficient reason to not to develop such credits.
2. Does the credit support the intent?	Y	Identifying processes that have the risk of unwanted labor types and promoting policies against them raise awareness and help decrease use of this type of labor.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Elimination of unwanted labor are significant human rights achievement, while it also helps creation of better educate and healthier generations.
4. Does the credit support market innovation?	Y	The credit improves promotes development of third party monitoring, certification and labeling of nonexistence of unwanted types of labor.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Additional costs that incur by use of third party monitoring, certification or labeling can be compensated with the positive effects of CSR efforts on branding and intangible assets.

*Y: Yes, N: No, P: Partially

7.2.6 CRE6: Percentage of the Organization Operating in Verified Compliance with an Internationally Recognized Health and Safety Management System.

Construction is an industry with high rates of fatal and nonfatal injuries and loss of working days. According to BLS data, the private construction industry has the fourth highest rate of fatal injuries with 9.1 per 100,000 full-time equivalent workers, which is approximately three times the fatal injury rate of all workers (Bureau of Labor Statistics, 2012d). In 2011, 738 people working in the construction industry in the US suffered fatal injuries (Figure 7.2). At 14 days, the construction industry had the highest median number of lost days in private industry in the US (Figure 7.3).

Falls, overexertion, caught-in and struck-by or against are the major types of injuries that occur during construction. Falls are 32% of the fatal and 23% of the nonfatal injuries. Most of the falls are from scaffolding and staging. Overexertion accounts for 18% of all nonfatal injuries, which mostly occur as musculoskeletal injury through repetitive movements. Falls are followed by caught-in fatal injuries by 12%. Stuck-by injuries that are caused by falling objects or heavy machinery are also among the major reasons for fatal and nonfatal construction related accidents (Fortunato, Hallowell, A.M.ASCE, Behm, & Dewlaney, 2012).

Several credits in LEED protect workers' health by regulating the environmental quality of the construction site. These are IEQCr3.1 IAQ Management Plan – During Construction, IEQCr4.1, Low Emitting Materials – Adhesive and Sealants, IEQCr4.2, Low-Emitting Materials - Paints and Coatings, IEQCr4.3, Low-Emitting Materials – Carpets and IEQCr4.4, Low-Emitting Materials – Composite Wood and Agrifiber Products. IEQCr3.1 decreases workers' exposure to generator exhaust and prevents exposure to acetone. The other four credits help decrease exposure to VOCs that are emitted from construction materials (Fortunato, et al. 2012). However, these credits, no are the only credits that address the many health related risks occur during construction.

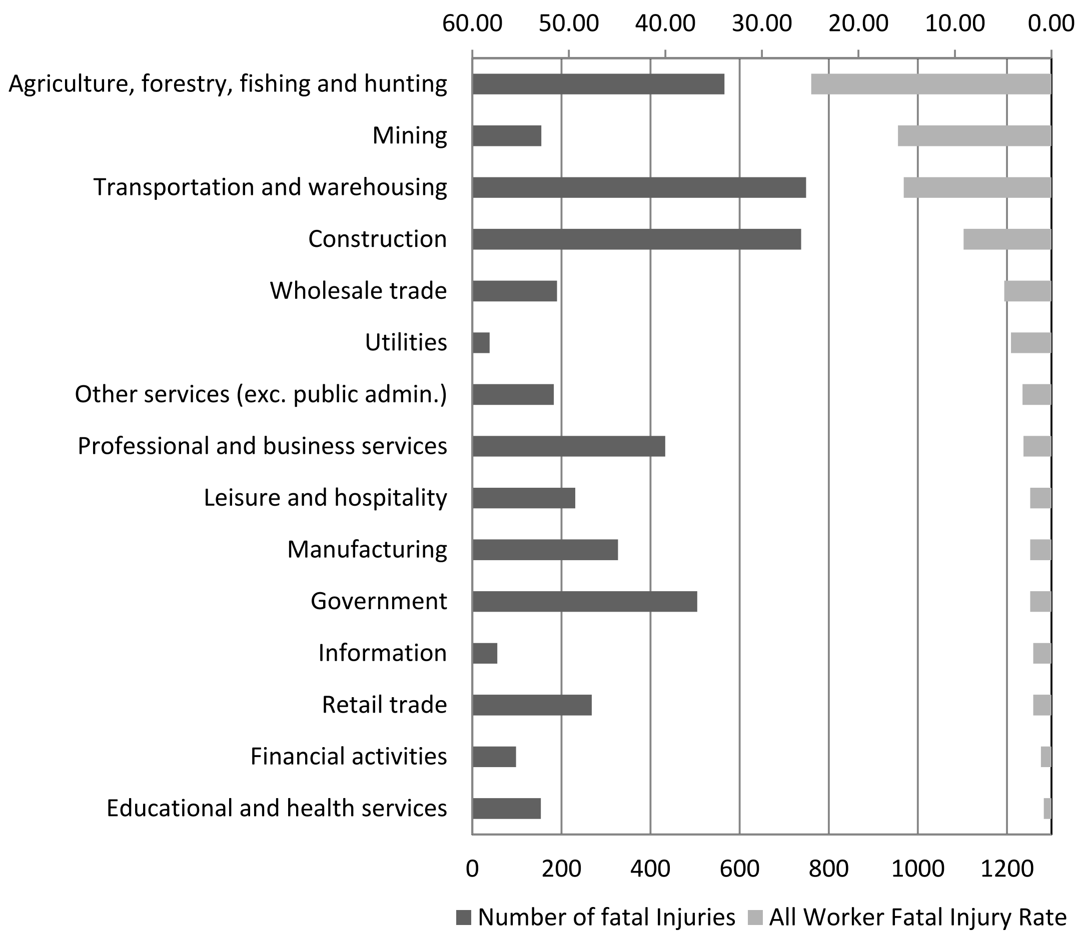

Figure 7.2 Number of fatal injuries and rate of fatal injuries for the private industry in the US (2011).
Source: *Bureau of Labor Statistics. (2012). Construction and Extraction Occupations. Washington, DC Bureau of Labor Statistics.*

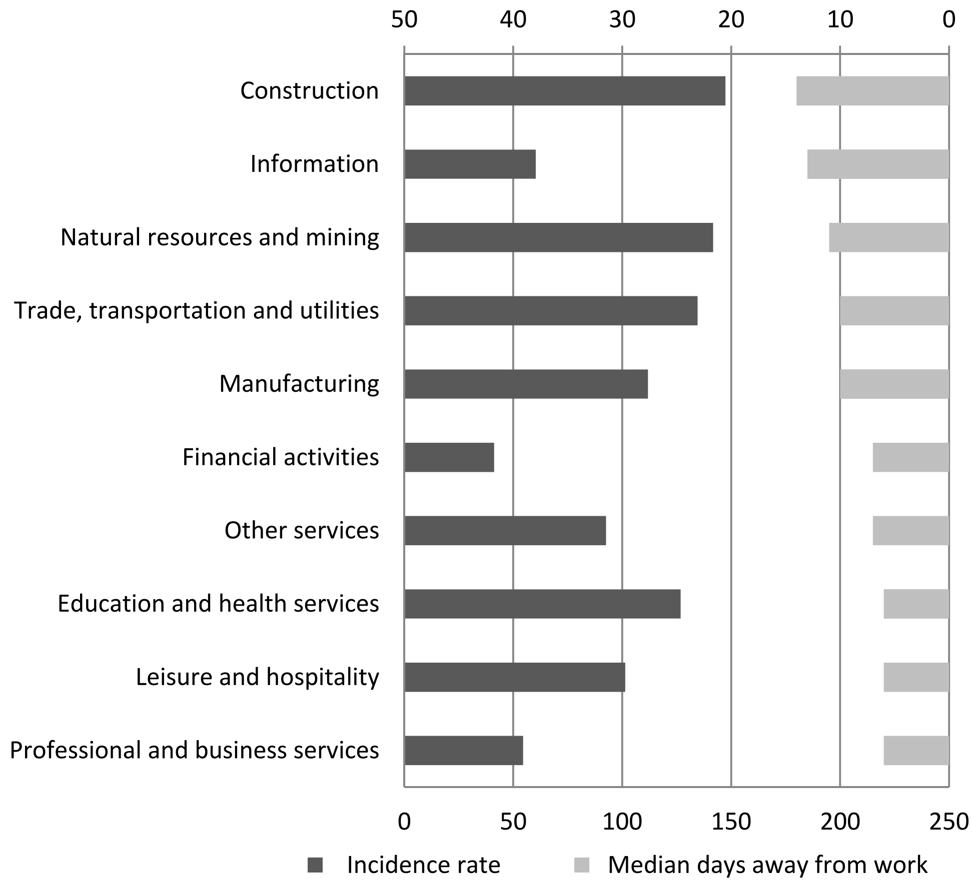

Figure 7.3 Rate of nonfatal injuries and the median number of lost days for the private industry in the US (2011).
Source: *Bureau of Labor Statistics. (2012). Construction and Extraction Occupations. Washington, DC Bureau of Labor Statistics.*

The need for credits to address a complete implication of the occupational health and safety (OHS) requirements is also supported with the findings of a research that shows that certified green buildings are associated with a 48% higher Occupational Health and Safety Administration (OHSA) recordable injury rate than non-certified projects (Rajendran, et al. 2009). Research conducted by Fortunato et al. (2012) on possible reasons for this 48% higher risk of injury in the construction of green buildings found that 13 LEED credits increase the safety and health risks whereas two of them have mixed effects. Most of these risks occur due to lack of experience with the new work environment required by green building systems.

Study conducted by Fortunato et al. (2012) shows that in many cases installation of equipment on roofs and ceilings increases the amount of work at height. New types of equipment also require increased contact with electrical current and increases the amount of work on unstable soil and near heavy equipment. For example, credits such as Stormwater Quality Control (SSCr.6.2), Optimize Energy Performance (EACr1), On-Site Renewable Energy (EACr2) and Outdoor air Delivery Monitoring (IEQCr1) increase the risk of falling, getting struck by heavy equipment and overexertion due to repetitive motion. Use of unconventional materials such as white thermoplastic olefin (TPO) as in case of Heat-Island Effect (Roof) (SSCr7.2) may also increase the risk of injuries if they are heavier, more slippery or "blindingly bright" in direct sunlight (Fortunato, et al. 2012). The study also suggests that increases in health and safety risks can be related to contractors' and workers' unfamiliarity with the new work environment. Contributing to these arguments, Gambatese and Tymvios (2012) emphasize that precautionary OHA procedures implemented by contractors can significantly decrease the risk of injuries in green building projects.

The significance of developing credits to address and require precautions regarding OHS risks in green building projects is evident in previous research. GRI Cre6 is an indicator developed with the same concerns, in order to increase instructional awareness about these risks and to eliminate or mitigate the risks. In order to achieve this, Cre6 requires identification of OHS management systems that are used, such as Occupational Health and Safety Assessment Systems (OHSAS) 18001 or the equivalent, disclosing the percentage of employees who operate under these management systems and disclosing the contractors that operate under these systems.

OHSAS 18001 is a standard developed by the British Standard Institution (BSI) to help organizations integrate quality, environmental and occupational health and safety management systems. Complying with the OHSAS standard necessitates accomplishing five basic tasks:

1. **Development of a Policy:** Organizations operating under OHSAS 18001 have to define and authorize an OHS policy which will identify the risks, includes strategies and commitments to prevent those risks and provide a framework that will help implement the OHS objectives.
2. **Planning:** Organizations have to develop plans and conduct risk assessments that will determine all different areas and activities that may pose risk to workers' health and safety and define measurable objectives consistent with the OHS policy.
3. **Implementation and Operation:** OHSAS 18001 requires designation of responsibilities and authority for achieving the OHS objectives among the construction employees, scheduling of these tasks and definition of the means of achieving them. Preparation of reports on the OHS performance and communication of these with the top management, training of the staff about the possible risks and preventative measures to be taken, establishment of an internal communication system about OHS and a consulting mechanism are tasks to be completed during the implementation stage. Organization should also record these activities, review their compatibility with the OHS requirements and

establish operational control mechanisms to prevent risks and be ready for emergency situations.

4. **Checking:** Organizations should establish a monitoring mechanism that will assess the effectiveness of the OHS policy, keep a record of incidents of injuries and incidents that confront OHS measures, investigate the reasons of these incidents, identify the corrective action and communicate the results with the rest of the organization. Control of records and internal audit are also required at this stage.
5. **Management Review:** The previous stages have to be reviewed by the management in terms of compliance with the objectives, suitability with the OHS requirements and to determine future improvements (BSI, 2007).

The importance of following OHSAS 18001 during construction for coping with the high injury rates in the construction industry was discussed in a study by Gambatese and Tymvios (2012). Addressing the OHS risks associated with green buildings, the authors propose a LEED pilot innovation credit on OHS, which would aim at increasing "safety throughout the entire process of design and construction, and by encouraging the use of safe practices and participation in safety thinking by all project participants (Gambatese & Tymvios, 2012, p. 50). The credit does not refer to OHSAS 1800; however it proposes development and implementation of an OHS policy for green building projects, which would accomplish each of the above listed OHSAS 18001 requirements.

Nevertheless, neither LEED v.4 nor other updates in LEED include an extended OHS approach, nor an innovation or pilot credit similar to the one suggested by Gambatese and Tymvios. But analysis of the documents within the scope of this research shows that it is technically possible to introduce such a credit into LEED. In fact, similar OHS measures are already being taken for credits NC IEQCr3.1 and EBOM IEQCr3.1. Besides, the submittals required for these credits mostly follow the same structure with the submittals that are required by OHSAS 18001. However, the scope of the IEQ credits in LEED are much more limited than the scope of OHSAS, which addresses all possible OHS risks that may occur during construction.

Submissions from Project1 for the IEQCr3.1, Construction IAQ Management Plan During Construction include a OHS management plan approved by a third party consultant and photos taken at the construction site to verify the measures taken. The plan includes a clearly defined intent (minimizing exposure of construction workers to air pollutants), a definition of pollutants and a delineation of the responsibilities among the construction staff. Informing the construction crew about the OHS management plan, supervision of the construction site to ensure the implementation of the plan, discussing the ongoing IAQ plans and keeping minutes, developing and implementing warnings where necessary and generating the necessary documents are listed among these responsibilities. The [roject manager, assistant project manager and the subcontractors are all listed as the responsible bodies in implementation of the plan.

The IAQ Management Plan also specifies the documents to be submitted along with the plan, which include deficiency reports showing corrective action taken, the schedule of temporary use of building mechanical equipment, the schedule of filter change-outs showing location, time, and filter type, cut sheets for all filtration media used, copies of duct testing and cleaning reports and job progress photographs. The plan also includes a detailed description of health and safety risks and the necessary actions each type of equipment activity that can affect the indoor air quality of the construction site.

A similar plan was also devised for Project 3 in order to achieve the EBOM IEQCr3.1, Green Cleaning, High Performance Cleaning Program. The credit requires providing a copy of the compliant high-performance cleaning program that covers the project building and associated grounds. The plan covers implementation of training of the maintenance staff in the hazards, use maintenance, disposal and recycling of cleaning chemicals, dispensing equipment and packaging. The report refers to OSHA's Hazard Communication Standard (29 CFR 1910.1200) to describe the possible dangers of being exposed to toxic substances in the workplace and clearly defines the responsibilities of the building management in protecting maintenance staff from these dangers. Training of the staff about these hazards, ensuring that used chemicals have the necessary safety labeling and keeping a record of each type of chemicals used in the building are also listed among the requirements of the plan.

As these examples show, there is no problem in accessing to the necessary data for achieving a credit that will address OHS risks since the credit itself requires the production of such data. There is also no technical barrier in the achievability of the credit. However, as was raised in several interviews, the amount of documentation and the increased costs are the two major problems that prevent developers from seeking certain credits. As mentioned by Gambatese and Tymvios (2012), a credit on OHS is expected to create some extra costs. The amount of documentation, additional training and monitoring activities, possible slowdown in work due to safety measures and additional needs for communication among different workgroups are possible sources of increased costs. Nevertheless, by reducing the risk of injuries and lost work days, higher efficiency rates can be achieved in the long run, in addition to reduced risks of legal consequences possible workplace injuries.

Compatibility of the credit with the requirements for being a pilot credit is presented in Table 7.11. Analysis shows that GRI Cre6 complies with the basic requirements for being a pilot LEED credit.

Table 7.11 GRI CRE6 Pilot Credit Analysis

Title:	Percentage of the organization operating in verified compliance with an internationally recognized health and safety management system.	
Intent:	To provide organizations with key processes to mitigate the health and safety risks associated with its operations.	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	

Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Percentage of employees, supervised employees and independent contractors, internally and externally verified to be operating in compliance with the health and safety management system(s), for example OHSAS18001..
2. Are the resources clearly defined?	Y	Internal audit reports, external audit reports and records of certification.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	Y	Not specified in GRI, but OHSAS 18001 can be used as a reference document.
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	Y	Analysis of the LEED certified projects shows that credit is technically achievable.
2. Does the credit support the intent?	Y	Developing a OHS plan and monitoring its implementation decreases OHS risks, while increases awareness towards those risks.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Elimination or mitigation of OHS risks at the construction site protects human life, enhances the labor force, increases efficiency and decreases health care expenses.
4. Does the credit support market innovation?	Y	The credit may trigger improvements in OHS assessment market and the consulting industry on OHS, create incentive for the development of new OHS measures and tools.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Additional costs may incur due to additional documentation, monitoring and auditing needs, however, these can be compensated by the increased workplace efficiency and decreased risk of legal cases against developers or the contractors.

*Y: Yes, N: No, P: Partially

7.3 Human Rights

Like sustainability, human rights is a concept that can become an empty signifier, where everyone agrees on its value without introducing clearly defined policies to change daily life routines to ensure it. In the construction sector, human rights issues relate to different stages of the lifecycle of a building ranging from the extraction of raw materials to the building demolition. In many cases human rights violations are obscured behind gray legislative areas where recognition of basic human rights is not supported by clearly defined regulations and a monitoring system. The interview with Sandy shows that even in countries like the US, where human rights are recognized and protected by strict laws, many violations, such as gender discrimination in the workplace, can be hard to detect and to prove. Mobbing, prevention of use of rights to associate and workplace discrimination are examples of hidden violations of human rights, which may not always be revealed through public data. Research (Baram, 2009; Huen, 2007) shows that the tacit character of the knowledge regarding human rights violations necessitates further actions other than simply issuing laws and regulations addressing human rights. The interview with Sandy and her description of a case that can be classified as case of gender discrimination shows that it is necessary to develop internal policies within construction firms that aim at revealing this tacit knowledge and taking preventive measures where necessary against human rights violations. These measures can include thorough surveys in the workplace, regular meetings with workers and training employee programs on human rights.

While managing the human rights issues at the construction site is one part of the problem, dealing with possible cases that occur in the supply chain is another. Within a total lifecycle perspective, identification and prevention of human rights violations becomes complicated since many organizations have little or no control over their global supply chains. In these cases, even green products, which promise an environmentally responsible lifecycle, cannot be guaranteed to have been produced under total compliance with human rights criteria at all stages of their supply chains. The breadth of the issues to be considered under human rights topic makes it even harder to give such a guarantee.

People involved in the green building industry agree on the difficulty of ensuring that all workplace practices are free from human rights violations. Jamie, a LEED AP BD+C Environmental Specialist and an interviewee for this research, thinks that "The idea of looking at the idea of human rights aspect is a fantastic one" but that it poses problems at the regional level. The concerns should be regional she says. For example, "What you expect from a project in India in terms of human rights is very different from what to expect for your workers and how you expect it to be implemented for a project in the US where there are certain labor laws and totally different construction methods." However, when asked about how things work for green buildings in the US in terms of human rights, she stated that she does not have the necessary information since green building consultants or designers do not handle the money or the contract. She said, "For all I know that is the standard clause in the US. I have absolutely no idea about what goes in that contract," She added that few people on design and consulting teams visit the construction site and these visits do not include any opportunities to monitor human rights related processes.

Albert, another interviewee, admitted that human rights is an important aspect of construction processes but he thinks that this cannot be brought into LEED through a holistic lifecycle analysis because LEED does not promise such an analysis. Only if, he said, there is enough evidence to judge the human rights issues within the spatial and temporal borders of a construction project could a human rights analysis be conducted. For this to happen, certain criteria have to be developed and maybe the workers or contractors should be certified based on these human rights issues. However, even this cannot happen in LEED within the near future but maybe in 2017 version he believes.

According to Hally, who is a program analyst and life scientist in EPA, the reliability of documentation poses another problem for measures concerning human rights issues. Measures regarding supply chains documentation are especially important she said. However "People do not trust many of the documentation especially the government agencies because most of them are self-documented and you can't be sure about which country and which regulation you should take as a benchmark" she added.

Victor stated that recognition of human rights related issues, such as worker's benefits, by the green building industry, are not independent from industry's preferences. According to him, the building industry operates as a mixture of lobbies and those who believe that human rights should be included in the green building rating system have to convince the industry that this is necessary and would benefits the industry.

In summary, these interviews raise five types of problems for developing human rights credits for the international green building rating systems. These are:

1- Human rights problems differ from region to region according to construction practices. Developing effective international measures to monitor and prevent human rights violations might not always meet regional necessities.

2- Regulations and types of documentation of human rights vary from region to region and the documents are not always reliable. Therefore submittals to comply with human rights measures cannot easily be standardized.
3- The current framework of LEED does not support a total lifecycle analysis of human rights so it can only be done within the temporal and spatial limits of construction.
4- Consultants and designers are not involved in processes that would include human rights issues at the construction site. This means that people who are involved in certification and auditing do not have the knowledge about these topics and during their visits to the site; they do not have the chance to monitor these issues.
5- Lack of human rights measures in the green building industry can also be a consequence of the lack of voice of interest groups that advocate for the inclusion of related measures within the green building industry.

Regarding these reasons, several interviewees stated that they are hesitant about including measures on human rights within the scope of green building rating systems. However, when asked to relate this vision to the definition of sustainability, all the interviewees agreed that sustainability has a broad perspective which includes human rights aspects as well. Many interviewees agreed that developing measures of social aspects of sustainability, such as human rights, require the introduction of strong incentives for the building industry. In relation to this argument, Mark presented one of his experiences in Kohl's, a department store, where he encountered a sign saying that the building was environment friendly without referring to any independent rating system or any further details. Mark claimed that the sign catches customers' attention and they seemed to enjoy it; showing that a plaque on social responsibility could also lead to customer appreciation and act as a means of positive marketing for building owners and organizations that use these buildings.

One of the biggest contributions of LEED to the building industry and to society is its function as a means of communication between building users and the building itself. It is a means of identifying the buildings that have better environmental and healthy features than conventional buildings. However, the absence of measures on human rights and other social aspects prevents the same communication from being implemented regarding social aspects. Building users do not have the opportunity to identify if a building was built in compliance with certain human rights criteria. Therefore it is important to develop measures that require building projects' compliance with human rights issues and ask project owners to disclose the level of compliance publicly. This could allow building users to know if human rights issues were taken into consideration during the construction and in the supply chain of a building. This of course necessitates finding ways to cope with the above listed hurdles mentioned by the interviewees.

One way of addressing these problems is to introduce a human rights credit that encourages and guides each project team to develop and implement their own human rights policy prior to t construction, instead of setting quantitative thresholds to be achieved. The new credit could simply determine the framework of these policies by providing a list of subtopics to be addressed such as workers benefits, child labor, forced labor, discrimination, training opportunities etc. Project teams may also be given the chance to pick a subset of these subtopics, instead of addressing them all. This can increase the flexibility of the credit, hence increasing universality and achievability of it, as a way to respond to the differences in regulations in practices among regions.

These policies can be can be put together with the project team, which would define important human rights risks at the workplace, devise a plan to monitor and prevent these risks and report these actions at the end of the project. Encouraging building projects to develop a human rights policy can both raise awareness of human rights in the construction industry and help develop new methods to fight against violations while still considering local needs and problems. If these policies become part of an integrated design approach, different stakeholders (designers, consultants, engineers, contractors, community representatives, etc.) may find the chance to contribute to the development of a sound plan that would bring in different aspects of the human rights issues, some of which might be hidden in a conventional design method. These policies and related reports can also function as benchmarks for future projects of project owners, developers and contractors.

Developing policies for sustainable design, bringing flexible achievement criteria and promoting their implementation through integrative design are not new to LEED's framework. In fact, all of these features exist in several prerequisites and credits. LEED prerequisite EAPr1 Fundamental Commissioning Plan and LEED credit EACr3, Enhanced Commissioning are two measures which require the development of a policy along with an energy management plan prior to the construction phase. The intent of EAPr1 is "to verify that the project's energy-related systems are installed, and calibrated to perform according to the owner's project requirements, basis of design and construction documents" (USGBC, 2010). Reducing energy use, operational costs, number of contractor callbacks, providing better building documentation, improving occupant efficiency and verification of compliance with the Owner's Project Requirements (OPR) are listed by USGBC as benefits of commissioning. EACr3 brings additional measures that will start the commissioning activity in the early design process, make sure that training for the operational staff and building occupants are completed and conduct a post-installation audit by an independent authority to ensure that the systems are functioning in compliance with the OPR.

The interconnected character of the energy systems of a building with each other and with the other components of the building makes early design an important strategy for finding optimum ways to ensure resource efficiency. Therefore the commissioning process constitutes a very significant part in the LEED certification process. To comply with the commissioning requirements of LEED, projects have to have a designated commissioning authority (CXA) that will monitor and ensure the installation, calibration and operation of the energy equipment that will meet the environmental and sustainability goals as they are defined in the OPR and basis of design[6] (BOD) documents. The commissioning requirements defined by these documents then have to be included in other construction documents and a commissioning plan has to be devised and implemented based on these requirements. Successful implementation of these requirements is then reported through a commissioning plan.

Similar to energy efficiency and environmental conservation, human rights is an issue that is related to all phases of the lifecycle of a building and many human rights issues have to be considered during the planning and design of the project. The lifetime of a construction project starts with the decision to invest. Therefore dedication to developing and implementing any human rights criteria has to be clarified at this stage along with other sustainability criteria. Investors who want to build projects that address human rights should openly disclose this intention as part of the investment decision and introduce a means of achieving this goal through design, hiring, purchasing, construction

[6]BOD is a document including description of systems, assemblies and the criteria behind design decisions. While OPR defines the basic requirements of a project, BOD functions as a technical guideline to achieve these goals.

and operation processes. For an effective human rights policy, this intention should also be described in documents that describe the objectives and principles of documents, such as Owners Project Requirements (OPR).

OPR is a document defining a project's intent, objectives and means achieving them. The major function of OPR in a building project is to communicate between the owner and other contributors (designers, engineers, contractors, etc.) about the needs and the acceptance criteria for submissions related to the project (Stum, 2002). The OPR defines the foundations of a project; it is the basis for all other documents and actions that are related to the project, including principles that define the content of contract documents. It is the OPR document where general requirements such as sustainable design, material quality, safety, aesthetics and budget constraints are to be found. Human rights targets of the project can also be listed in the OPR document as the align with the general framework and the function of the document.

The OPR document submitted for Project1 defines itself as a document detailing the functional requirements of the project and defining the expectations for use and operation. The intent of the project is described as developing "a high performance building applying sustainable development principles and practices, including the use of environmentally conscious construction techniques and materials, in a practical, well planned, timely and cost effective manner." The sustainability mentioned in the intent, however, is limited to the environmental impacts. The key objectives of the project, listed below, do not include any reference to human rights or any other social sustainability principles:

- Minimization of environmental impacts
- Durable and secure building with low utility and maintenance costs

- Comfortable and healthy environment for building tenants
- On-time and on-budget delivery of building on or around December 2011

The document also specifies the "sustainable design requirements of the projects" including details about energy, water and lighting efficiency, IEQ standards, use of building materials and basics rules for building operations. Human rights is not a concept that is addressed through these requirements. Additionally no LEED credit addresses explicitly human rights issues; nor does it promote development of human rights related policies prior to construction. However, the documents that were analyzed for this research show that some contractor agreements and construction documents already have human rights clauses, including anti-discriminatory policies, encouragements of employment of women and verification of IAQ for the construction site. The interviews also reveal many positive human rights related actions taken but undocumented during green building design and construction process such as lifelong employee training opportunities, use of unionized workers or application of minimum wage standards.

These findings indicate that there is a field in green building practices that includes best practices for sustainable building design, which are however not being addressed in the LEED certification process. This can be an opportunity for LEED to improve its structure to better address the social aspects of sustainability while also rewarding some of the practices that are already being implemented by project teams.

Introducing a human rights policy at the early design stage and monitoring its implementation can help construction teams recognize possible hidden relationships between the technical requirements of the design and the human rights aspects of the project such as safety, working hours, training, discrimination, etc. No different from the commissioning practices, projects might plan this effort starting at the preparation of the OPR document and make it part of the integrative design process, thus allowing insights from different stakeholders as to the possible negative aspects of each design decision.

Eight GRI indicators selected for this study tare listed in Human Rights section of GRI. but only three of them address “human rights” as a concept and discuss it in broader perspective. The other five indicators, however, address specific problems that are defined through documents and regulations on human rights such as freedom of association and collective bargaining, elimination of child labor, prevention of discrimination. For this reason only these three HR indicator are analyzed under the Human Rights title while the others are examined under their own specific areas. These indicators are:

1- **HR1:** Percentage and total number of significant investment agreements and contracts that include human rights clauses or that have undergone human rights screening.

2- **HR2:** Percentage of significant suppliers, contractors, and other business partners that have undergone human rights screening, and actions taken.

3- **HR3:** Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained.

Although none of these three indicators addresses the introduction and implementation of a holistic human rights policy within the organization, together they address three different dimensions of human rights within an organization. HR1, 2 and 3 together make up three basic components of a lifecycle analysis of an organization’s operations, where HR2 addresses the supply chain, HR3 addresses the current state of service/production and HR1 addresses the investments. In a chronological perspective, they can also be reinterpreted as the past, present and future of an operation (Figure 7.4).

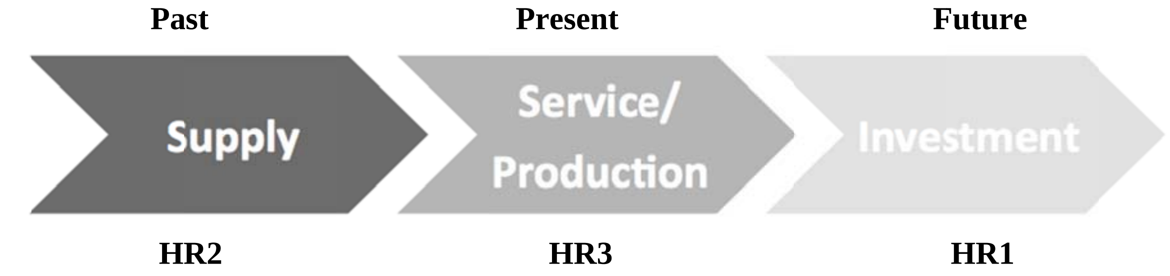

Figure 7.4 Interconnectedness of human rights indicators.

Organizations that employ a total lifecycle perspective and aim to achieve social sustainability are expected to develop human rights criteria that will be implemented in all these three phases of their operations. For the construction sector, this approach would include the supply of construction materials, the construction and design period and the decision making process on the investment. However, while GRI looks at operations at the organizational level, spanning multiple investment projects in various locations, the unit of analysis in LEED and other green building rating systems is single building projects. Therefore, the schema presented in Figure 5.4 does not fit the structure of green building rating systems.

The biggest difference between the structure of LEED and the schema presented above is the scope of HR1, which covers all investments decisions of an organization. But LEED takes only a single construction project as its unit of analysis. Contrary to what is presented in figure 7.4, for a single construction process, investment comes before all other stages, since the lifetime of a building project starts with the decision of investment. This poses a challenge for introducing HR1 is LEED as a human rights indicator.

Another challenge is the lack of enough specification in GRI's definition of human rights clauses, which makes HR1 highly flexible and broad in scope, allowing the disclosure of various actions under the same indicator. For example, the clauses of the RFQ for Project 4 which prohibits discriminatory hiring practices and promotes local hiring and hiring of minorities can all be reported under this HR1 as examples of human rights clauses. Responsible marketing and training of workers on human rights laws fall under the scope of this indicator as well. However, training of workers on human rights can also be reported under HR3 at the same time. The broad scope and flexibility of HR1 allow it to function like a big umbrella that can gather all possible aspects of social sustainability.

The GRI report issued by the Munich Airport in 2009 (Stadtwerke München GmbH, 2009) includes several examples of possible reporting practices through HR1, 2 and 3, showing how these indicator can be applied. The report also illustrates the interconnected relationships among them. In order to disclose on HR2, the airport conducted a questionnaire sent to its suppliers about social responsibility that ask for the origins of their products, their employee pay scales, their OHS policies, current working conditions and minimum wages. Results of this questionnaire are presented in the report. Disclosures on HR3 include data about the training programs provided for managerial employees of the airport under Germany's Equal Treatment Act are exemplified and disclosures on HR1 include the airport's advertising policies. These advertisements are claimed to avoid all forms of discrimination and unfairness, misleading information and remain within the framework of being "decent, proper and moral." All of these efforts are listed as examples of investments including human right clauses.

Both for the sake of avoiding the disadvantages of the broad scope of HR1, 2 and 3 and to comply with the framework of LEED credit requirements, these three GRI indicators can be consolidated into a single one, which will resemble the structure of EAPr1 and EACr3. In other words, HR 1, 2, and 3 can be rephrased to create a new credit, which will encourage the development and implementation of a human right policy in green buildings. Borrowing the tools of LEED's commissioning related measures, a human rights policy planning credit can be developed. This credit can require development of human rights policies at early design and disclose this policy as a part of the integrated design process. By asking project teams to define their human rights goals, without excluding the topics addressed by HR1, 2 and 3 (human rights clauses in contractor agreements, agreements with suppliers and human rights training at the workplace) this new credit can both encourage the development of sound, measurable human rights goals for the project. Such a strategy could also help eliminate the hurdles raised by the interviewees, which deter an introduction of human rights measures into the green building industry.

Table 7.12 GRI HR1 Pilot Credit Analysis

Title:	Percentage and total number of significant investment agreements that include human rights clauses or that have undergone human rights screening.	
Intent:	To measure the extent to which human rights are integrated in an organization's economic decisions.	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Agreements that are significant in terms of size or strategic importance and total number and percentage of significant investment agreements that include human rights clauses or that underwent human rights screening.
2. Are the resources clearly defined?	Y	Reporting organization's legal, investor relations, and financial departments, as well as documentation collected through quality management systems..
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	N	N/A
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	N	Credit is designed for organizations to report multiple investment decisions. LEED's scope includes only one investment. The indicator needs to be modified.
2. Does the credit support the intent?	Y	Reporting the amount of agreements with human rights clauses help identify the extent of integration of human rights in organizations' decision making processes.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Inclusion of human rights clauses in investment agreements increase awareness and can change the structure of investment requirements in the long run.
4. Does the credit support market innovation?	Y	The credit may help CSR market improve and development of new consulting tools that will assess the human rights aspects of investments.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Disclosing the amount of agreements with human rights clauses does not have significant cost effects.

*Y: Yes, N: No, P: Partially

Table 7.13 GRI HR2 Pilot Credit Analysis

Title:	Percentage of significant suppliers and contractors that have undergone screening on human rights and actions taken.
Intent:	To measure how reporting organizations apply their human rights policies to their supply networks to provide evidence of an organization's positive impact on the wider business community..
Impact categories addressed:	None (LEED 2009` Enhance communit al equity, Environmental justice, and quality of life (LEED v4)

Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Percentage of contracts with significant suppliers and contractors that included criteria or screening on human rights, percentage of contracts with significant suppliers and contractors that were either declined or imposed performance conditions, or were subject to other actions as a result of human rights screening.
2. Are the resources clearly defined?	Y	Reporting organization's procurement or purchasing and legal departments.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	N	N/A
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	P	The credit is achievable as far as related data is available from the suppliers.
2. Does the credit support the intent?	Y	Identification of the amount of suppliers with/without human rights screening show how much attention is given to human rights in formation of the supply chain.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Human rights screening in the supply chain can encourage suppliers develop policies toward improving human rights problems.
4. Does the credit support market innovation?	Y	The credit may improve human right screening, monitoring and labeling tools; improve the market for consulting and certification in this area.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Depending on the market for products with human rights screening, the price premium, ease of collecting related data, the cost may change.

*Y: Yes, N: No, P: Partially

Table 7.14 GRI HR3 Pilot Credit Analysis

Title:	Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained.	
Intent:	To get insight into an organization's capacity to implement its human rights policies and procedures.	
Impact categories addressed:	None (LEED 2009) Enhance community: social equity, Environmental justice, and quality of life (LEED v4)	
Required Information	**Y/N/P***	**Attributes**
1. Are submittals and performance metrics clearly defined?	Y	Total number of hours devoted to employee training, total number of employees, employees who have received formal training in the organization's policies and procedures on human rights issues their applicability to the employees' work, total number of hours in the reporting period devoted to training, percentage of employees trained. underwent human rights screening.
2. Are the resources clearly defined?	Y	Employee records of training and training schedules.
3. Is the credit applicable to at least one rating system and one project type?	Y	Applicable to all
4. Are there any resources provided to guest expert?	N	N/A
Required Qualification	**Y/N/P***	
1. Is the credit achievable?	P	Absence of third party certification and labeling for nonexistence of unwanted labor in construction processes and supply chain is an important hurdle. However, previous experiences such as FSC shows that it is not a sufficient reason to not to develop such credits.
2. Does the credit support the intent?	Y	Identifying number hours on human rights training help organizations set limits and assess their achievements on human rights training.
3. Does the credit lead to better outcomes in environment, society or ecology?	Y	Training on human rights at the workplace help develop a self-control mechanism on human rights, reducing violations.
4. Does the credit support market innovation?	Y	The credit may support improvement of the market on human rights training.
5. Does the credit align with the direction and advancement of LEED?	Y	By enhancing the socio-economic structure, the credit aligns with the foundations of LEED and responds to the increasing attention on the socio-economic aspects of sustainability as it is dictated in LEED v4.
6. Is the credit effective in cost, time and effort?	P	Additional costs that incur by allocation of extra hours on training and/or hiring a professional for this task.

*Y: Yes, N: No, P: Partially

The pilot credit analyses of HR1, 2 and 3 are presented in Tables 7.12, 7.13 and 7.14. The analyses show that HR1 is not suitable for application in LEED without modification of its language. Although inclusion of human rights clauses in investment agreements is a very important action that can change investment decision making and improve the market for human rights assessment and consulting, the scope of the indicator does not fit LEED's scope. LEED takes a single building project as its unit of measurement, whereas HR1 covers all investments of an organization.

Since HR2 and HR3 do not have similar problems, they are more suitable for adaption within LEED's framework. The biggest problem in implementing HR2 is gaining access to the human rights records of suppliers, unless they have certifications such as FSC or Fair Trade. Although Albert, who is a sustainability consultant in Manhattan and an interviewee for this study, stated that the LEED framework does not allow for a whole lifecycle analysis of LEED projects, LEED actually does go beyond the temporal and spatial boundaries of the project through credits addressing the use of certified wood, development density and material resourcing (in LEED v4). HR2 is a significant indicator that completes the limited lifecycle perspective by adding the supply chain and helps develop a holistic approach to the lifecycle management for social sustainability. Although its applicability depends on the existence of related data and certification tools, this could also spur market interest in developing more labeling tools that will assess the human rights aspects of building materials.

The framework of HR3 fits with the framework of LEED since its focus is the amount of training received by workers engaged with the organization. In the case of the construction business, this would be staff training on human rights, including construction workers, designers, engineers, etc. HR3 can easily be translated into LEED's language with minimum modification. For example certain benchmarks, such as minimum amount of training on human rights, can be required for achieving HR3. It is also possible to suggest a list of topics to be covered in these training programs, in order to comply with the credit. The biggest handicap for implementing HR3 is possibly the cost that will be incurred because of the hours spent on education and hiring a training company.

While HR1, 2 and 3 each has their own possibilities and hurdles, they are all in limited in addressing local needs on human rights. With their current structure they are also not helpful in revealing the tacit knowledge that can only be revealed through stakeholder meetings. Regional differences in availability of data, regulatory impositions and costs also limit their applicability. For these reasons, consolidating the topics addressed by these indicators under one credit in order to promote and guide the development of a human rights policy at the early design phase might better serve the needs of an international rating system which requires some level of flexibility to respond to the needs of the building industry.

CHAPTER 8

IMPLICATIONS: WHAT IS NEXT?

"Sustainability is a process, not a goal" said Nicky, who is the CEO of a GRI reporting consultant company. Indeed it is. It is a discourse that gathers together information about the scattered elements of physical and social environments and creates a narrative through which people can reach a meaningful understanding of what we call "reality." But it is not only a way of interpreting reality; it is also a way of creating reality by bringing together artifacts, concepts, emblems, numbers, rules and values to form a new system of meanings with which people act and communicate, hopefully in a more cautious and empathetic manner than in the past.

Once religion had been dispelled from its privileged position as the only valid system for explaining the world, human beings gained a new subject position and ceased to be mere transmitters of the religious order. As matter was ripped from its "sprit," its "sou,l" or the *nouméa,* using Kant's words, success for the "enlightened," "modern" man became associated with the degree of control that he can establish over the material world. The most evolved form of this thought was crystalized in the institutionalization of the growth oriented economic perspective that has dominated the 20th century and carried its legacy in the 21st Century. All over the world states have centered their policies on boosting their GDP numbers, eventually creating an economic machine that swallows natural and human resources in return for growing economies and increased control over political systems. Thanks to several warnings such as global warming, depletion of natural resources, desertification of large land masses, loss of species, increasing food prices and endless civil wars, human kind has recently learned that continuous growth without respecting the interrelated mechanisms of ecological and social systems will soon turn into a self-destructing activity by destroying the earth's life-sustaining systems and social cohesion.

With the Enlightenment, the human learned that the earth is not the center of the universe, not even the solar system. Now, the rise of sustainability discourse presents another chance for us to understand that humans are not the center of the universe either. If there is one thing to be learned from the collapse of the ancient Greek cities or the empires of the last millennium, it is to realize that given the entropy of the physical world that surrounds us, gaining absolute control over a limited portion of a complex system is not a good survival strategy. What is more helpful is to understand how the complex systems of ecology and society work and to gain the ability to manage our relationship with these systems, instead of seeking to exert absolute control over them.

The pursuit of sustainability requires establishment and the implementation of a management approach where people assess the outcomes of their actions and plan for the future before interfering with the complex and contingent systems of ecology and the society. Being sustainable means continuously collecting and analyzing of data about social, economic and ecological systems in order to manage negative outcomes of human actions and preserve the systems that sustain the life on this planet. More than that achieving sustainability also requires the establishment of participatory governance mechanisms that allow tacit knowledge hidden in different segments of society to be shared and made available in decision making.

8.1 Lessons from the Research

The building industry has a distinguished place in sustainability discussions because it acts as a nexus connecting all three aspects of sustainability while changing the built environment. Three forms of capital -- financial, human and natural capital -- become visible in the physical structure of a building. During its lifecycle a building not only brings these three forms of capital together but it also acts as a hub channeling them into particular locations and transforming the economic, social and ecological structure of these locations.

Buildings have long been more than architectural structures providing shelter for humans. For over a century they have been as a major tool of investment creating significant effects on the socioeconomic structure. Effects of the building industry on the economic structure are mostly considered as the creation of economic value and as fluctuations in the real estate market. But the 2008 subprime mortgage crisis revealed that the influence of the building industry on global economies and social structure reaches far beyond the boundaries of real estate markets. The cost of the 2008 financial crisis, triggered by the subprime mortgage failure, has exceeded 12 trillion dollars, leaving 21 million Americans unemployed and pushing 46 million people below the poverty line (Kelleher, Hall, & Bradley, 2012). Many industries supplying goods and services to the building industry, including wood and lumber production, real estate companies, the cement and concrete industry, building material dealers and furniture stores, were negatively affected and some of them experienced losses in sales reaching 6% in 2008. Many other industries that are not directly related to the building industry were also negatively affected, such as credit intermediation, motor vehicle wholesale, florists, dry cleaning and drug wholesale (Rampell, 2008).

This domino effect of the 2008 recession in many sectors following the burst of the “real estate bubble” is no surprise when the hub-like structure of the building industry is considered (Figure 8.1). During the lifecycle of a building various industries from different locations engage in the extraction of resources used in manufacturing of building materials, transporting these materials to the building site, assembling them to erect the building, operating the building and demolishing it at the end of its lifetime. For example, the mining of the raw materials for concrete and steel may be supplied from local resources while high-tech equipment such as solar panels and HVAC control systems may be coming from overseas. While the construction workers would likely be hired from local job markets, design and commissioning of the building could be undertaken by companies located overseas. The supply of energy and other resources to operate the buildings can also affect several industries depending on how these resources are supplied, whether site or grid energy is used and if grid energy is used whether the source is fossil fuel, nuclear power or renewable resources.

By connecting different sectors with each other and concentrating different forms of capital at one location the hub-like structure of a building gives the building industry opportunities to generate positive or negative changes in other industries, thereby affecting the environment, the labor markets and the economy. For example, use of certified wood in a building project, such as FSC wood products, not only protects rainforests by reducing the demand for rainforest wood but it also supports the market for sustainable forestry. By supporting sustainable forestry practices a building project also discourages illegal harvesting and use of hazardous pesticides while promoting fair labor practices in wood supply.

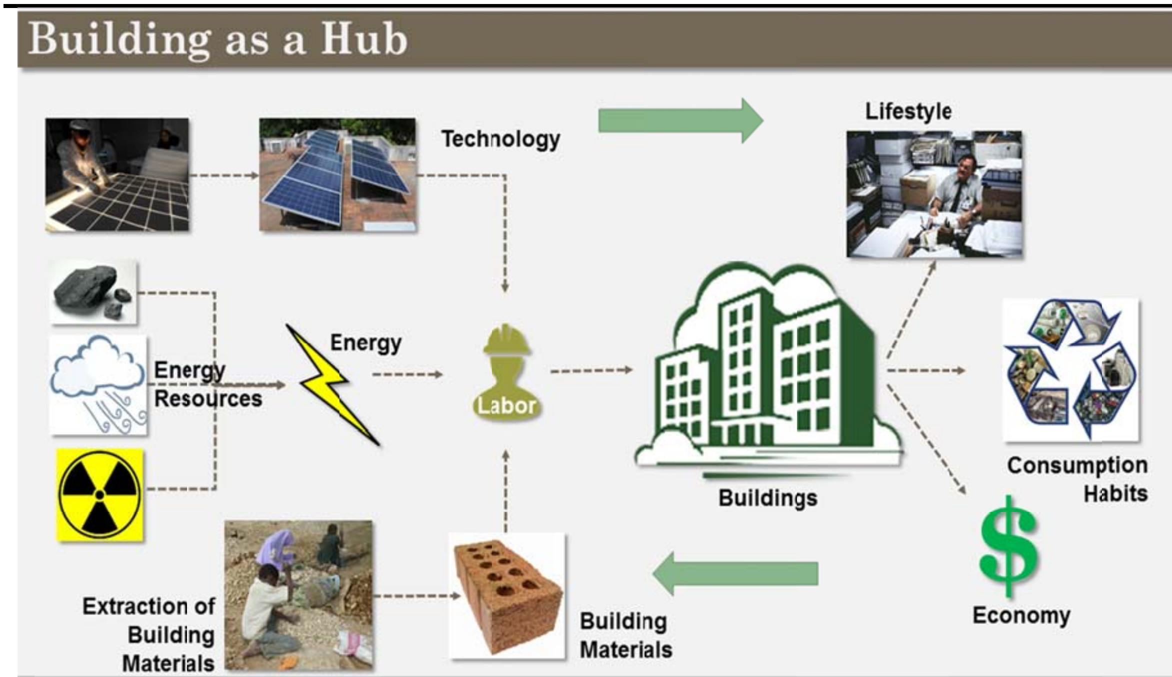

Figure 8.1 Building as a hub: How buildings connect different aspects of sustainability
Source: *Findings from this study*.

Installation of solar panels on buildings is another example of how buildings operate like hubs. Although increased use of renewable energy via solar panels in building projects is usually considered as a sign of a growing ambition to build more sustainably, considerations regarding the relationship between sustainability and the use of solar power in building projects should go beyond carbon emissions calculations. It is important to acknowledge that use of solar panels in building projects also creates financial support of the growing market for solar energy. By installing solar panels building project owners channel a portion of their financial resources to the emerging solar energy industries instead of supporting the fossil fuel industry. In return, they acquire a technology-intense product that concentrates a mixture of different materials and different forms of labor from various parts of the world. A scenario developed to analyze the lifecycle of a solar panel installation (Reich-Weiser, Fletcher, Dornfeld, & Horne, 2008) shows that photovoltaic cells of a solar system might be produced in India, packaged in Mexico, assembled to make a panel in Germany, combined with a tracker that was produced in Japan and finally installed together as a solar energy system on a building in the US. All of these stages in the production and distribution of the components of a solar panel should be considered within the lifecycle of a building if it is uses a solar system, including the earlier stages related to the production of raw material necessary to produce all of these components. Therefore a full sustainability analysis of the use of solar power in a building project should consider the environmental, social and economic effects at all of these stages by focusing on a wide range of issues possibly including total energy used to produce solar cells, environmental and health risks that might occur during the mining and purification of raw materials, amount of waste produced during production, effects of this waste on the health and economic activities of local communities and the working conditions of workers who are involved in each of these stages of the lifecycle of a solar panel.

It is important recognize that the hub-like structure of a building operates in a bi-directional way. While a building brings existing forms of technology, labor and capital together to provide living, working and leisure spaces it also helps shape people's lifestyles, can change their consumption habits and can contribute to local and global economies. But this relationship also operates in the opposite direction. Exiting structures of the economy, the lifestyle of people and their consumption habits can also determine the features of the buildings (Figure 8.1). For example, as public consciousness about climate change increases and markets begin to respond to the risks of fossil fuel dependency, the demand for green buildings will increase. With the help of increased public awareness and legal regulations on indoor environmental quality, health aspects of buildings attract more attention, creating an increasing demand for low-VOC materials, lead-free paint and better ventilation units for higher indoor air quality. Therefore the rise of sustainability discourse is an important opportunity to rethink our building habits.

Advocates of the green building industry have long been acknowledged this opportunity and used it to address and manage the impacts of buildings on the environment and human health. LEED has emerged as one the most successful green building rating systems; it has recognized the hub-like structure of buildings and introduced its credits to create a positive impact on the supply chain of building materials. LEED has not only increased the demand for green building certification exponentially but has also changed the dynamics of the supply chain of buildings by creating a new demand for resource efficient, healthier building materials. By turning the idea of "green building" into a norm, a responsible way of building, LEED has contributed to the development of many other businesses around the idea of green building, such as sustainable forestry, green building design, energy efficient lighting systems, energy modelling, rain water collection and renewable energy systems.

Through changing the conventional ways of building LEED undertakes an important role by carrying sustainability in building design from goodwill to an actual practice. By defining the guidelines of building an environmentally responsible building LEED saves the concept of sustainability from being an empty signifier and shifts it from *lexis* to *praxis* by reintroducing the hitherto romantic idea of "being green" to something that can actually be built and demanded in the market. However, despite its power to promote the idea of sustainability in the form of green building, LEED has not used this opportunity to fully address sustainability by introducing measures to help manage the impacts of buildings on economy and society.

As this research showed, the current structure of LEED allows designers and project owners to consider only the environmental and health impacts of buildings as they are evident in the actual building. The current approach of LEED takes each building as a living monument carrying traces from different phases of its lifecycle. As a hub, each piece of building material, each form of technology, capital and labor leaves its trace in the finished final product, the actual building, and the lifecycle approach of LEED operates through these traces to decide if a building is green. But these traces do not tell the full story behind a building. While it is easier to document the environmental and health aspects of a building through these traces, its effects on the economy and society need further investigation. Even for the environmental and health aspects, the impacts that occur during the production and transportation of building materials are not always visible in the actual building. As previous research shows, (SVTC, 2009) even green products such as solar cells may lead to health and environmental hazards if their production is not properly monitored and regulated. While contributing to sustainability by reducing the carbon footprint of site energy use, their manufacturing process might challenge the social aspects of sustainability by failing to provide fair working conditions for workers. For these reasons it is necessary to ask: "Is green always sustainable?" "Do green buildings contribute to sustainability in all three aspects?" "Is there room for improvements in LEED and other green building rating systems that will help attain social and economic sustainability, as well as environmental sustainability?"

This research has shown that green building certification is a significant step towards attaining sustainability in the building industry, but green does not necessarily mean sustainable. A sustainable building requires a broader lifecycle perspective that takes social, economic and environmental impacts at all stages of the lifecycle of a building into consideration, from extraction of resources to the building's demolition. However the lifecycle approach of LEED is based on the embodied-energy of building materials. In addition to site energy use, energy used to produce and transport building materials are given significant attention by LEED credits. By doing so, LEED utilizes the hub-like character of buildings and creates a market mechanism that requires the production of less energy intensive, environmentally responsible building materials, but it does not include the social or economic impacts of these materials, nor does it do so for the construction phase of the building.

Similar to embodied-energy, every building and building material also contains some form of embodied-labor. Labor is inherent in every stage of the lifecycle of a building either transforming resources into finished or semi-finished products or in the form of service. Like embodied-energy, labor is also channeled through the hub-like structure of a building from different geographies to the construction site, reaching its final form as the actual finished building. Even after that, the operation, maintenance and demolition of a building are only possible with the use of some form of labor. For those reasons labor related issues, including working conditions, compensation and benefits of workers, occupational health and workplace security and human rights issues such as use of child or forced labor are significant parts of sustainability in the building industry, and the building industry has the potential power to positively affect these labor processes. However, none of these issues is covered by LEED or other green building rating systems yet.

Impacts of the building industry on the socioeconomic structure, especially on labor processes are not negligible. By accounting for four percent of employment in the US (5.5 million employees) the building industry remains to be one of the main engines of the US economy even after the 2008 mortgage crisis. Any improvements in the average wage of construction workers, their access to benefits and improvement in working conditions would lead to positive changes in local economies by increasing the purchasing power of 5.5 million people and would enhance the labor force by providing a healthier and more secure workplace for construction workers. When the entire lifecycle of a building is considered, these effects can reach even further if building materials and services that respect responsible labor practices are preferred for the construction of buildings.

As this research has shown, parallel to the decrease in unionization rates, real wages in the construction sector have dropped 25 percent in the US since 1970s. In many major US cities, such as Austin (Texas), Denver (Colorado), New York (New York), San Francisco (California) and Washington (DC) typical hourly wage in construction are below the living wages determined by the Massachusetts Institute of Technology (MIT, 2013). Additionally, the construction sector has still one of the highest fatal injury rates and the highest number of lost work days. If the whole lifecycle of buildings is considered at an international scale, the type and magnitude of labor related problems become even bigger. While human rights related issues might not be common in the US construction industry, at the international scale human rights problems such as child or compulsory labor becomes an issue. Although these issues are managed through regulations and laws in the US, many other countries and construction companies in these countries either do not have these regulations or do not execute them effectively.

Given the hub-like structure of buildings, these social problems get even more complicated because of the possibility of their occurrence at different levels of the lifecycle of a building. Although child labor is not a problem that is likely to occur within US borders, currently there is no green building measure that guarantees the absence of child labor embodied in the imported green building materials. In a similar fashion, if the construction occurs in a country where child labor is not efficiently prevented, it is technically possible to have a green building built using child labor. These problems challenge the "sustainability" claim of the green building rating systems such as LEED and require development of new measures that will address the social aspects of the building industry as well, especially labor processes and human rights issues.

The green building industry holds great potential to address these aspects of sustainability so they too can be actualized in building practices. As this research has found, issues related to labor practices during construction, accessibility to green certified spaces, a building's impact on the local community and compliance with human rights principles in the supply chains of building projects can be addressed by the green building rating systems and the hub-like structure of buildings can be mobilized to create positive changes in these social processes.

As the creator and manager of a widely accepted international green building rating system, USGBC holds a significant position in the building industry which gives it the political power to mobilize the market to acknowledge and manage its impacts on socioeconomic structures, as well as on the environment. By developing measures that address the issues listed above, USGBC can once again be a pioneer in the building industry by taking another big step towards creating a sustainable built environment. Some of the findings from this research can be used as the components of a roadmap towards developing and implementing those measures. However, possible use of these findings is not limited to the green building industry; they can also be used in different types of research about the building industry and building materials, as well as in research about the development of sustainability indicators and sets of indicators in other industries.

8.2 Future Research

One of the necessities that became apparent in this study is the need for redefining the concept of sustainability for the building industry. The findings presented in Chapter 5 show that several aspects of sustainability, especially those that address social issues, are not sufficiently addressed by the building industry. All those aspects of sustainability that are underrepresented by the building industry, such as economic efficiency, accessibility, social enhancement, lifecycle costs, cultural preservation and service life planning provide clues for the topics that should be included in this new definition, along with the environmental protection and human health aspects. It is also important to base this new definition on a total lifecycle assessment approach in which the sustainability of buildings and building materials are examined from their birth to their death, instead of a result-oriented approach where assessment is limited by the spatial and temporal boundaries of the actual building.

Expanding the existing definition requires going beyond simply adapting existing sustainability indicators to the green building industry. It requires creating a system of continuous data collection and analysis regarding the social and economic conditions that are affected by the operations of the building industry. Similar to baseline buildings developed to set the standards for energy and resource use of a conventional building, a baseline building can be defined to exemplify the social and economic impacts of a conventional building. For this aim data on the social and economic impacts of a conventional building should be collected. These data can be used to outline the socioeconomic characteristics, such as of labor practices that occur during the construction of an average building, risk of having child labor embedded in building materials or unionization rate in construction workers. For each type of building (office, schools, health services, etc.) information regarding average entry level wages, percentage of union workers used and number of health and safety measures taken can be identified. Likelihood of the occurrence of risks regarding human rights violations can be determined for both the construction process and for the earlier stages of the lifecycle of a conventional (non-green) building (i.e. supply of materials, excavation of resources and transportation). This information can then be used to form a baseline building against which the social performance of new building projects will be compared. For example, if the average level of contributions to retirement accounts of construction workers is known for a certain location, building projects that exceed this average can be rewarded by points. Collection of this information however requires research that focuses on the social sustainability aspects of the construction process.

Data collection is a crucial part of the development of new socioeconomic measures for the green building industry and this cannot be achieved by a single research team alone. What is also needed is the proliferation of labelling systems supported with detailed information at the level of single products. Projects such as Environmental Product Declaration (EPD), which aims at creating a system to document the environmental impact of products based on lifecycle assessment principles. The significance of these declarations lies in their ability to provide quantitative data for comparing each product, rather than only presenting labels such as "green," "sustainable," "gold," This approach, provided by the EPD project can be adapted to create a system to disclose not only the environmental impacts of products, but also their social and economic impacts. Identification of the major data points to be presented in such declarations and creation of a consistent system are some of the tasks that waiting to be completed by the research community.

Advancements in technology provide many opportunities for collecting the necessary data for projects such as EPD or a modified version for social impacts. An online application, such as sourcemap.com, which is a web-based lifecycle impact tracking tool, can be created specifically for the building industry, which will allow building owners and developers to record every building material that is used in a building project, disclosing the related data on a map, showing the carbon footprint at each stage of operation (extraction, transportation, manufacturing, etc.), working conditions in the workplaces in the supply chain, information about the existence of sustainability reports of suppliers, design and construction companies involved in the construction and the profile of potential users of the building. Many programs such as EPA’s Portfolio Manager are out in the market, for collecting data on the uses of energy, water and refrigerant in buildings, and their waste management. These programs can be taken as models and duplicates can be created to achieve the same goals for socioeconomic issues.

Another important area which is waiting to be investigated by future researchers on is the market mechanism that determines the locations of green buildings and the amount of space that is being certified. The findings from this research showed that at large scales, such as states in the US, green building certification is positively related to population density. However, within cities, population density may be insignificant while household income becomes a more important determinant. Nevertheless, both variables are not sufficient to predict the market patterns of the green building industry and further research is needed with the inclusion of more variables and a larger sample that would include many other states and cities to see how other demographic and urban features affect the green building market. The findings of this research can be used to answer the questions “Why do certain locations have more green buildings?”, “Who uses the benefits from green buildings the most?” and "What are the main incentives behind green building investments?” Answering these questions could also help create new incentive mechanisms for the green building industry and encourage developers to build more certified buildings in disadvantaged areas with high population densities and low income populations.

Finally, for all the ten GRI indicators that were examined in this study, further research is needed to develop a roadmap for the building industry about how to implement socioeconomic measures during design and construction. This is not only needed to improve the conditions of the workforce in the building industry but also is an important step towards creating a more efficient and resilient workforce. For this aim, new data can be collected to shed light on how the industry would respond to measures that target improvements in working conditions by setting thresholds for contributions to benefit plans, regulating entry wage levels, encouraging unionization and collective bargaining and requiring the introduction of human rights protocols at the organizational level to be applied to all operational and purchasing processes. How does the building industry define materiality? Which socioeconomic issues are more significant for the industry in attaining sustainability? These questions can be used as guidelines for determining the next steps in further research on social sustainability in the building industry.

8.3 Future of the Industry

The building industry could respond to the findings of this study and to future research in several ways. The most important step to be taken by the building industry is to cooperate with USGBC and the rest of the green building assessment community to develop new credits that would address the socioeconomic issues described in Chapter 7. Interviews for this study showed that many construction companies are already taking measures to hire only unionized workers, to provide them with on the job training and to give opportunities to disadvantaged groups in their hiring process. For these organizations that already focus on their socioeconomic impact the introduction of socioeconomic credits could be an advantage for earning more points while gaining a distinguished position in the building market by gaining official recognition for their efforts. They could even take the process one step further and coordinate with the research community to develop pilot credits to be presented to USGBC or to fund such research.

Management tools on environmental impact and corporate social responsibility are also a powerful means of creating brand names and additional value for companies. What might have been seen as a burden 30 years ago is now an opportunity for those in the business of design and construction, which allows them to find niches in the market and distinguish themselves as socially and environmentally responsible companies. The development of new sustainability indicators to guide the building market would provide many advantages for the whole industry by increasing its efficiency and its resilience in the long-run, while eliminating those who run unsustainable operations.

The second possible response to the need for a socioeconomic assessment tool is cooperation with projects such as EPD to develop social assessment criteria for individual products. LEED v4 already encourages use of the products by companies that have GRI reporting. However, given the socioeconomic impact of the entire set of building materials producing a GRI report for a small portion of suppliers is not enough to collect accurate information. In addition, for the third parties, such as building users or investors, to look at the GRI reports of the suppliers is not a convenient way of assessing the social and economic effects of building materials used in a building project. Individual product declarations for social impact, in compliance with a reporting standard such as ISO 14025, would make it easier for building developers to choose among building materials and to inform end-users about how socially responsible their building project is. For this reason, cooperation with projects such as EPD to develop assessment criteria for social impact can have significant consequences for both to building industry and the overall social sustainability of the building industry.

Finally, probably the easiest and least costly step to address social sustainability in the building industry would be the institutionalization of a transparency mechanism in the industry. Although confidentiality requirements lead many organizations and developers to abstain from sharing information about their construction projects, increased transparency in the building industry could have significant long-term effects both on the industry and society. By requiring building developers to report the socioeconomic footprint of their construction projects by using reports such as GRI, both the data vital for future research can be collected and social awareness can be raised about these socioeconomic conditions. These public reports could include information about the number of workers employed, the total amount of benefits provided, the difference between the highest and median salaries earned during construction, the number of injuries that occurred, the total economic value created, the total premium added to the building value compared to a baseline, the total number of affordable housing units provided, the total amount of publicly accessible space provided and the total contributions to the infrastructure of the neighborhood.

More transparency is also needed in the existing green building industry. USGBC has already established a very important feedback mechanism where public members of them can contribute to discussions at USGBC on pilot credits and provide feedback from their actual experiences with those pilot credits. This feedback mechanism can also be an effective means of continuous communication with the building industry and the sustainable design community, while also helping to represent the needs of the green building industry through an ever evolving system. To collect information about project teams' experience with pilot credits, USGBC also conducts some surveys. However, the results of these surveys are not accessible to the public, which limits the level of transparency of the decision making process of the pilot credit selection. While discussions in forums can also be a good source of information for understanding public opinion on the newly suggested credits, they only represent individual opinions and not standardized statistically important data showing users' experience about the pilot credits. Public disclosure of the survey results could provide further guidance for those who want to propose new credits to the green building industry while also informing the public about preferences of the building industry on newly developed credits. This could also contribute to USGBC's achievements of transparency, which is an important aspect of sustainability.

All these attempts can be gathered under the umbrella of creating a new concept, which will either be part of the green building industry or appear as a parallel, complimentary rating process. Similar to the fair trade movement, emergence of a certification system that rates and labels the socioeconomic impacts of buildings throughout their lifecycle, including their supply chain, would be one of the biggest contributions that this research can make. What a "fairly-built building" would be is a question for future research that would focus on determining the list of socioeconomic issues that are relevant to the building industry, the buyers, the users, the stock market and the communities affected by new construction. But the findings presented in this study are a good starting point for discussing these possibilities and for carrying the concept of green building to a higher level that we can name the “sustainable building.”

APPENDIX A

ASSOCIATION OF KEYWORDS FROM THE LITERATURE WITH INDICATOR CATEGORIES AND CALCULATION OFCATEGORY SCORES

As described in Chapter 4 and Chapter 6, aspects of sustainability that are addressed by the literature more than the green building industry were identified by a method that analyzes how often a keyword is used to address a particular aspect. These keywords were then matched with the pre-defined categories described in Chapter 5. Their weights provided information about how much each aspect of sustainability is addressed by the literature or the green building industry. The allocation of these keywords under categories and their points are presented in Table A.

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Access to Water	0.19	●																			●										●
Accessibility	0.38	●																													
Acoustic Comfort	0.19		●																		●										
Affordability	0.94	●					●																								
Automation	0.75						●	●	●				●	●			●		●												
Behavior	0.38			●																											
Benchmarking	0.19								●																						
Bld Enrg Mng Sys (BEMS); Enrg Info Sys(EIS)	2.83			●					●				●	●	●																
Budget / Cost	2.26	●					●											●													
Building Information Modeling (BIM)	0.57		●			●	●	●	●				●	●	●	●	●	●	●	●		●		●			●		●	●	
Building Size	0.19	●					●		●		●														●						

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Combined Heat and Power (CHP)	0.57						●		●											●		●									
Community Development	1.13	●			●																●										
Community Space	1.51	●			●						●														●						
Control Systems	0.38								●				●	●		●	●		●				●				●			●	
Cultural Preservation	2.45	●			●																●										
Daylighting	1.13					●			●					●															●		
Decision Making	0.94			●																											
Drainage System	0.38								●		●																			●	●
Durability	1.70						●		●									●						●							
Education/Training	1.32	●		●					●											●				●				●		●	
Embodied Energy	0.94								●	●								●						●							
Energy Auditing	4.72			●			●	●	●				●	●	●				●	●											
Energy Efficiency	9.62						●	●	●				●	●	●			●		●											
Energy Forecasting	2.64			●			●	●	●				●	●	●			●						●							
Environmentally Preferable Materials	0.38									●						●															●

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Ethics	0.19	●					●														●										
Facility Management	0.38			●																				●							
Finishes	0.19														●									●							
Gender	0.19	●																			●										
Glare Control	0.19					●			●				●		●												●		●		
Governance	0.19	●		●																	●										
Health	1.51						●		●				●																		
Heat Pump	0.19						●		●				●									●									
Heat Recovery	0.19						●		●				●																		
High Albedo	0.19						●		●		●		●														●				
Hot Water	0.19						●		●				●																	●	
Humidity Control	0.19						●		●				●			●															●
Incentive and Policies	4.91	●		●	●		●			●	●									●	●	●				●		●		●	●
Indoor Air Quality (IAQ)	4.91												●			●															●
Infiltration	0.57						●		●				●		●	●															
Information Systems	1.13			●													●							●							

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Insulation	0.94						●		●				●		●												●				
Integrated Design	2.08			●														●						●							
Labor Processes	0.57	●					●									●					●		●								●
Language / Taxanomy	0.75			●																											
Life Cycle	4.72						●			●								●						●							
Life Style	1.51	●		●	●		●		●		●	●							●	●	●		●	●				●		●	●
Locality	0.38	●			●		●		●									●			●							●			
Low Emissivity	2.64								●	●										●											
Market Development	1.32	●					●														●										
Monitoring	0.75						●		●								●						●	●						●	
Natural Ventilation	2.45						●		●				●			●											●				●
Occupancy Level	0.38						●		●							●									●						
Operations and Maintenance (O&M)	0.57						●		●									●						●							
Orientation and Ratios	0.38		●			●			●																				●		
Outdoor Thermal Environment	0.57	●			●						●																				

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Passive System	0.38					●	●		●				●		●					●		●				●					
Phase Change Material (PCM)	0.19						●		●						●											●					
Photovoltaics (PV)	0.75																			●		●				●					
Plug Loads	0.19						●		●										●												
Rainwater Harvesting	0.19						●				●									●						●				●	
Recycled Material	0.38									●								●		●						●					
Reflectivity	0.38					●	●		●						●												●				
Regional Materials	0.57									●								●			●							●			
Remediation / Retrofit	3.96	●			●																●			●							
Renewable Energy	1.51						●		●											●		●									
Renewable Materials	0.38									●								●		●						●					
Resilience	0.57	●					●																●	●							
Return on Capital	0.19						●														●										
Security	0.38																						●								●
Sick Building Syndrome (SBS)	1.13	●														●															●

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
Site	0.19										●																				
Social Attachment	0.19	●																			●										
Social Capital	0.57	●			●		●														●										
Social Exclusion / Segregation	0.94	●																			●										
Social Identity	0.19	●			●																●										
Social Interaction	0.75	●																			●				●						
Solar	0.19					●			●													●					●				
Solar Gain	0.38					●			●																		●				
Sound Absorption	0.38		●																												
Street Life	0.57	●			●																●										
Thermal Comfort	4.53												●			●											●				
Thermal Energy	0.19						●		●				●																		
Thermal Resistance (R-Value)	1.32						●		●						●																
Thermal Transmittance (U-Value)	0.38					●	●		●						●																
Transportation	0.38								●		●									●								●			

Table A.1 Association of Keywords From the Literature with Indicator Categories and Calculation of Category Scores (Continued)

Keywords	%	Accessibility / Social Enhancement	Acoustic Comfort	Commissioning, Planning and Management	Cultural Preservation	Daylighting	Economic Efficiency	Energy Efficient Appliances	Energy Performance	Environmentally Preferable Materials	Environmentally Responsive Site Planning	Flexibility and Adaptability	High Performance HVAC	High Performance Electric Lighting	High Performance Building Envelope	IAQ	Information Technology	LCC	Plug Load Management	Pollution / Waste Production	Regional Development	Renewable Energy	Safety and Security	Service Life Planning	Spatial Efficiency	Stimulating Arch.	Thermal Comfort	Transport	Visual Comfort	Water Efficiency	Water Quality / Health
User / Consumer Behavior	0.19	●		●	●		●		●										●	●	●		●	●	●					●	●
Visual Comfort	0.19																												●		
Vulnerability	0.19	●			●																●										
Waste Management	0.75						●				●									●											
Water efficiency	0.19						●				●																			●	
Wind Tunnel	0.75										●																				
Zero Energy	1.51						●	●	●				●	●	●				●			●				●					
TOTAL		29	1.5	24	18	4	54	20	48	15	12	1.5	40	24	26	16	3.6	27	9.8	31	22	11	4.3	23	3	8.7	10	9.1	2.5	11	17

APPENDIX B

INERVIEW PROTOCOL

The interview protocol used for the interviews is presented below. Details of the interviewees were presented in Chapter 4. The protocol consists of two parts. The first part includes general questions. The second part includes questions specific to building projects. For each interviewee the same protocol was used, but questions in the second part were asked only if the interviewees were engaged with an actual LEED project.

Interview Protocol

Research Title: Green vs. Sustainable: Analyzing and Expanding LEED (Leadership in Energy and Environmental Design) through an Examination of Sustainability Indicators

Date: ________________________
Interviewee: ____ (name)
____ (title)
____ (Institution)

Introduction

My name is Sonay Aykan. I am a doctoral candidate in the Joint Ph.D. program in Urban Systems at NJIT-Rutgers-UMDNJ. I would like to thank you for your time today and for allowing me to speak with you in person. Your contribution will help me develop suggestions to improve the green building industry. Before we start I would like to summarize my research very briefly.

My current research focuses on sustainability indicators in green building rating systems, particularly in LEED. It explores the possibility of including some of the GRI indicators in LEED and expanding the borders of LEED to cover not only the environmental aspects but also the social aspects as well.

Therefore, my interview will be two folded: In the first phase I will ask questions about your perspective about sustainability and green building codes on a broader scale. In the second phase my questions will specifically be related to the GRI indicators that could have been included in LEED.

The confidentiality agreement below outlines how my dissertation committee and I will keep personal and sensitive information completely confidential in my dissertation and any published work that results from this study. Pseudonyms will be used for rating systems and institutions such as LEED, GRI, USGBC, etc. You should also be aware that you may choose to not respond to any questions you do not feel comfortable answering and you may withdraw from the interview at any time. May I record this interview? If you have any questions or concerns, please feel free to ask

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A- General Questions

Sustainability and Rating Systems

1. A lot has been written about sustainability and there are already multiple definitions of it. Which one of these definitions is closest to you, or simply how would you define sustainability?
2. How does LEED / GRI relate to this definition in terms of its requirements and its applications?
3. What should be the criteria for developing sustainability rating systems, in terms of choosing the indicators, areas to be focused on, method of measurement and scale of assessment?
4. Where do you see LEED / GRI in the future, let's say 10 years from now on?

Workers' Benefits

5. In GRI, there are credits concerning workers' benefits (GRI EC3 and GRI EC5). These credits require disclosure of the details of organizations' benefit plan obligations and look at the difference between entry level wages and local minimum wage at significant locations of operation. Currently these measures do not exist in LEED. However, there are other measures that require monitoring the activities of contractors for the benefit of workers such as IEQ Cr3: "Construction IAQ Management Plan During Construction". If LEED was to be expanded to regulate workers' economic benefits by including measures similar to IEQ Cr3:
    a. Which processes of the construction would be needed to be screened?
    b. What type of measures and documents would be necessary?
    c. Who would be responsible with providing these documents?
    d. Given the current structure of LEED would it be feasible?

Human Rights

6. In GRI, there are credits concerning human rights (HR1-HR2). These indicators mainly focus on the existence of human right clauses in investment agreements, and percentage of suppliers and contractors that have undergone human rights screening. If LEED was to be expanded to include similar measures:
    a. Which processes of the construction would be needed to be screened?
    b. What type of measures and documents would be necessary?
    c. Who would be responsible with providing these documents?
    d. Given the current structure of LEED would it be feasible?

Training

7. Training of employees enhances social sustainability by investing in social capital and increases their chance of being successful in their later stages of life. GRI has introduced several indicators related to training of the employees (HR3, LA11 and LA12). These credits basically focus on provision of programs for skill management and lifelong learning, percentage of employees receiving regular performance and career development reviews and total hours of human rights training for employees. If LEED was to be expanded to include similar measures:
    a. Which processes of the construction would be needed to be screened?
    b. What type of measures and documents would be necessary?
    c. Who would be responsible with providing these documents?
    d. Given the current structure of LEED would it be feasible?

Labor Security

8. There are several credits in GRI concerning the labor security or unlawful use of labor during production process, such as child labor, forced labor, health problems that are related to the production and discrimination in the work place (HR4, HR6, HR7 and PR2). These credits mainly inquire existence of child or forced labor at any stage of production, the existence of discriminatory practices in the work place and existence of a health threat towards the labor force due to the work related activities. Although these problems are eliminated or reduced to a minimum within the developed countries such as the US, there are still risks that can occur in the developing countries where these regulations are not strong. Since LEED is an international rating system and the materials that are being used in LEED projects are mostly being produced in developing countries, it is still possible to associate a LEED project to one or more of these problems indirectly. If LEED was to be expanded to monitor and prevent the association of these problems to the certified projects,
    a. Which processes of the construction would be needed to be screened?
    b. MR section of LEED is already monitoring the contents of the products. Would it also be possible to extend LEED EB MR Pr1 "Sustainable Purchasing Policy" in a way that will also cover concerns about the production conditions of the materials used?
    c. What type of measures and documents would be necessary?
    d. Who would be responsible with providing these documents?
    e. Given the current structure of LEED would it be feasible?

Labor Rights

9. In credit HR5 GRI concerns the right to exercise freedom of association and collective bargaining of the employees in an organization. Freedom of association and collective bargaining are significant in terms of sustaining the work force's life comfort at a certain level, hence contributing to social sustainability by supporting job security and livable wages. However these conditions are not always met in the construction industry. Provision of these conditions is less common in the supply chain of the products and the projects that are developed in developing countries. If LEED was to be expanded to secure labor rights for the certified projects,
    a. Which processes of the construction would be needed to be screened?
    b. What type of measures and documents would be necessary?
    c. Who would be responsible with providing these documents?
    d. Given the current structure of LEED would it be feasible?

Community Connectivity

10. GRI has several indicators concerning effects of the projects on the built environment and the communities. The main concern of these credits are the impacts of operations on communities, including entering, operating, and exiting and possible violation the rights of the indigenous people during operation. They require corporation with the community members during the decisions that can affect the cultural or historical structure, or their economic wellbeing. LEED ND is already concerning community connectivity in many aspects. Communication with the existing community members are also being encouraged in many LEED guidelines in the market. However, except LEED ND, there is no credit that requires a direct communication between the project owners and the community leaders.
    a. Do you think communication with the community during the design and construction can affect the actual value of a LEED project? How?
    b. SS Cr2, "Community Density and Community Connectivity" suggests two options: the project should be in a community with a minimum density of 60,000 sf/acre, or within ½ mile of a residential zone with 10 basic services. Why do you think the first option does not require existence of services? Does this bare the risk of encouraging clusters of one type of income groups, hence hindering the "mixed-use" goal of the measure?
    c. LEED ND NPD Cr4 requires inclusion of residents from a wide range of economic levels by offering a sufficient variety of housing sizes. Would it be possible to include a similar measure in LEED NC as well?

11. GRI EN28 focuses on the existence of monetary sanctions and fines that occur due to the violation of environmental laws and regulations. As a rating system that measures the environmental footprints of buildings it might be unusual to associate a LEED project with any kind of violation of environmental law or regulations. However,
    a. Would it be possible to have companies that are responsible for such actions who are also providing materials or services to a LEED project?
    b. If so, which processes of the construction would be needed to be screened further?
    c. What type of measures and documents would be necessary?
    d. Who would be responsible with providing these documents?
    e. Given the current structure of LEED would it be feasible?

B- Questions Related to Existing LEED Projects

I would like to ask some questions about the certification process of the LEED project that I have chosen as a case for my study:

1. What was the intention (of the owner) behind acquiring a LEED certification?
2. How did you decide on which LEED certification you wanted to acquire?
3. How did you decide on the LEED credits that you wanted to pursue?
4. How did the certification process affect the market value of the project in the short and in the long term? Do you have an estimate? Who do you think will benefit from this more, the developer or the owner? How?
5. Did you have any meeting session that involves the community representatives or are you planning to have one in the future?
6. How do you select your contractors?
7. Are there any measures that were taken during this project that will monitor and secure the workers' benefits? Is this part of any deals with the contractors?
8. Do the workers that were involved in this project get any job training or any form of training that will contribute to their life-long learning?
9. During the construction or certification period, have you encountered with any situation that you would call as the violation of labor security, or labor rights, or human rights?
10. What were the biggest challenges that you have encountered during this project?

Thank you very much for your assistance in my research. Please feel free to contact me if you have any questions about this study.

---End of the Interview---

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