Green Marketing Research Tool for Developers

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ABSTRACT

Market researchers employ various tools to determine whether certain products and features are likely to succeed. In real estate development, the process typically entails examining the demographics and characteristics of the market area and reviewing long-term national, regional, and local customer preference trends for a given product. Conventional market research compares existing products serving similar customers, often overlooking the possibility of new products or new customers. Conventional market research typically asks questions only about historic market performance of comparable products ("comps"). This practice may be one of green building's greatest barriers, because comps do not necessarily give an accurate reading of the appeal of the new, greener product.

However, while the comps used in conventional market research examine similar projects, the analogs used in creative feasibility enable the researcher to pick and choose among projects, or specific features, much more widely without being limited by circumstances.

Therefore, first of all, a reliable database of analogs has been created by collecting a large number of authentic case studies and associated performance statistics. Secondly, a faster, easier and more precise search engine has also been developed to enable the extraction of accurate analogs from the database and apply them to a certain building in this study.

Utilizing the tool developed in this study, reasonable green designation levels that are now cost effective and more sustainable compared to conventional buildings have been established. These results assist developers forwarding understanding achievable environmental performance goals in green buildings that use little of energy, little of virgin materials and give little of negative impacts on natural environment in future.

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PREFACE

During the two years of my study in University of British Columbia, I have mostly focused on studying Green Building Issues and Green Building Practices, and learning lessons about Cost and Value in Building Green from Dr. Raymond J Cole through numerous lectures, seminars and directed studies.

After those academic years, I realized the importance of introducing an innovative way to convince developers in the marketplace and prove them following green is cost effective and an irresistible tide. However, it became increasingly necessary to understand the current trends and to establish what constitutes reasonable green building practices within current market conditions and expectations with the primary aim of convincing developers and involved in the business of building green.

Therefore, through the process of a research, over 200 case studies have been examined, and 153 of 200 projects have been selected and included with a database. The case studies analyzed in this study demonstrate various levels and analogs of green buildings. No green building project thus far is "perfect", but each one stored in the database offers a valuable lesson and works as an element to show trends and patterns. These patterns of the green buildings will eventually become the rule rather than the exception in the development marketplace.

Furthermore, the market research tool developed in this study – Green Data Base Version 1.0 – will assist in highlighting which currently available technologies and strategies can be achieved with relatively little investment of time for real estate developers, architects, planners, contractors, lenders, city officials, and all those who are concerned with the impacts of the built environment.

ACKNOWLEDGEMENTS

I am grateful for the generous support, assistance, and information from the many people who made this thesis possible.

Without the academic support of Dr. Raymond J Cole over the two years of researching and writing this dissertation, it could not have happened. With sincerest gratitude I also acknowledge the faculty members in Architecture.

It has been quite an extensive research to complete the thesis from collecting case studies to developing a web-based database. Especially, in the process of developing the database, I sincerely appreciate enormous help from Min Park who has been my best friend and business partner in Vancouver and his family.

It has been already over four years since I came over Vancouver from Korea to study more about environmentally responsible buildings for possibly becoming a professional consultant in the field of building green. Like other international students, I have gone through a number of troublesome incidents in adaptation, language and finance. In the journey, numerous people have helped me out to overcome all those barriers. I cannot name all the people who have been friendly, generous and supportive to me. But, Keuntaek, Hyungju, Rocky and my girlfriend remind me of lots of happiest memories in Vancouver. In addition, the university of British Columbia has been very generous to lighten my financial burden by giving me supportive awards.

Now I have to go back to Korea and practically utilize all these resourceful knowledge and experiences that I have learned in University of British Columbia, particularly in the field of Green Buildings. Well, it won't be easy. Innovation is always not easy. However, I am very proud of myself for the academic and researching years in the University of British Columbia.

Dedicated to my mother, and I pray for her recovery from everything

CHAPTER I INTRODUCTION

PART 1. What is a Green Building?

Rather than ask the question - What is a Green Building, it may be more appropriate to ask why aren't all buildings currently being built to higher environmental standards? The reason is fairly clear. Simply, urban living keeps accelerating unsustainable energy consumption rates, and the construction industry has contributed significantly to overall consumption patterns. For example, in 2000, according to Transports Canada, 29 per cent of total energy use in Canada was consumed in the operation of buildings (commercial, 12 per cent and residential, 17 per cent. [**Fig. A**] Similarly, in 1997, 36 per cent of total energy use in the United States was consumed in the operation of buildings (commercial, 16 per cent and residential, 20 per cent. This figure represents almost 9 per cent of total worldwide energy use for that year. However, materials consumption by the construction industry represents an even greater proportion of total use energy. William Rees at the University of British Columbia estimates that 40 per cent of materials consumption worldwide is for the construction and repair of the built environment. Buildings also represent a major source of the pollution that causes urban air quality problems. They account for 49 per cent of sulfur dioxide emissions, 25 per cent of nitrous oxide emissions, and 10 per cent of particulate emissions, all of which damage urban air quality. In addition, buildings produce 35 per cent of the country's carbon dioxide emissions – the primary pollutant associated with climate change.

Green Building [1] practices offer an opportunity to create environmentally responsible buildings by using an integrated approach to design. Green buildings promote resource conservation, including energy efficiency, renewable energy, and water conservation features; consider environmental impacts and waste minimization; create a healthy and comfortable environment; reduce operation and maintenance costs; and address issues such as historical preservation, access systems. The entire life cycle of the building and

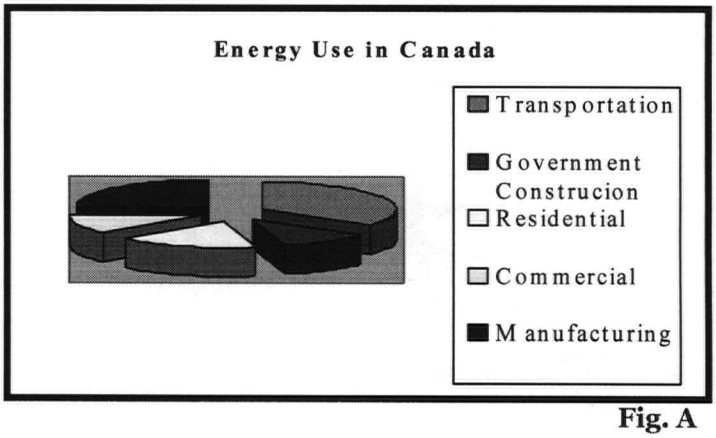


Fig. A

[1] The term *Green Building* is used synonymously with Environmentally Responsible Building

its components is considered, as well as the economic and environmental impact and performance. Green Performance[2] is comprehensive in scope and not just concerned with energy efficiency[3].

PART 2. How Green is Green?

There are many assessment tools in the marketplace that are used to measure the environmental impact of building. The Leadership in Energy and Environmental Design (LEED™) rating system is gaining tremendous momentum in North America and offers practical and comprehensive way to both discuss and introduce green building. LEED™ is a product of the US Green Building Council (USGBC) – a US, non-profit organization with a broad-based industry membership formed in 1993 to "accelerate the adoption of green building practices, technologies, policies, and standards."

The currently available version of LEED™ Version 2.1 is specifically applicable to new designs and renovations of:

- New commercial buildings
- Institutional buildings; and
- High-rise residential building

Performance Category	No. of Available Credits/Pts
Sustainable Sites	8 Credits / 14 Points
Water Efficiency	3 Credits / 5 Points
Energy and Atmosphere	6 Credits / 17 Points
Materials and Resources	7 Credits / 13 Points
Indoor Environmental Quality	8 Credits / 15 Points
Innovation and Design Process	2 Credits / 5 Points

[*Table A*] LEED Performance Categories and Available Credits

LEED ™ Designation	Required Points
Total Possible Credits	64 + 5 innovation points
LEED ™ Certified Platinum Level	52 + points
LEED ™ Certified Gold Level	39 – 51 points
LEED ™ Certified Silver Level	33 – 38 points
LEED ™ Certified	26 – 32 points

[*Table B*] LEED Performance Certification Thresholds

LEED ™ Designation	Points / Total Points
LEED ™ Certified Platinum Level	75 + per cent
LEED ™ Certified Gold Level	57 – 74 per cent
LEED ™ Certified Silver Level	48 – 55 per cent
LEED ™ Certified	38 – 46 per cent

[*Table C*] Enhanced Green Performance in Percentage (Achieved Points / Total Points)

[2] The term *Green Performance* refers to performance that goes beyond conventional building practice by integrating the following elements: environmental responsiveness – benefiting the surrounding environment; resource efficiency – using resources in the construction and operations of buildings in ways that are not wasteful; and indoor environmental quality – optimizing interior spaces for building occupants.

[3] *Energy Efficiency* is using less energy to perform tasks. A strategy or system is energy efficient if it provides comparable or better quality of service while using less energy than a conventional technology.

LEED™ is basically a self-assessment system, with assessments undertaken within the design team and then submitted for certification. It consists of an explicit set of environmental performance criteria, organized within five (5) key performance categories:

- Sustainable sites (SS)
- Water efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (EQ)

A sixth category - Innovation Credits and Design/Build Process - rewards exceptional environmental performance or innovation over and above that explicitly covered in the basic LEED credits. Each credit (and sub-credit) carries an assigned number of "points." The number of credits and points available in each performance category is shown in [**Table A**]. The total number of points earned is aggregated and a final designation of the building is based on the threshold reached, as shown in [**Table B**]

In addition, since "LEED™ Performance" addresses the same three broad practices: environmental responsiveness, resource efficiency and indoor environment quality as discussed earlier, the LEED™ designation levels determined by the aggregation of five categories of LEED™ performance – *Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & resources and Indoor Environmental Quality* – can be translated into "Green Performance Levels", and, finally, the performance levels communicates the green performance of buildings [**Table C**]. Buildings beyond the level of LEED™ Certified – an aggregate score of 26 ~ 32 points corresponded to 38 ~ 46 percent of more enhanced green performance – can be understood and qualified as green buildings by U.S. Green Building Council.

PART 3. Why Aren't All New Developments Green?

If green developments are so profitable, and so marketable, why aren't all new developments Green? There are many reasons, but the most significant is probably lack of awareness by the development community of the opportunities. There remains a widespread lack of understanding about what constitutes green real estate, the market for it, why it is beneficial, how to do it, and the business case. And, the second most important reason is developers fear that following a green agenda may delay project schedules and subsequently incur costs.

A means to overcome developer concerns and uncertainties about "Green Building" is to learn from the positive experiences. By seeing and hearing how such projects are envisioned, financed, built, and marketed, developers and landlords will gain confidence that this approach is not only possible but beneficial. Furthermore, if the actual profile and feasibility of currently reasonable green buildings can be provided by a faster and more specific way, developers are more likely to be convinced.

PART 4. Is Green a Cost to Build Better or Investment Guaranteed?

Current Green Building faces a potential image problem. Often, it is regarded as a luxury that can only be afforded by public or well endowed institutions. Green building typically requires greater up-front investments of time and money in design, but this need does not mean higher overall costs or delayed project schedules. Careful "front-loaded" planning and design can pay for itself – with interest – in avoided downstream costs such as elaborate mechanical systems, expensive redesigns, drawn-out approvals, litigation, and stalled construction.

The US Green Building Council has asserted that a LEED Silver-rated building should not cost more than a conventional building (LEED platinum does typically cost more because it may involve cutting edge technologies and levels of performance that are far above and beyond standard construction). The goal of green building is not to squeeze energy-efficiency features into a tight construction budget but to analyze such interconnected issues as site and building design, energy and water efficiency, resource efficient construction, lighting and mechanical design, and building ecology, and optimize all these aspects in an integrated design for overall green performance.

Moreover, many players in the real estate market are increasingly realizing that green development is good business and that "Green" enhances not only quality of life and environment, but also makes strong economic scene by selling faster than typical and an increased value for the region. For example, the Inn of the Anasazi is a fifty-nine-room luxury resort hotel in downtown Santa Fe. The value has increased by more than $2 million in less than 3 years, and the hotel features an outstanding 83% average occupancy rate and 35% repeat traffic. The development team's attention to environmental and community issues has boosted the inn's and the restaurant's performance by 15-20%.

CHAPTER II DIRECTION OF STUDY

A key conclusions from Part I are the increasing need for green building, given their key role, and, the necessity of finding ways to convince developers of their value. Therefore, this work seeks to define currently reasonable green buildings and delivering the lessons from the experiences of others by analyzing mass of authentic case studies. More specifically, the research is intended to establish reasonable levels of green performance that are currently cost effective and more sustainable[4] compared to conventional buildings, and, eventually, relieving developers from unsustainable forward to green buildings that use little of energy, little of virgin materials and give little of negative impacts on natural environment in future is the ultimate purpose of this research.

PART 1. What Convinces Developers?

Market research assists developers understand whom to target as buyers or renters, what features they are looking for, where they want to live and work, and how much they are willing to spend. Market research informs the planning and design phases of real estate development and provides a direction for positioning the product in the marketplace. Finally, market research provides critical information about the economic climate that will help the developers and any investment partners determine whether to risk moving ahead with a project.

Market researchers employ various tools to determine whether certain products and features will succeed. In real estate development, the process typically entails examining the demographics and characteristics of the market area and reviewing long-term national, regional, and local customer preference trends for a given product.

PART 2. Limitations of Conventional Market Research

Conventional market research, however, compares existing products serving similar customers, often overlooking the possibility of new products or new customers. Conventional market research asks questions only about historic market performance of comparable products ("comps"). This practice can be one of green building's greatest barriers, because comps may not give an accurate reading of the appeal of the new, greener product. The information presented by conventional market research can stymie innovation and encourage risk-averse developers and financiers to shy away from entering the world of green building. This "rear-

[4] **Sustainable:** Meeting the needs of the present without compromising the ability of future generations to meet their own needs

view mirror" approach to market research that bases feasibility studies on an extrapolation of the past often portrays innovative green developments as inherently less feasible, because there is no way to evaluate them using traditional methodology.

However, despite their limitations, comps remain one of the most important tools for real estate development both in figuring out what buyers are looking for and in securing financing. In seeking comps for new development plans, market researchers collect detailed information about the value of buildings or space in terms of price, size, demand, and the value of particular features. These features are evaluated as negative, positive, or neutral – a neutral attribute being one that all products of that type would necessarily have, such as a roof on a house. For example, a homeowner may purchase a house because of such positive attributes as the floor plan, unique design features, or proximity to work, schools, and shops. Negative attributes, such as an inefficient heating system, may be tolerated if the positive attributes are judged to be of greater value or the customer does not perceive that he or she has another option.

However, given a choice between two buildings with the same positive attributes, if one also has a more efficient heating system, this attribute may differentiate the product enough to give it an advantage in the marketplace. The product has all the comparable features of a conventional product and some green features as well.

PART 3. Invitation of an Advanced Market Research Method – Creative Feasibility

Just as product innovation in other markets relies on more creative market research to determine customers' needs and wants, green building may require more innovative strategies in order to demonstrate viability. Creative Feasibility uses such conventional standard market research strategies as focus groups, surveys, and interviews, with potential buyers. This information is then combined with analysis of analogs – similar projects or green design features – in other green buildings, usually outside the local market. Analogs are used to compare and assess the best practices of various real estate products and development methodologies of existing successful projects with new project ideas.

While the comps used in conventional market research examine similar projects, the analogs used in creative feasibility enable the researcher to pick and choose among projects, or specific features, much more widely without being limited in locations. Analogs may be models, prototypes, or ideas developed by others that are analogous in some way to the planned

elements or green design features of a new building product. In other words, since the analogs consist of features and ideas developed by others, they are applicable to any circumstances.

PART 4. Creation of an Advanced Market Research Tool

Any attempt to create an advanced market research tool that uses the idea of creative feasibility and utilize the tool under any circumstances, needs up-front investments of time and effort likewise green buildings. First of all, a reliable database of analogs should be built by collecting mass of authentic case studies as many as we can compile statistics. Secondly, some kind of fast, easy and precise search engine is also absolute to extract accurate analogs from the database and apply them to a certain building. In addition, the engine should be able to find any intended analogs whatever the search criteria is.

Eventually, when both parts – a reliable database and a fast, easy and precise search engine – are tied and work as one, the entire tool will become an advanced market research tool to attract developers and make them get involved in the business of green.

PART 4-1. Building a Database of Analogs by Collecting Authentic Case Studies

The database for this research consists of authentic case studies and case studies made of analogs that include applied green design features, location, date completed, building type and any valuable fragments from green buildings.

The authentic case studies which are fundamental for the database, were derived from a number of sources – US Green Building Council and Rocky Mountain Institute.* The case studies have been selected under the condition of whether they include the following profiles. [Table D01]

* Rocky Mountain Institute was established in 1982 by resource analysts L. Hunter Lovins and Amory B. Lovins. What began as a small group of colleagues focusing on energy policy has since grown into a broad-based institution with more than 45 full-time staff, an annual budget of nearly $7 million (much of it earned through programmatic enterprise), and a global reach. RMI brings a unique perspective to resource issues, guides by advisory services within these areas of expertise:

- Energy Use and Supply
- Buildings and Land Development
- Community Economic Development
- Business
- Profitable Climate Protection
- Water Use and Supply

It also contains over 200 case studies of green projects around the world and counting.

Profile	*Characteristic*
Location	Offers the regional characteristics with their neighborhood
Date Completed	Offers the overall trend of green buildings in the marketplace
Description of Building Type	Offers the sphere of building green
Description of Project Type	Offers the use of green buildings
Construction Cost & Market Value	Offers the economic trend of green buildings
Applied Green Design Features	Offers the technological trend of green buildings
LEED™ Evaluation Sheet	Offers the trend of the performances for green buildings

[Table D01] The Required Profiles of Authentic Case Studies

One hundred and fifty three case studies covering ten kinds of project types were selected and stored in the database as shown in [**Table D02**]

Project Type	*No. Of Case Studies*	*Official*	*Un-Official*
Commercial / Office	55	**25**	30
Educational	19	**6**	13
Health Care	3	**-**	3
Hotel / Resort	16	**2**	14
Mixed Use	7	**-**	7
Industrial /Warehouse	14	**5**	9
Institutional	15	**3**	12
Laboratory	4	**3**	1
Residential	12	**-**	12
Retail	8	**-**	8
			153

[Table D02] Classification of Case Studies by Project Types

The case studies are divided into the two phases of "official" and "un-official" through the process of qualification. The official case studies are the green buildings beyond certified buildings are those assessed using the U.S. Green Building Council's LEED Rating System. On The un-official case studies have been scored by the assessment based on their minimum green performances expected and engraved on the same evaluation criteria as official buildings, but by the author.

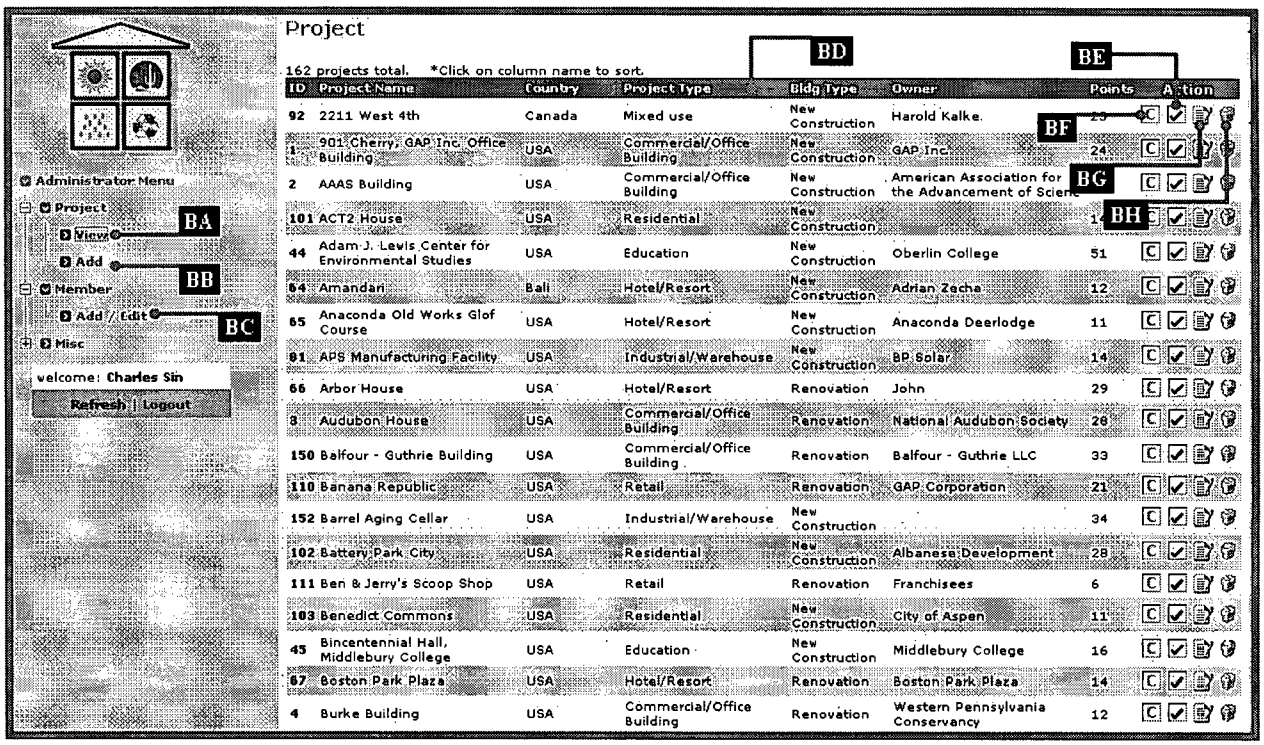
PART 4-2. Developing a Database and Programming Search Engine

The primary purpose of the study is to establish what constitutes a currently reasonable level of performance of green buildings. This is achieved by processing the statistics by extracting analogs from a mass of authentic case studies incorporated within an advanced market research tool – Green Database Version 1.0.

Therefore, the intention of Part 4-2 has been focused on developing and programming the far better green building database and search engine than any other tools in the marketplace.

PART 4-2-1. Comparison of Functions with Conventional Database Tools in the Marketplace

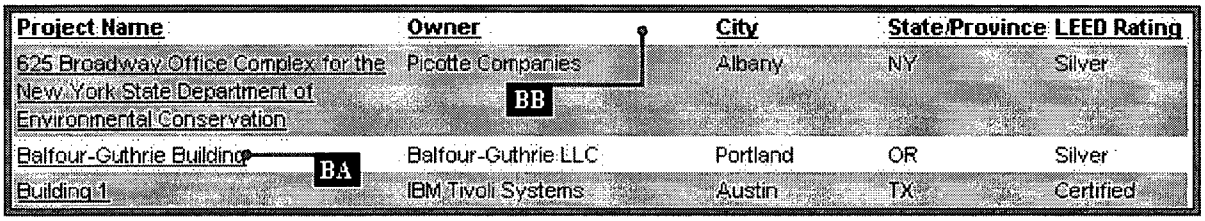
The comparison of the functions with conventional database tools – Rocky Mountain Institute and U.S. Green Building Council present – has been made to show the possible abilities of the databases.



[Fig. B 01] Screenshot of the Database of Green Database Version 1.0

Icons	*Description of Function*
Button A (BA)	Show the entire list of the database with active icons
Button B (BB)	Add new case study
Button C (BC)	Add/Delete members and Edit information
Button D (BD)	Sort by any criteria in the bar – ID, Project name, Country, Project type, Building Type, Owner and Points
Button E (BE)	On/Off the status of projects to include or exclude from compiling analogs
Button F (BF)	Edit the full evaluation sheet of LEED™ Rating System
Button G (BG)	View and Edit the full document of the project descriptions including green design features, costs and so on
Button H (BH)	Delete project
GENERAL	The database contains both official and unofficial projects, and they are titled as official or unofficial

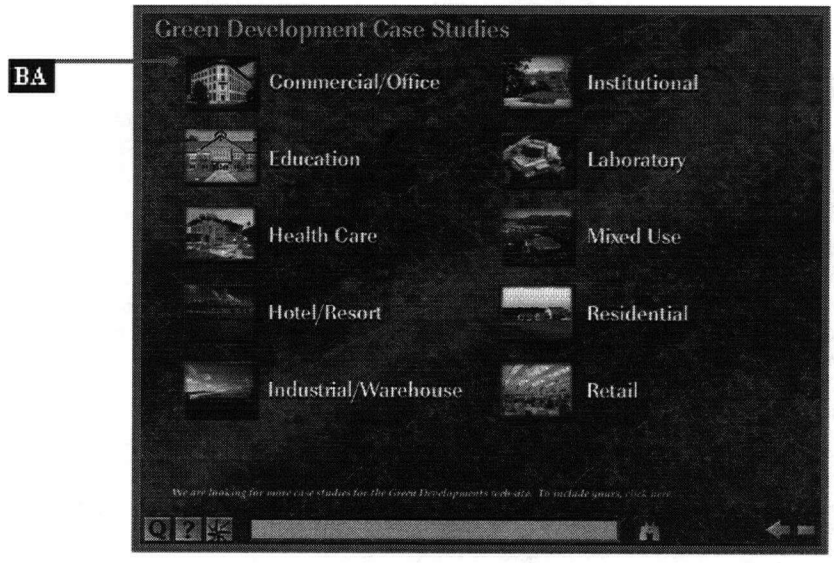
[Table D03] Description of the Database of Green Database Version 1.0



[Fig. B 02] Screenshot of the Database of U.S. Green Building Council

Icons	*Description of Function*
Button A (BA)	Show the document of project descriptions or the evaluation sheet of LEED™ Rating System
Button B (BB)	Sort by any criteria in the bar – Project name, City, State, LEED Rating
GENERAL	The database contains only official projects qualified through U.S. Green Building Council

[Table D04] Description of the Database of U.S. Green Building Council



[Fig. B 03] Screenshot of the Database of Rocky Mountain Institute

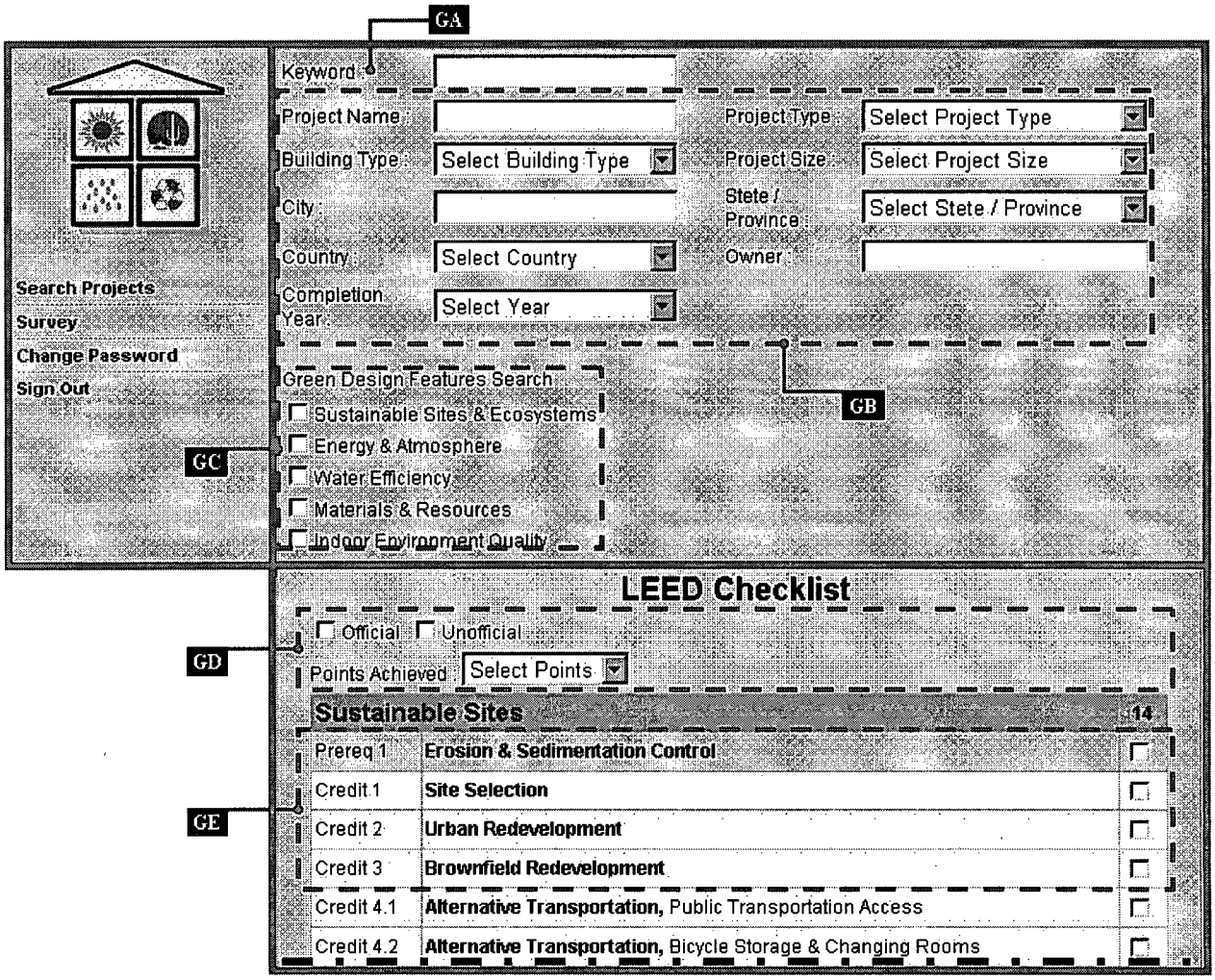
Icons	*Description of Function*
Button A (BA)	Show only the document of project descriptions
GENERAL	The database contains both official and unofficial projects, but they are not titled as official or unofficial

[Table D05] Description of the Database of Rocky Mountain Institute

From the figures and tables above, it is believed that the database of "Green Building Database Version 1.0" can support a more variety of functions associated with establishing reasonable levels of green performance. At the same time, it is believed that the tool represents a more reliable database than others currently in the marketplace in terms of the user-friendly interface and number of authentic case studies.

PART 4-2-2. Comparison of Capabilities with Conventional Search Engine Tools in the Marketplace

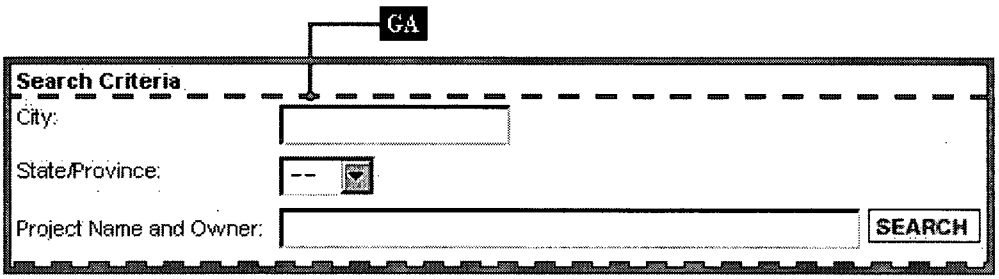
A comparison of the capabilities with conventional search engine tools – Rocky Mountain Institute and U.S. Green building council present – was made to identify the possible capabilities of the proposed search engine.



[Fig. C 01] Screenshot of the Search Engine of Green Database Version 1.0

Criteria (Analog)	*Description of Function*
Group A (GA)	Search by Keyword
Group B (GB)	Search by Fundamental Profiles
Group C (GC)	Search by Applied Green Design Features in the five categories – SS, WE, EA, MR, IEQ
Group D (GD)	Search by Qualification & Points Achieved
Group E (GE)	Search by 71 Credits
GENERAL	N/A

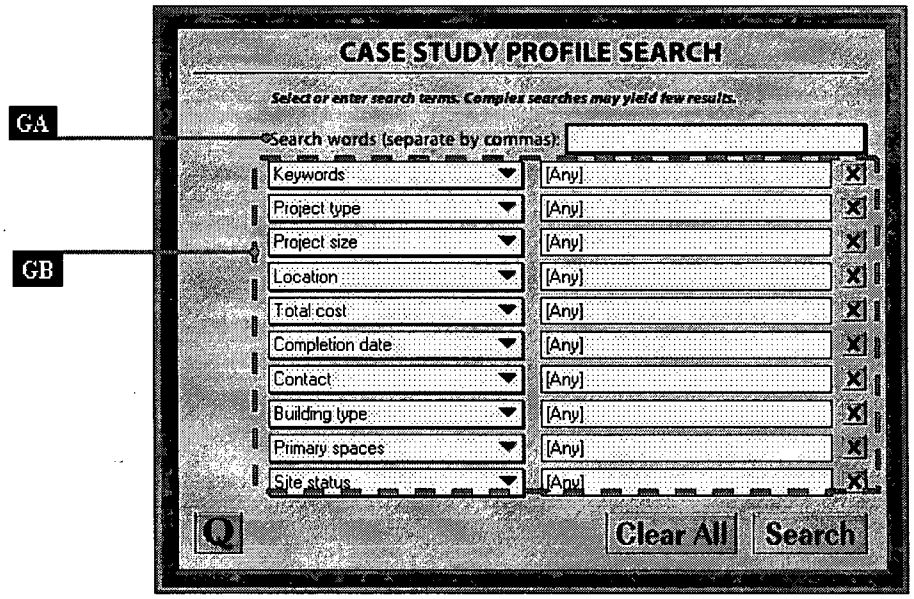
[Table D06] Description of the Search Engine of Green Database Version 1.0



[Fig. C 02] Screenshot of the Search Engine of U.S. Green Building Council

Criteria (Analog)	*Description of Function*
Group A (GA)	Search by Fundamental Profiles – Only City, State/Province, Project name and Owner
GENERAL	N/A

[Table D07] Description of the Search Engine of U.S. Green Building Council



[Fig. C 03] Screenshot of the Search Engine of Rocky Mountain Institute

Criteria (Analog)	*Description of Function*
Group A (GA)	Search by Keyword
Group B (GB)	Search by Fundamental Profiles
GENERAL	N/A

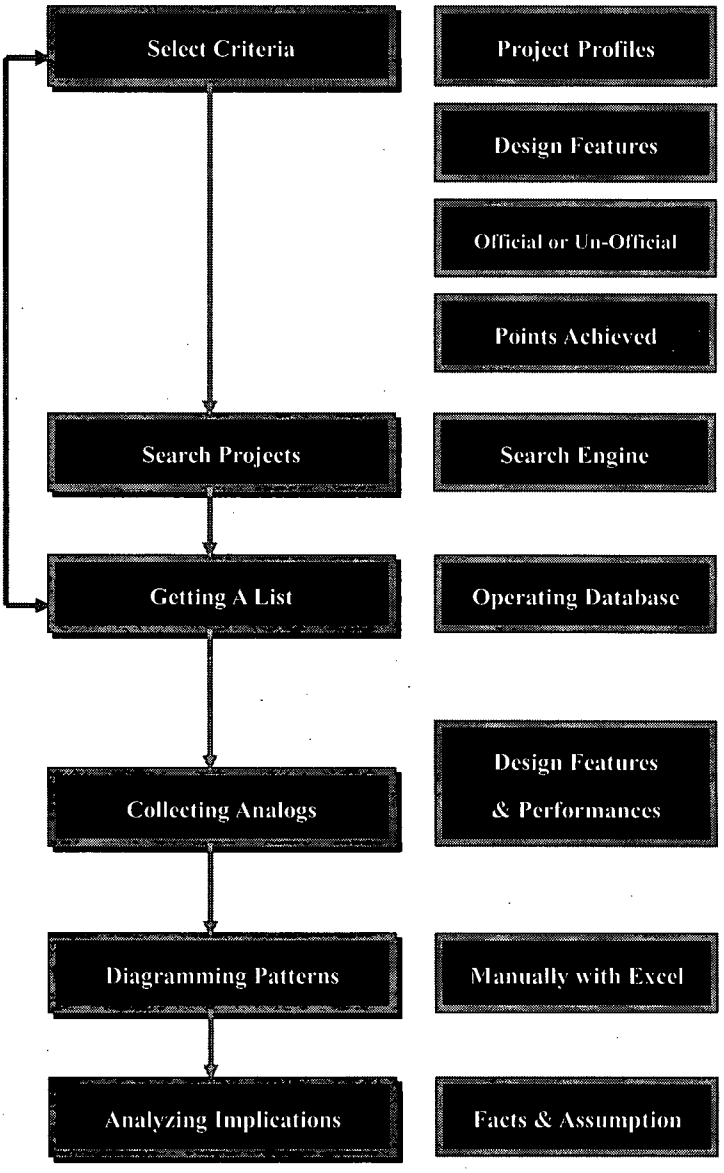
[Table D08] Description of the Search Engine of Rocky Mountain Institute

From the figures and tables above, it is believed that the proposed search engine of "Green Building Database Version 1.0" performs a better capability than any other search engines in the marketplace in terms of the elaborateness.

CHAPTER III METHODOLOGY

Part 4 of Chapter II described the advanced market research tool – a database and search engine. The tool searches the database and furnishes the analogs of the green buildings in the marketplace to seekers. However, to establish the reasonable green buildings in the marketplace, it is necessary to define what constitutes reasonable green performances.

Therefore, the research will be focused on gathering the entire analogs, and then, putting them in order for the purpose of displaying the patterns of the phenomenon. So, eventually, the implications of the patterns will be explained by an analysis for this study. [Fig. D]



[Fig. D] Flow Chart of Study Methodology

In addition, the following three parts are the specific explanations of the methods and targets for finding out the reasonable green performances for each project type. However, because of limited number of projects to display the patterns of phenomenon and insist the implications of the patterns, five project types – Health Care, Laboratory, Mixed Use and Retail Buildings – have been excluded in this research.

When researchers currently evaluate case studies in the marketplace, they normally tend to have classified them by project types in terms of building uses as shown in Table D02 – Commercial/Office, Institutional, Educational , Industrial/Warehouse, Residential, Hotel/Resort, Health Care, Laboratory, Mixed-Use and Retail buildings. Needless to say, it is useful to collect case studies and then classify them by building uses in the beginning of a research for the

convenience of classification and also for the analysis of characteristics. However, case-studies can also be re-classified by two broad sectors – Private Development and Public Development – in terms of what types of financing sources developers go after. In general, private developments seek the sources of financing such as bank loans, venture capital, and private investment while public developments seek after federal or state funding, organization or individual donations, grants, and the like. This classification by types of financing offers us the information about the influences of financing types on green performances, and how green developers react to green buildings in applying green design features on buildings. [Table D09]

Through the re-classification by types of financing sources along with the classification by building uses, it is supposed that the implications of reasonable green performances will be revealed not only from an economic feasibility point of view but also from a developer point of view.

Type of Financing	*Associated Project Types*	*Type of Financing Sources*
Public Development	Institutional Educational	Governmental Funding Organization or Individual Donations Various Grants
Private Development	Commercial/Office Industrial/Warehouse Residential Hotel/Resort	Bank Loans Venture Capital Private Investment Development Revenue Bonds Internal Financing by Corporation

[Table D09] Description of the Classification by Types of Financing Sources

PART 1. Establishing Cutting Edge Performances for Both Types of Financing

First of all, to define reasonable green performances for each project type, it is important to establish the cutting edge green performances for each project type. For example, for commercial/office buildings, if only 5 cases of the green buildings have achieved beyond 40 points of green performance while the other 45 cases are in the range of 30 to 49 points, we could say the five cases have the cutting edge performance for commercial/office buildings. Moreover, if the developers reveal that the buildings cost considerably more than the market price, it is necessary to establish the reasonable green performance for commercial/office buildings within the range of 30 to 49 points or even below the performance.

Therefore, to indicate the cutting edge green performances for each project type, the possible LEED™ point distribution and applied green design features intensity for each project type have to be determined. In other words, to find out the common and reasonable green building performance for each project type and to insist the implications, the distribution of the achieved green performance and the intensity of the applied green design features for each project have to be established. This intention can be realized by utilizing "Green Database Version 1.0" through the steps as shown in [Fig. D],

PART 2. Establishing Green Design Performance Intensities in Each Category by Contribution Level

By the statistics compiled from Part 1, it shows possible LEED™ points distribution and green design features intensity for each project type. However, each category has its own different contribution to the entire green performance. For example, while the "Energy and Atmosphere" category has 17 points (**25%**) of green performance contribution to the entire performance, the "Water Efficiency" category has only 5 points (**7%**) of green performance contribution to 69 points (**100%**) of the entire performance. Therefore, to carefully select the core analogs that have a great influence on green performance, it is necessary to indicate the patterns of how much performances they are picking from each category at each green designation level within the given performance.

In addition, for this study, the levels of green designation for green buildings have been divided into seven levels based on LEED™ Rating System: 0 – 9 Points (Level A), 10 – 19 Points (Level B), 20 – 29 Points (Level C), 30 – 39 Points (Level D), 40 – 49 Points (Level E), 50 – 59 Points (Level F), 60 – 69 Points (Level G).

PART 3. Establishing Points Distribution in the Category of Energy & Atmosphere

As mentioned in Part 2, the category, the "Energy and Atmosphere" category has the most contribution to the entire green performance of environmentally responsible buildings. However, not just because of the fact that Energy and Atmosphere has the most contribution to the entire green performance, the analysis of the category, "Energy and Atmosphere" has another significant implication to green buildings in terms of defining the economic feasibility if green buildings fit into the marketplace. More specifically, Credit 1 - "Optimize Energy Performance" - has considerable 10 points of 17 in the category of Energy and Atmosphere. In

addition, the energy performance – the points of the energy performance[5] in the category of Energy and Atmosphere can be translated into the energy efficiency of conventional buildings – often becomes a critical indicator to determine the whole construction cost because of the significant weight that could cause extra costs in plants and structures. Therefore, the intention of Part 3 has been aimed at establishing the achieved energy performance point distribution within the category of Energy and Atmosphere to indicate the levels of energy efficiency at each green designation level and analyzing the implications through the same procedure as Part 1 and 2.

[5] **Energy Performance** = Energy Efficiency

CHAPTER IV RESULTS

PART 1. Cutting Edge Green Performances for Public and Private Developments

In processing the procedure of Part 1 in Chapter III by utilizing Green Data Base Ver.1.0 and Microsoft Excel, the patterns of "Possible LEED™ Point Distribution" and "Applied Green Design Features Intensity" have been indicated for both types of financing as described in the following diagrams.

PART 1-1. PRIVATE DEVELOPMENT

PART 1-1-1. Commercial/Office

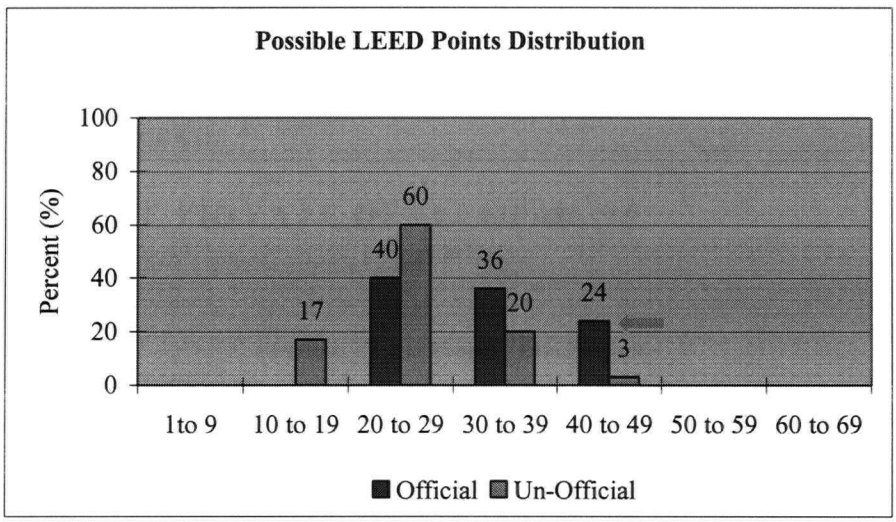


Fig. E 01

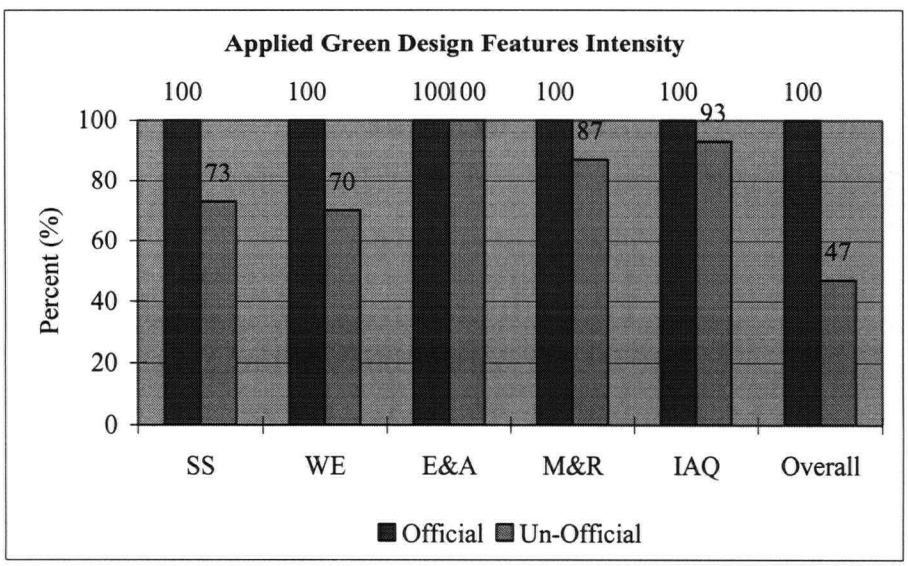


Fig. E 02

Most environmentally responsible Commercial/Office buildings – whether Official or Unofficial – are in the range of 20 to 39 points, corresponding to LEED™ Certified to LEED™ Silver (Official: 76%, Unofficial: 80%). Figure E 01 further shows that no commercial/office building achieves a green performance better 40 to 49 points. In addition, as shown in [Fig. E 02], all official buildings include all aspects of green design features – Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality.

Therefore, achieving 40 to 49 points currently represents the cutting edge green performance of commercial/office buildings.

PART 1-1-2. Industrial/Warehouse

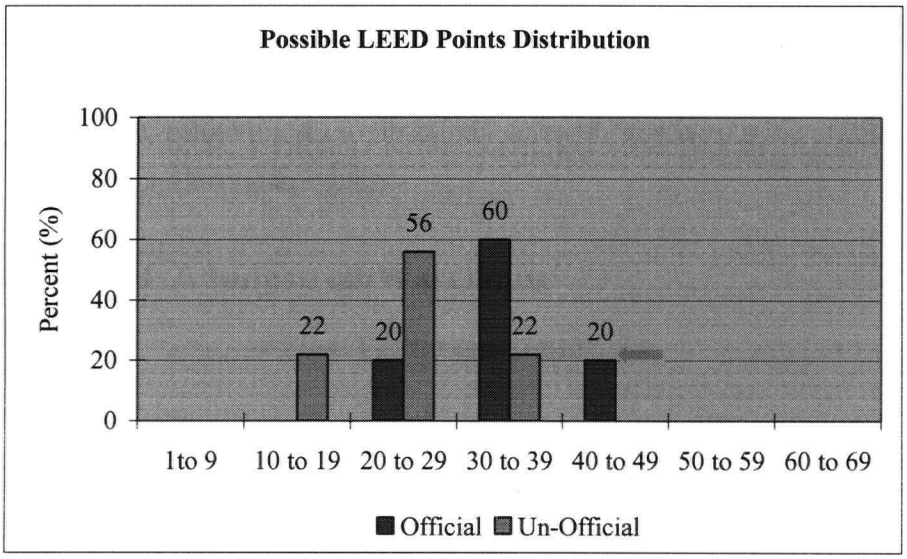


Fig. E 03

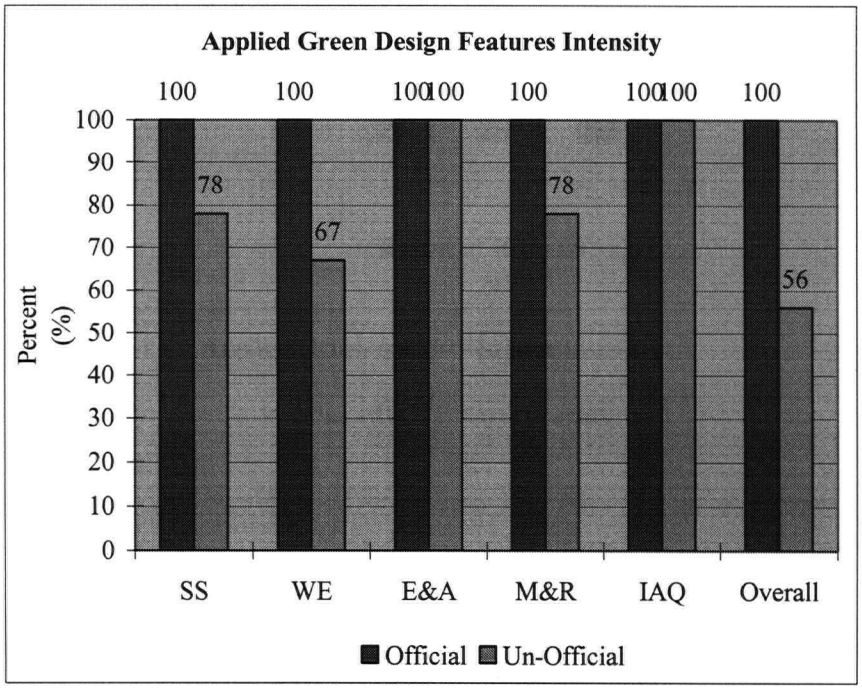


Fig. E 04

Most environmentally responsible Industrial/Warehouse buildings are in the range of 20 ~ 39 points, corresponding to LEED™ Certified to LEED™ Silver (Official: 80%, Unofficial: 78%) [Fig. E 03]. Especially, a major portion (**60%**) of Industrial/Warehouse official buildings is in the range of 30 to 39 points, corresponding to LEED™ Silver. In addition, as shown in [Fig. E 04], all official buildings include all aspects of green design features (Sustainable Site, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality).

Therefore, achieving 40 ~ 49 points currently represents the cutting edge green performance of industrial/warehouse buildings.

PART 1-1-3. Residential

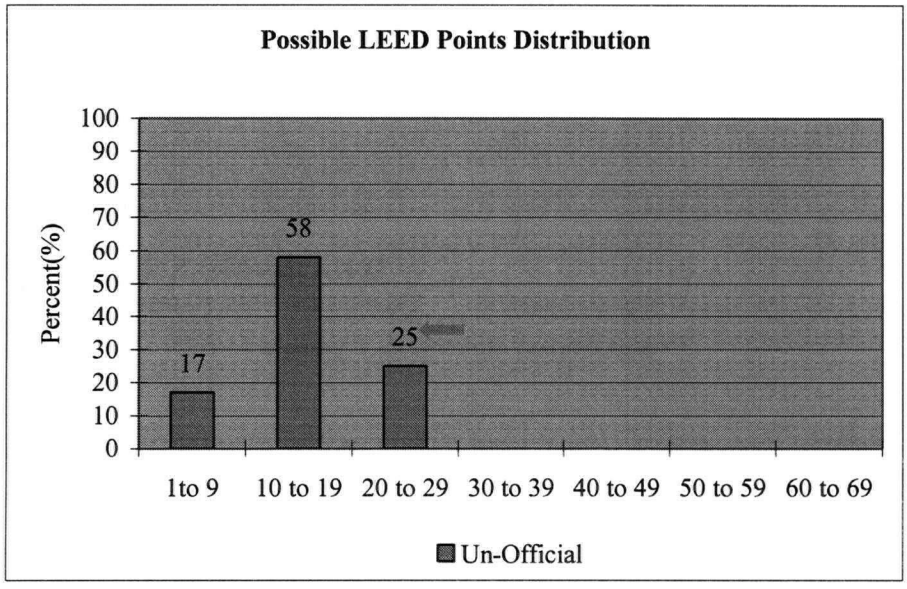


Fig. E 05

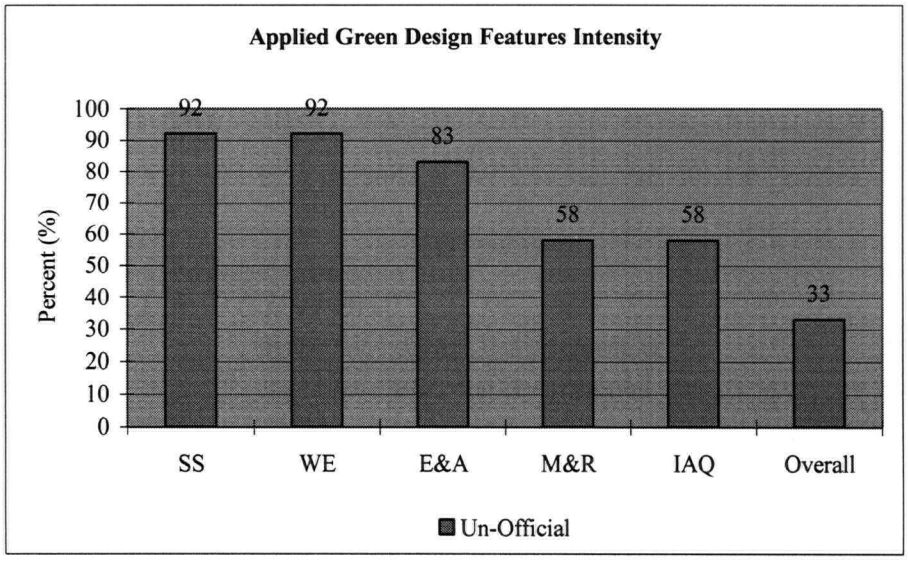


Fig. E 06

Unfortunately, there is no official case proven through LEED™ Rating System 2.0 for Residential Buildings at present, and most of environmentally responsible residential buildings are in the range of 10 ~ 19 points (58%) [Fig. E 05]. However, even if most of cases are not aggressive enough in green performance to be qualified by U.S. Green building council to gain media exposure, it is obvious that they yet hold 15 ~ 28 percent (The range between 10 ~ 19 points) of more enhanced green performance than conventional residential buildings in the marketplace.

Therefore, achieving 20 ~ 29 points currently represents the cutting edge green performance of residential buildings.

PART 1-1-4. Hotel/Resort

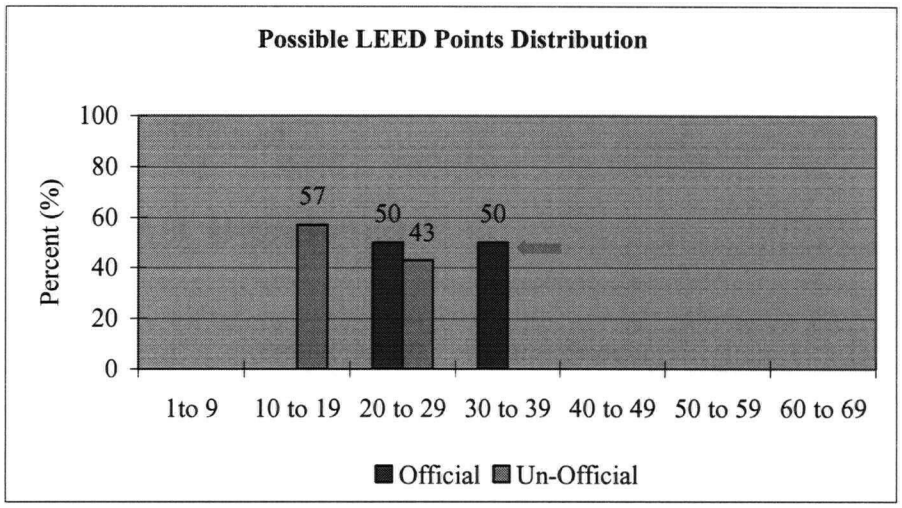


Fig. E 07

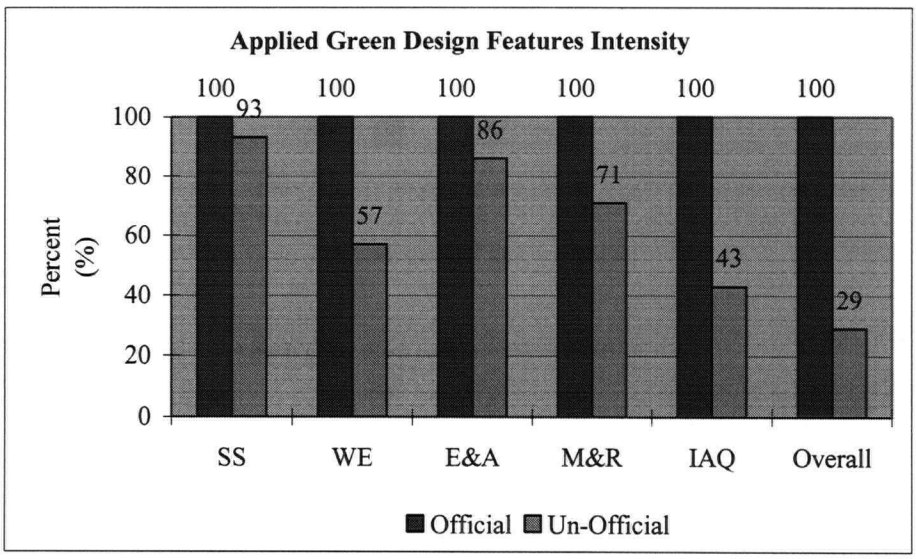


Fig. E 08

Approximately 50% of environmentally responsible Resort/Hotel buildings are in the range of 20 ~ 29 points, corresponding to LEED™ Certified, and the other 50% are within 30 ~ 39 points, corresponding to LEED™ Silver rated in official buildings [Fig. E 07]. In addition, in un-official buildings, 43% of the buildings are in the range of 20 ~ 29, corresponding to LEED™ Certified [Fig. E 07]. And, as shown in [Fig. E 08], all official buildings include all aspects of green design features (Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality).

Therefore, achieving 30 ~ 39 points currently represents the cutting edge green performance of resort/hotel buildings.

PART 1-2. PUBLIC DEVELOPMENT

PART 1-2-1. Institutional/Educational

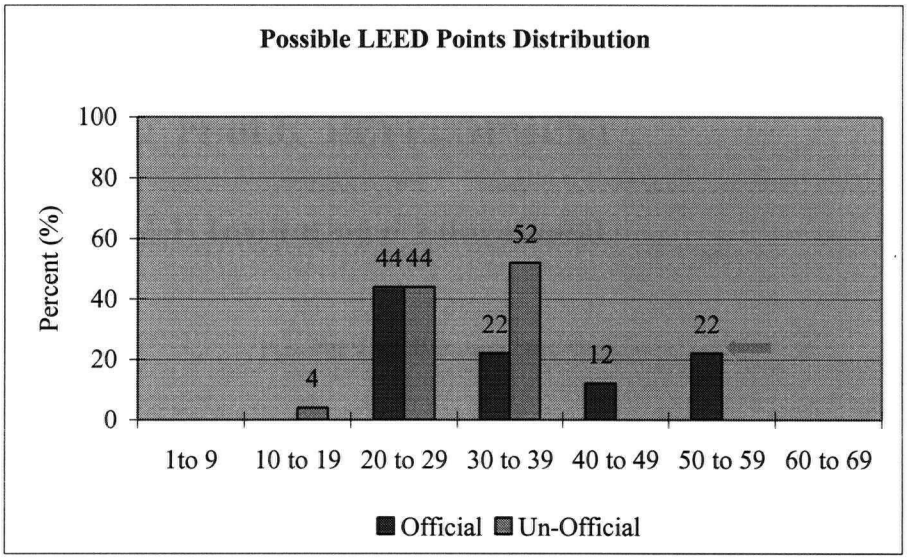


Fig. E 09

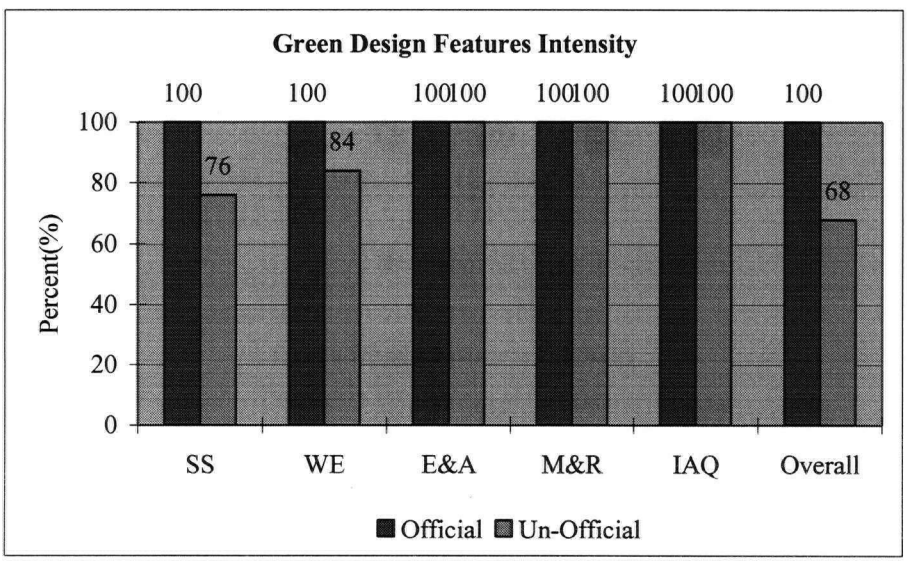


Fig. E 10

Most environmentally responsible Institutional/Educational buildings are in the range of 20 ~ 39 points, corresponding to LEED™ Certified to LEED™ Silver as well (Official: 66%, Unofficial: 96%) [Fig. E 09]. However, there is a distinct difference from Commercial/Office buildings in that that a considerable portion of official buildings (**22%**) are in the range of 50 ~ 59 points, corresponding to LEED™ Platinum. This suggests that Institutional/Educational buildings are in the position of leading the technology and educating the public – they push the projects to the cutting edge with less anxiety of economic feasibility and marketability compared to Commercial/Office buildings. In addition, as shown in [Fig. E 10], all official

buildings include all aspects of green design features (Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources and Indoor Environmental Quality).

Therefore, achieving 50 ~ 59 points currently represents the cutting edge green performance of institutional/educational buildings.

PART 2. Green Design Performance Intensities in each Category by Contribution Level

In processing the procedure of Part 2 in Chapter III by utilizing Green Data Base Ver.1.0 & Microsoft Excel, the patterns of green design performance intensities in each category by contribution extent" have been indicated for both types of financing as described in the following diagrams.

PART 2-1. PRIVATE DEVELOPMENT

PART 2-1-1. Commercial/Office

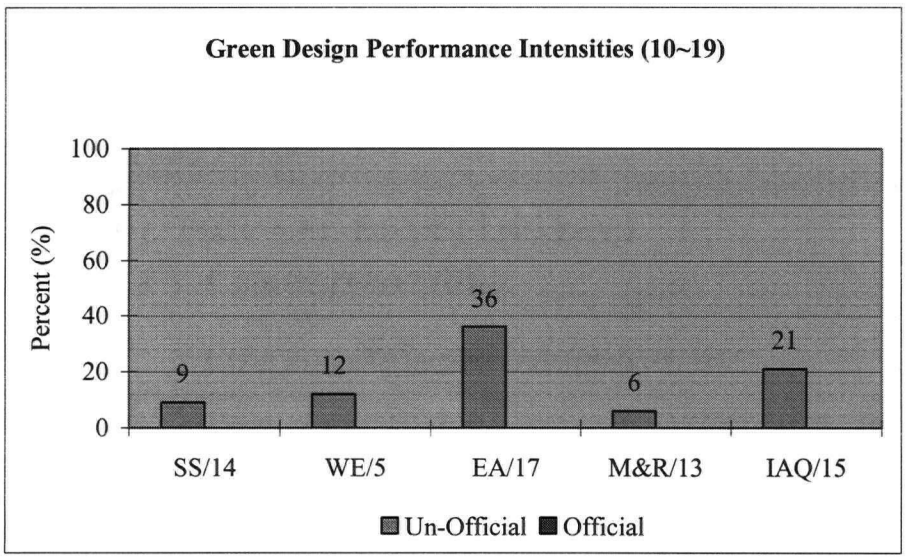


Fig. F 01

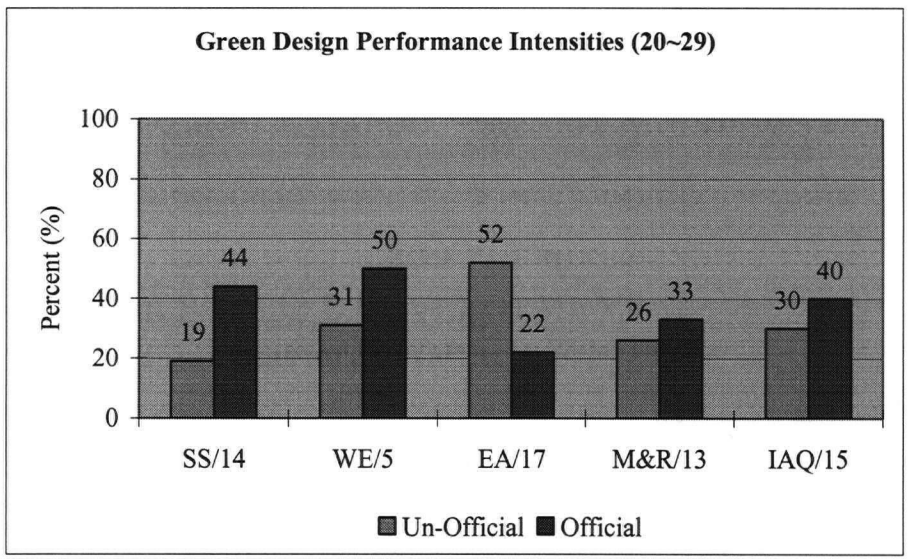


Fig. F 02

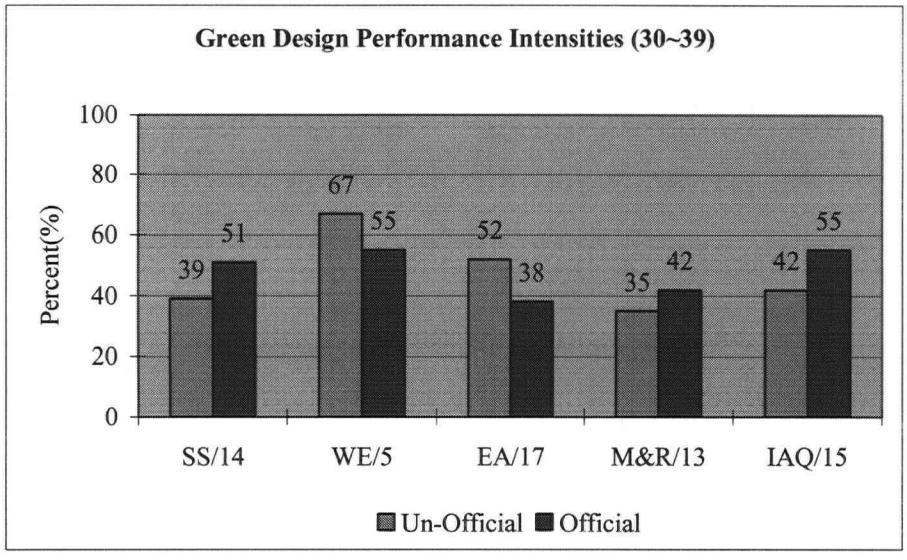


Fig. F 03

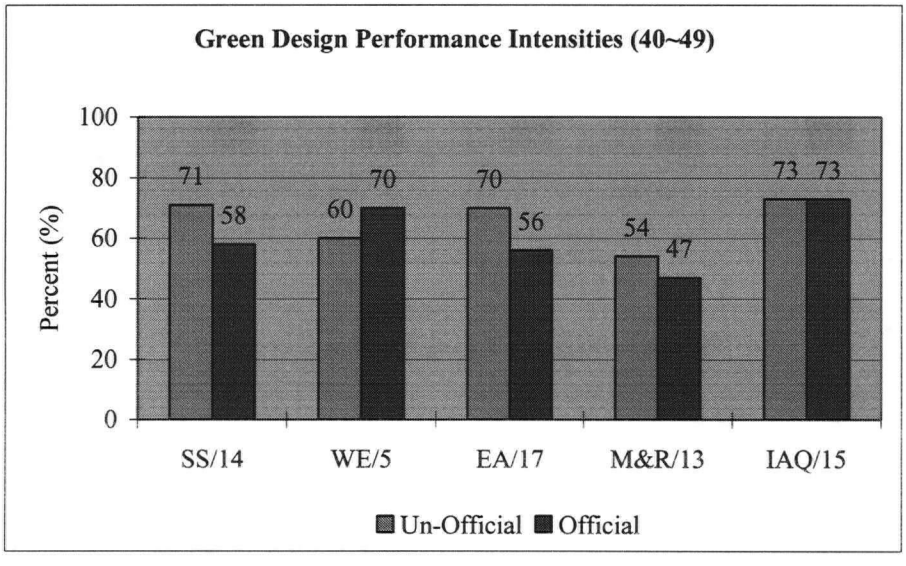


Fig. F 04

[Table E 01] Increase & Decrease Table of Performance Intensities for Official Buildings of Commercial/Office

Official	Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)		Level E (40 ~49)		Level F (50 ~59)	Level G (60 ~69)
SS / 14	-	-	44	51	⇑ 7	50	⇓ 1	-	-
WE / 5	-	-	50	55	⇑ 5	70	⇑ 15	-	-
EA / 17	-	-	**22**	38	⇑ 16	56	⇑ 18	-	-
MR / 13	-	-	33	42	⇑ 9	47	⇑ 5	-	-
IEQ / 15	-	-	40	55	⇑ 15	73	⇑ 18	-	-

The performance in "Energy & Atmosphere" category shows the least Performance (**22%**) at Level C. However, EA has the most rate of increase (**34%**) in performance intensity while the

designation level advances from Level C to Level E. In addition, the performance, in the category of "Indoor Environmental Quality", shows a considerable rate of increase (**33%**) in Performance Intensity along with energy & atmosphere.

At Level E, all performances for each category show beyond 50% of the full performance except Materials & Resources.

PART 2-1-2. Industrial/Warehouse

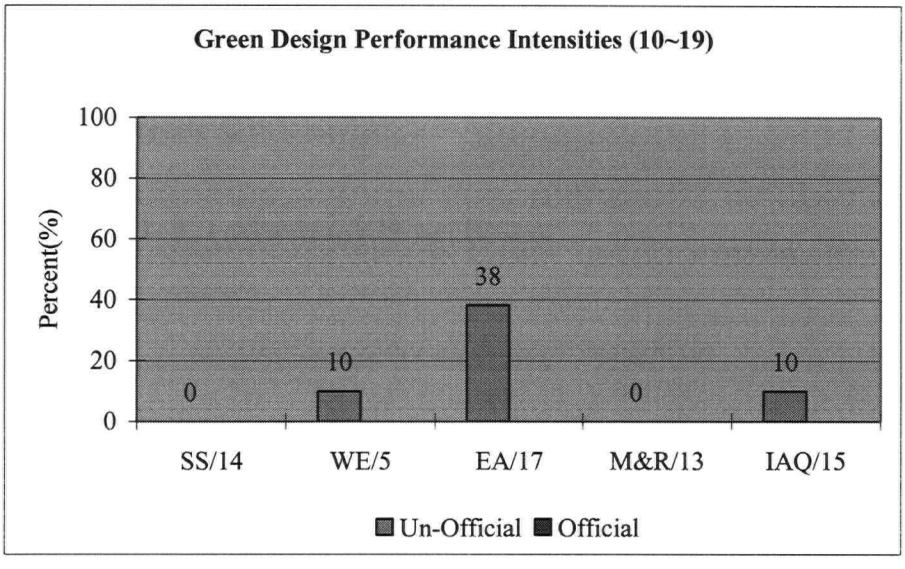


Fig. F 05

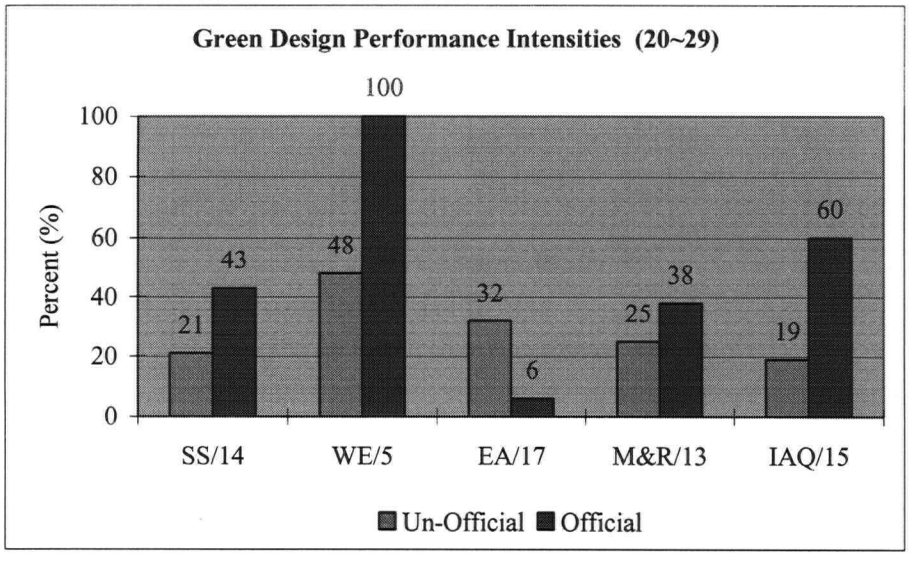


Fig. F 06

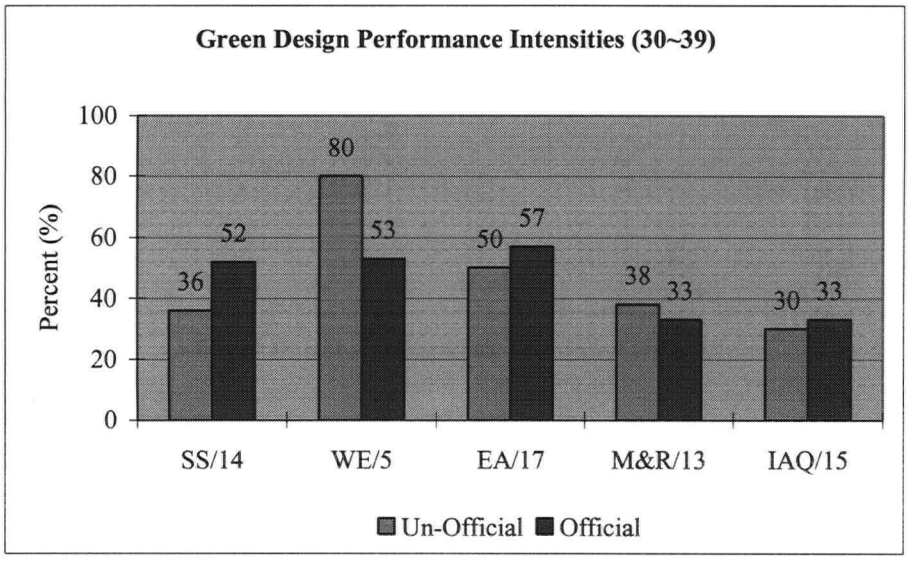


Fig. F 07

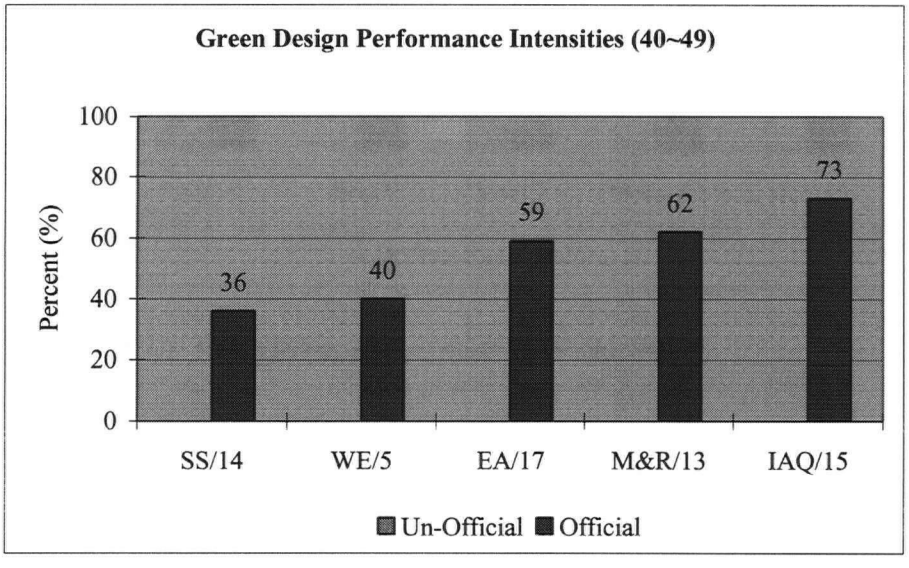


Fig. F 08

[Table E 02] Increase & Decrease Table of Performance Intensities for Official Buildings of Industrial/Warehouse

Official	Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)		Level E (40 ~49)		Level F (50 ~59)	Level G (60 ~69)
SS / 14	-	-	43	52	⇑ 9	36	⇓ 16	-	-
WE / 5	-	-	100	53	⇓ 47	40	⇓ 13	-	-
EA / 17	-	-	**6**	57	⇑ 51	**59**	⇑ 2	-	-
MR / 13	-	-	38	33	⇓ 5	62	⇑ 29	-	-
IEQ / 15	-	-	60	33	⇓ 27	**73**	⇑ 40	-	-

The performance, in the category of "Energy & Atmosphere", shows the least Performance (**6%**) at Level C. However, EA has the most rate of increase (**53%**) in Performance Intensity

while the designation level advances from Level C to Level E.

At Level E, the "Energy & Atmosphere" category has a similar performance intensity (**59%**) as the performance intensity (**56%**) of "Commercial/Office" buildings. In addition, commercial/office and industrial/warehouse buildings have an identical performance intensity (**73%**) in the category of Indoor Environmental Quality. These two facts suggest that the environmentally responsible buildings for the uses of commercial/office and industrial/warehouse buildings show the very similar performance intensities in Energy & Atmosphere and Indoor Environmental Quality.

PART 2-1-3. Residential

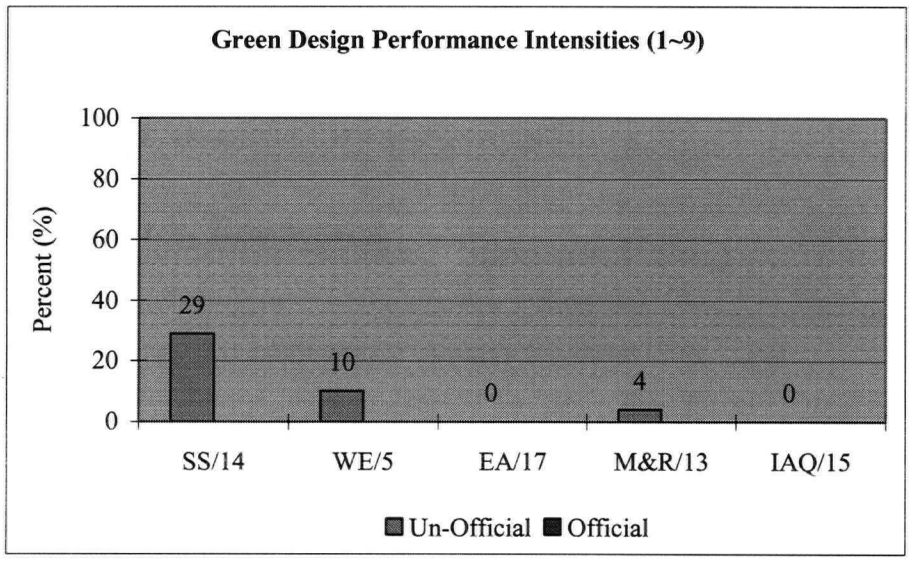


Fig. F 09

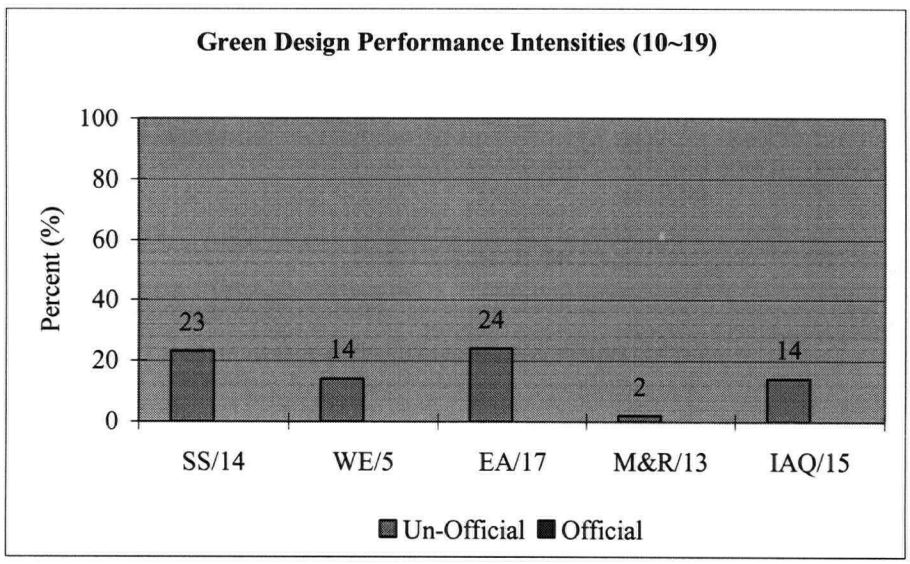


Fig. F 10

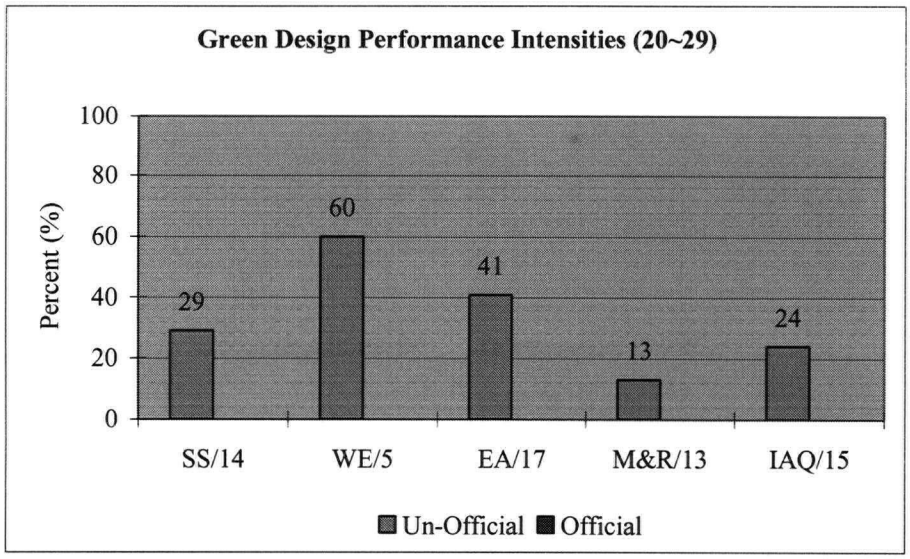


Fig. F 11

[Table E 03] Increase & Decrease Table of Performance Intensities for Un-official Buildings of Residential

Official	**Level A** (0 ~ 9)	**Level B** (10 ~19)		**Level C** (20 ~29)		**Level D** (30 ~39)	**Level E** (40 ~49)	**Level F** (50 ~59)	**Level G** (60 ~69)
SS / 14	29	23	⇓6	29	⇑6	-	-	-	-
WE / 5	10	14	⇑4	60	⇑46	-	-	-	-
EA / 17	0	24	⇑24	41	⇑17	-	-	-	-
MR / 13	4	2	⇓2	13	⇑11	-	-	-	-
IEQ / 15	0	14	⇑14	24	⇑10	-	-	-	-

The performance in the "Energy & Atmosphere" category shows the least Performance (**0%**) at Level A. However, EA has a significant rate of increase (**41%**) in performance intensity while the designation level advances from Level A to Level C. In addition, the performance in the "Water Efficiency" category shows the most rate of increase (**50%**) in Performance Intensity. But, even if the most rate of increase occurred in the category of Water Efficiency, the influence of the performance in Energy & Atmosphere is more critical in terms of the contribution level to the entire green performance.

PART 2-1-4. Hotel/Resort

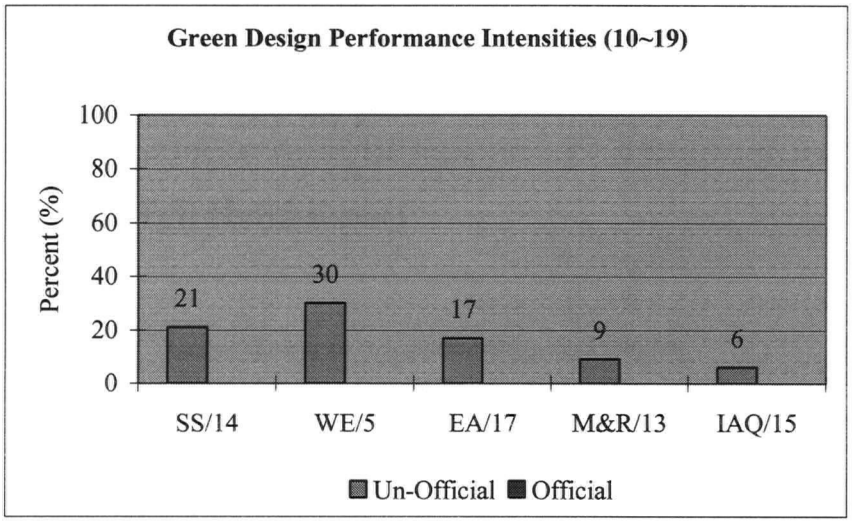


Fig. F 12

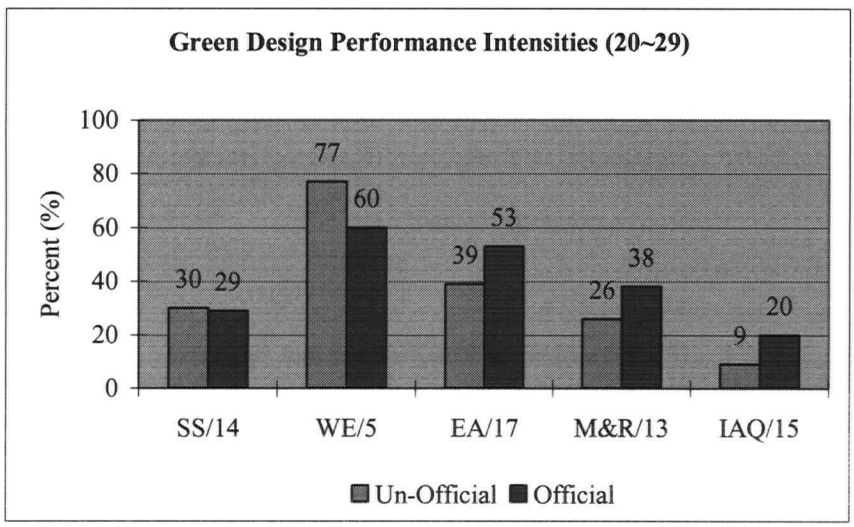


Fig. F 13

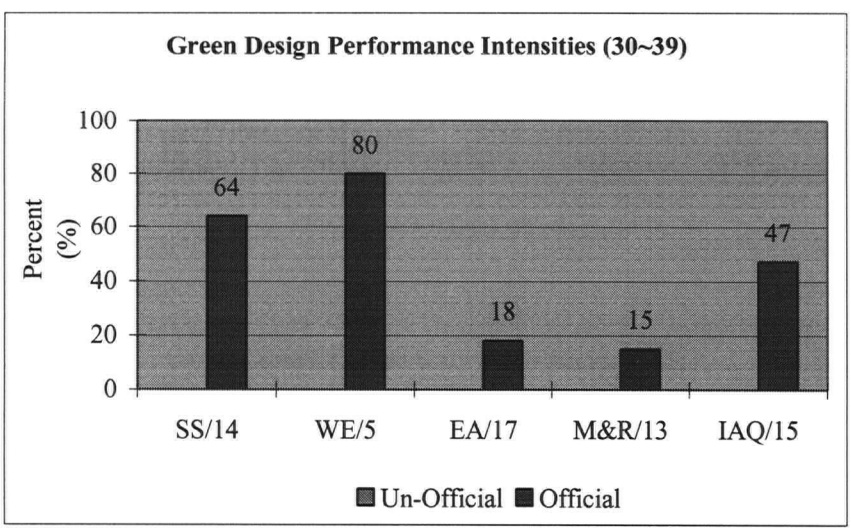


Fig. F 14

[Table E 04] Increase & Decrease Table of Performance Intensities for Official Buildings of Hotel/Resort

Official	Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)		Level E (40 ~49)	Level F (50 ~59)	Level G (60 ~69)
SS / 14	-	-	29	64	⇑35	-	-	-
WE / 5	-	-	60	80	⇑20	-	-	-
EA / 17	-	-	53	18	⇓35	-	-	-
MR / 13	-	-	38	15	⇓23	-	-	-
IEQ / 15	-	-	**20**	47	⇑27	-	-	-

[Table E 05] Increase & Decrease Table of Performance Intensities for Un-official Buildings of Hotel/Resort

Official	Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)		Level D (30 ~39)	Level E (40 ~49)	Level F (50 ~59)	Level G (60 ~69)
SS / 14	-	21	30	⇑9	-	-	-	-
WE / 5	-	30	77	⇑47	-	-	-	-
EA / 17	-	17	39	⇑22	-	-	-	-
MR / 13	-	9	26	⇑17	-	-	-	-
IEQ / 15	-	6	**9**	⇑3	-	-	-	-

Since only two cases of official buildings have been found in the marketplace and stored in the database for Hotel/Resort buildings in this research, un-official buildings have been utilized to indicate "Increase & Decrease Table of Performance Intensities of Hotel/Resort" for the reliability of the pattern.

The performance, in the category of Water Efficiency, has the most rate of increase (**53%**) in performance intensity while the designation level advances from Level B to Level C in addition to the highest performance (**77%**) among all categories at Level C.

On the other hand, the performance of Indoor Environmental Quality (Unofficial: **9%**, Official: **20%**) seems to be relatively lower than the performances of the other project types – at Level C, Commercial/Office (**40%**), Institutional/Educational(**50%**), Industrial/Warehouse (**60%**) and Residential (**24%**).

PART 2-2. PUBLIC DEVELOPMENT
PART 2-2-1. Institutional/Educational

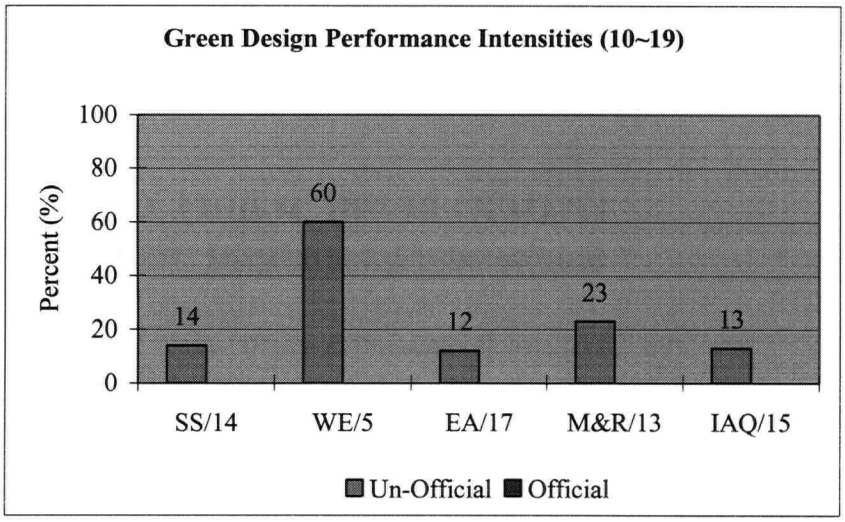


Fig. F 15

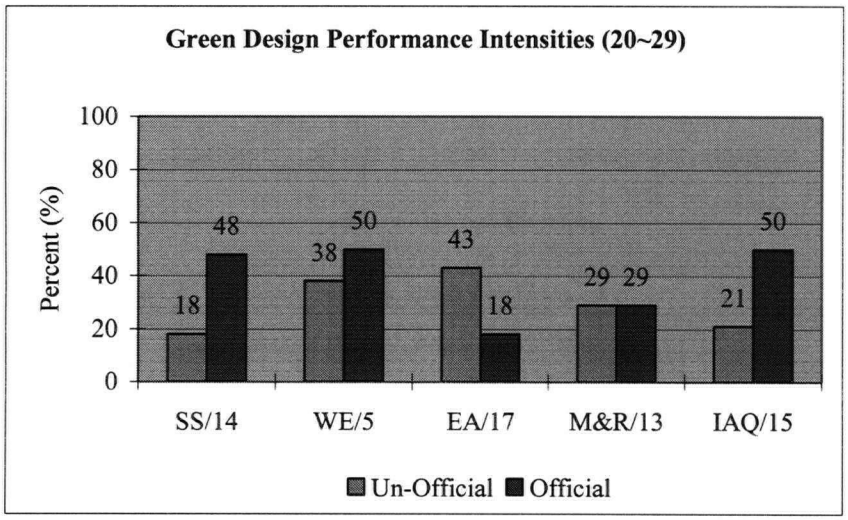


Fig. F 16

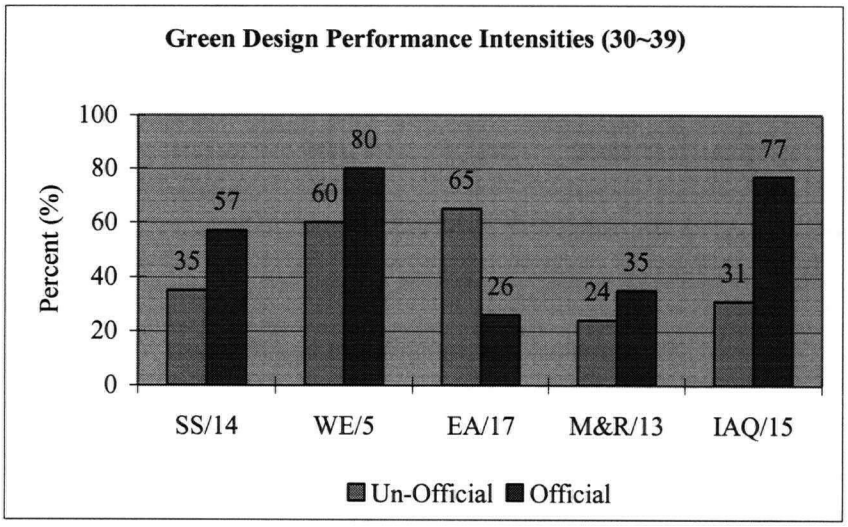


Fig. F 17

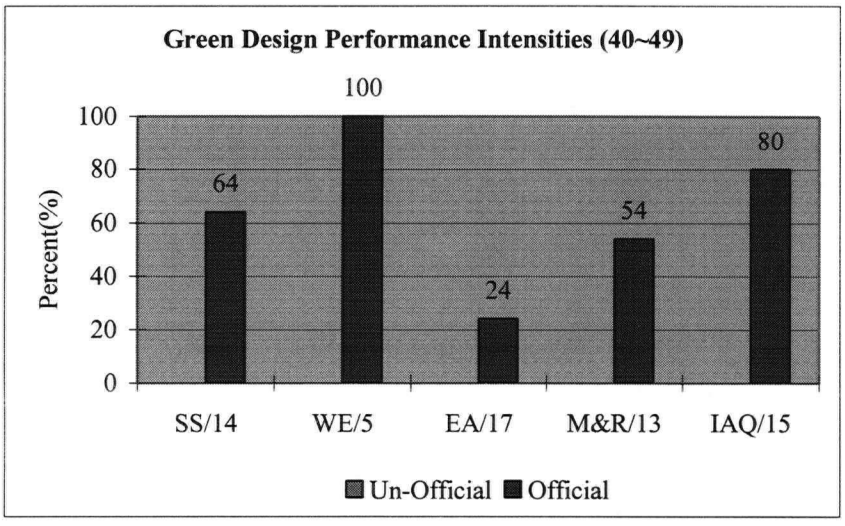


Fig. F 18

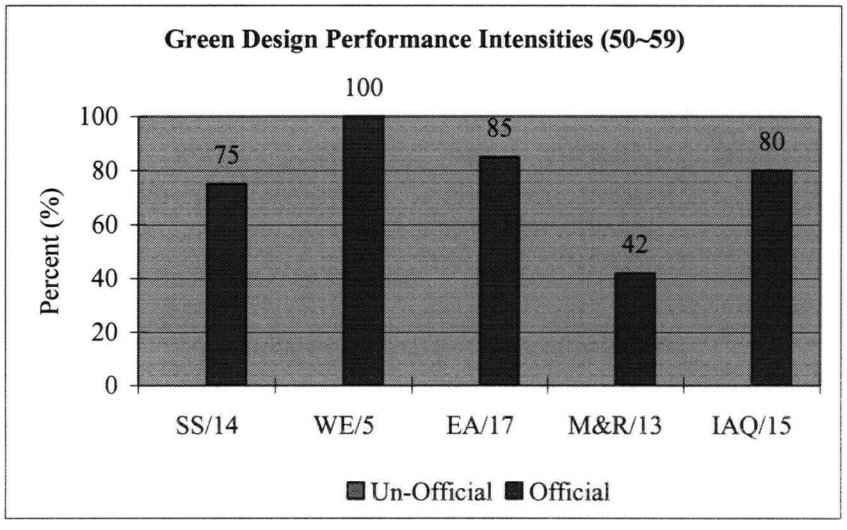


Fig. F 19

[Table E 06] Increase & Decrease Table of Performance Intensities for Official Buildings of Institutional/Educational

Official	Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)		Level E (40 ~49)		Level F (50 ~59)		Level G (60 ~69)
SS / 14	-	-	48	57	⇑ 9	64	⇑ 7	75	⇑ 11	-
WE / 5	-	-	50	80	⇑ 30	100	⇑ 20	100	⇑ 0	-
EA / 17	-	-	**18**	26	⇑ 8	24	⇓ 2	85	⇑ 61	-
MR / 13	-	-	29	35	⇑ 6	54	⇑ 19	42	⇓ 12	-
IEQ / 15	-	-	50	77	⇑ 27	80	⇑ 3	80	⇑ 0	-

The performance, in the category of "Energy & Atmosphere", shows the least Performance Intensity (**18%**) at Level C corresponded to LEED™ Certified. However, EA has the most rate

of increase (**67%**) in performance intensity while the designation level advances from Level C to Level F. In addition, the performance, in the category of "Water Efficiency", shows a significant rate of increase (**50%**) in performance intensity along with 100% of the maximum performance.

Currently, in Level E, all performances for each category show beyond 50% of the full performance except Energy & Atmosphere. Moreover, at Level F, all performances for each category reach considerable performances – SS (**75%**), WE (**100%**), EA (**85%**), IEQ (**80%**) – except Materials & Resources.

PART 3. The Achieved Points Distribution of Energy and Atmosphere Category

In processing the procedure of Part 3 in Chapter III through the utilization of Green Data Base Ver.1.0 & Microsoft Excel, the patterns of achieved energy performance point distribution within the category of energy & atmosphere" have been provided for both types of financing as described in the following diagrams. However, because of the doubt of the reliability due to the small number of official projects in Residential & Hotel/Resort buildings, those project types are additionally excluded from the study in this part.

The U.S. Green Building Council currently requires green buildings to meet certain energy efficiency and performance as required by ASHRAE/IESNA 90.1-1999 or the local energy code, whichever is the more stringent to be official. However, the majority of un-official buildings represent their enhanced energy performances measured by the comparison with the conventional energy performance that is inferior to the performance of ASHRAE/IESNA 90.1-1999. According to Mark. Graham's technical article in ASHRAE, "ASHRAE claims it should result in site energy savings of about 16 percent and source energy savings of about 20 percent above the previous edition or conventionally marketed buildings and state codes".

Therefore, the energy performances for un-official buildings are corrected into 'Revised Energy Performances' to display consistent "Achieved Energy Performance Point Distribution".

PART 3-1. PRIVATE DEVELOPMENT
PART 3-1-1. Commercial/Office

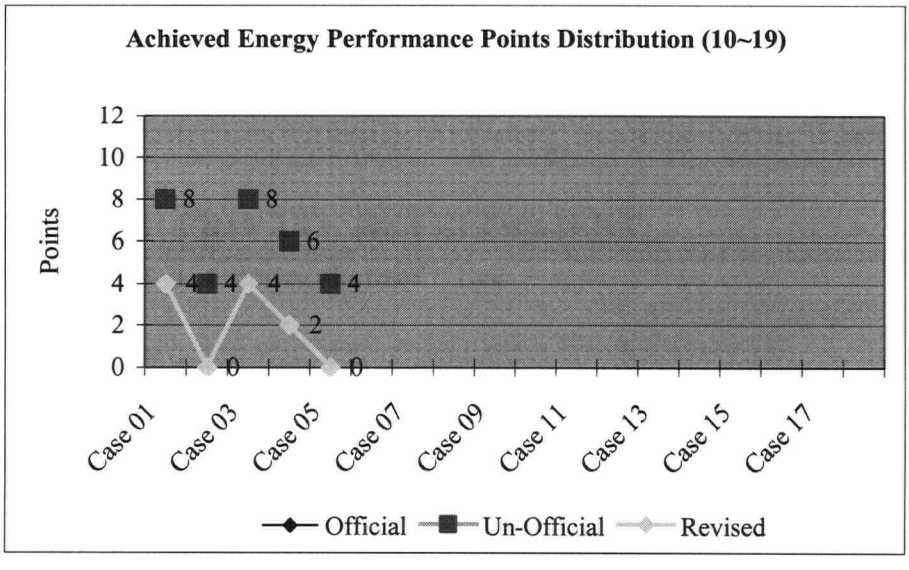


Fig. G 01

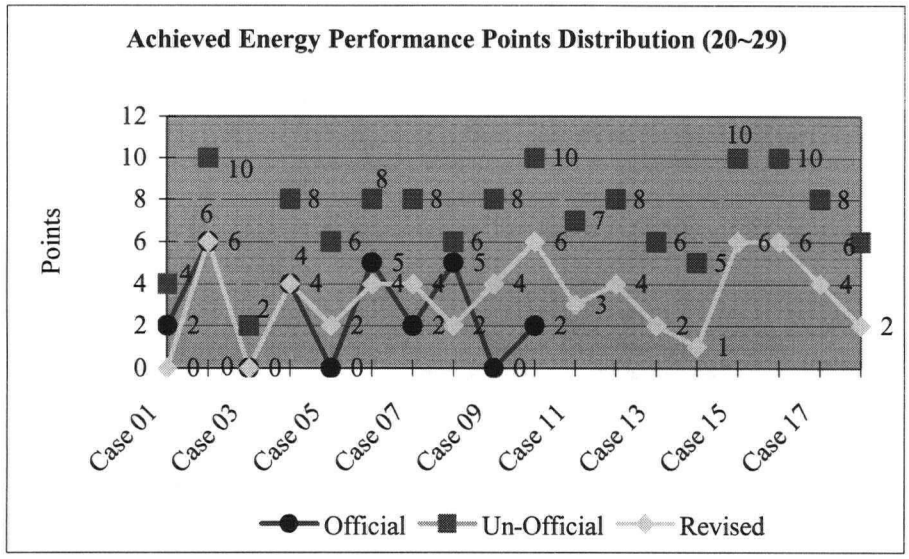


Fig. G 02

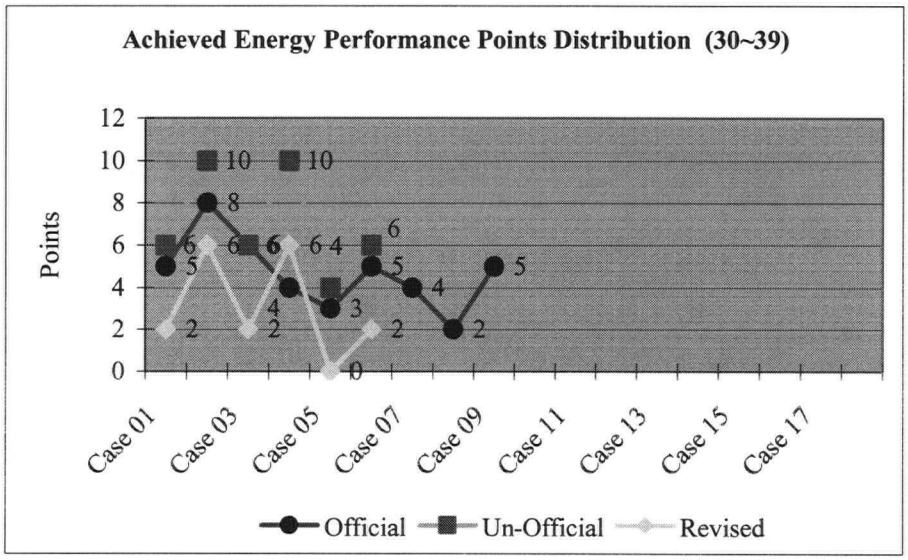


Fig. G 03

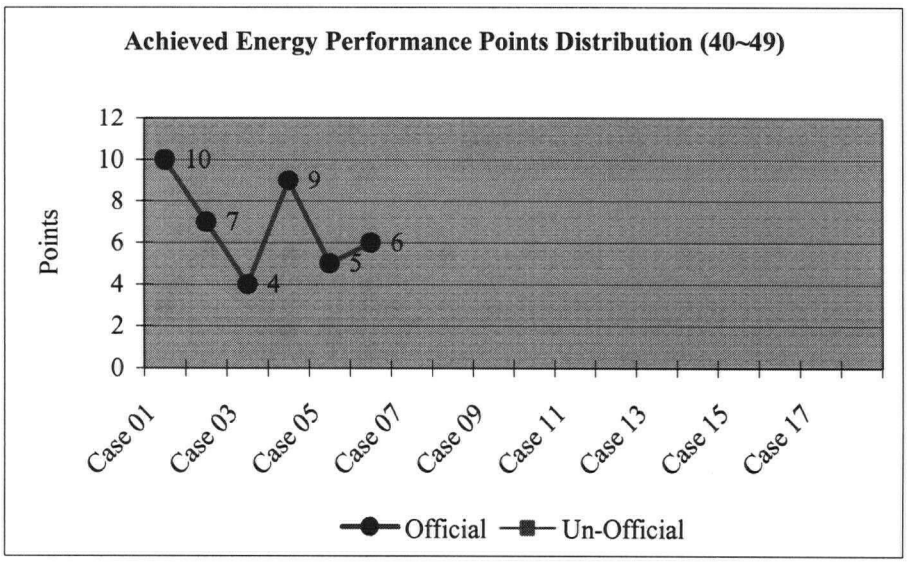


Fig. G 04

[Table F 01] Summary Table of Achieved Energy Performance for Commercial/Office Buildings

		Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)	Level E (40 ~49)	Level F (50 ~59)	Level G (60 ~69)
Official	Min	-	-	0	2	4	-	-
	Max	-	-	6	8	10	-	-
	A.P	-	-	**2 ~ 5**	**3 ~ 6**	**5 ~ 9**	-	-
Revised	Min	-	0	0	0	-	-	-
	Max	-	4	6	6	-		
	A.P	-	2	**1 ~ 5**	**2 ~ 6**	-	-	-
Un Official	Min	-	4	2	4	-	-	-
	Max	-	8	10	10	-		
	A.P	-	6	**4 ~ 8**	**6 ~ 10**	-	-	-

Min: Minimum, Max: Maximum, A.P: Average Point

Achieved Points Distribution by Credits in Energy & Atmosphere

CREDIT 1 – Optimize Energy Performance (Max. 10 Points)

CREDIT 2 – Renewable Energy (Max. 3 Points)

CREDIT 3 – Additional Commissioning (Max. 1 Point)

CREDIT 4 – Ozone Depletion (Max. 1 Point)

CREDIT 5 – Measurement & Verification (Max. 1 Point)

CREDIT 6 – Green Power (Max. 1 Point)

[Table F 02] Achieved Points Distribution for Commercial/Office Buildings: Official (20 ~ 29)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	2	-	-	-	-	-	**2**
Case 02	6	-	-	-	-	-	**6**
Case 03	-	-	-	1	-	-	**1**
Case 04	4	-	-	1	-	-	**5**
Case 05	-	-	-	1	-	-	**1**
Case 06	5	-	1	1	1	-	**8**
Case 07	2	-	1	-	1	-	**4**
Case 08	5	-	-	-	-	-	**5**
Case 09	-	-	-	1	-	-	**1**
Case 10	2	-	1	-	1	-	**4**

[Table F 03] Achieved Points Distribution for Commercial/Office Buildings: Official (30 ~ 39)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	5	-	1	-	-	-	**6**
Case 02	8	2	-	1	1	1	**13**
Case 03	6	-	-	1	1	1	**9**
Case 04	4	-	-	-	-	-	**4**
Case 05	3	-	1	-	-	-	**4**
Case 06	5	-	1	-	-	1	**7**
Case 07	4	-	1	-	-	-	**5**
Case 08	2	-	1	1	1	-	**5**
Case 09	5	-	-	-	-	-	**5**

[Table F 04] Achieved Points Distribution for Commercial/Office Buildings: Official (40 ~ 49)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	10	3	-	-	-	1	**14**
Case 02	7	-	1	-	1	-	**9**
Case 03	4	-	-	-	1	-	**5**
Case 04	9	3	-	1	1	1	**15**
Case 05	5	-	1	1	1	-	**8**
Case 06	6	-	-	-	-	-	**6**

PART 3-1-2. Industrial/Warehouse

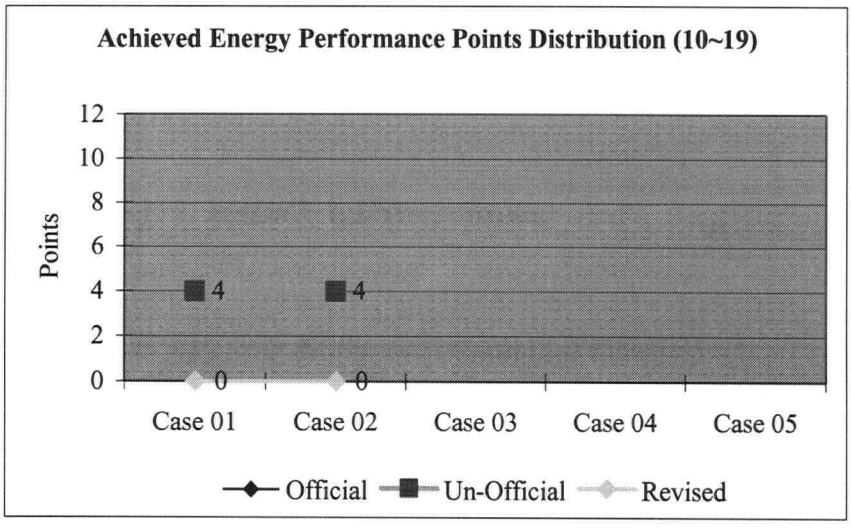


Fig. G 05

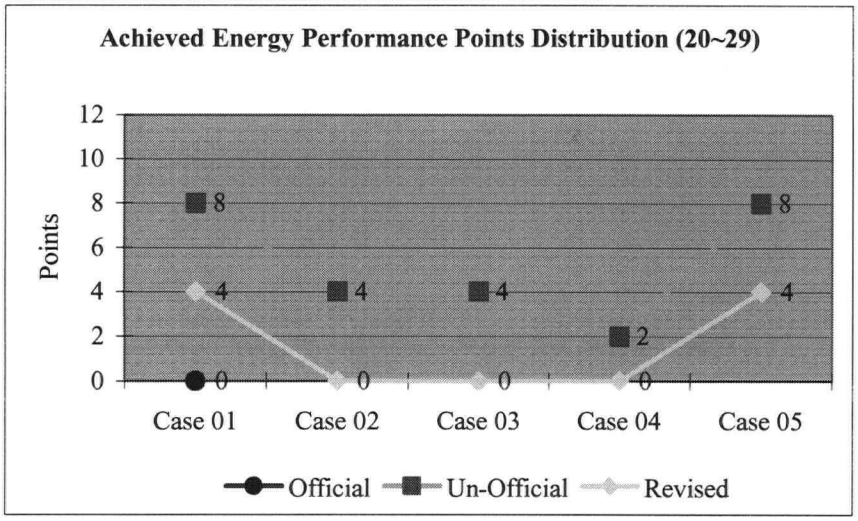


Fig. G 06

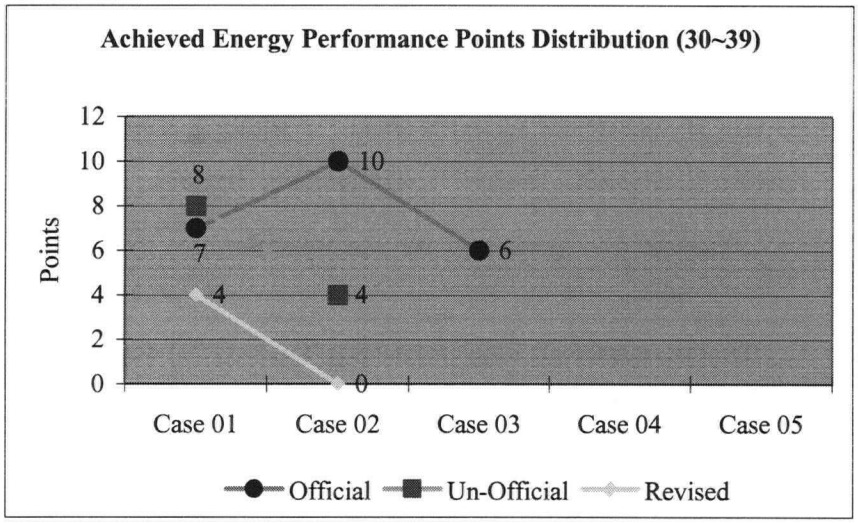


Fig. G 07

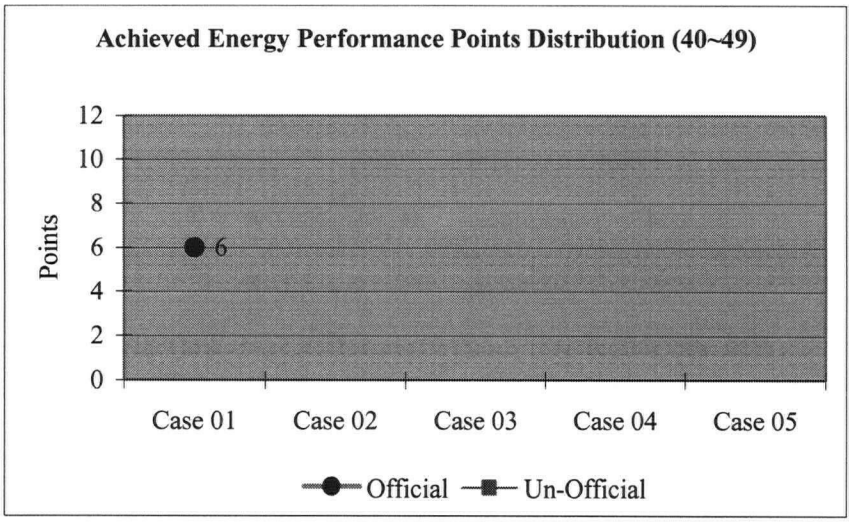


Fig. G 08

[Table G 01] Summary of Achieved Energy Performance for Industrial/Warehouse

		Level A (0 ~ 9)	Level B (10 ~19)	Level C (20 ~29)	Level D (30 ~39)	Level E (40 ~49)	Level F (50 ~59)	Level G (60 ~69)
Official	Min	-	-	-	6	-	-	-
	Max	-	-	-	10	-	-	-
	A.P	-	-	**0**	**7**	**6**	-	-
Revised	Min	-	-	-	0	-	-	-
	Max	-	-	-	4	-		
	A.P	-	**0**	**0 ~ 4**	**4**	-	-	-
Un Official	Min	-	-	2	-	-	-	-
	Max	-	-	8	-	-		
	A.P	-	**4**	**4**	**4 ~ 8**	-	-	-

Min: Minimum, Max: Maximum, A.P: Average Point

Achieved Points Distribution by Credits in Energy & Atmosphere

CREDIT 1 – Optimize Energy Performance (Max. 10 Points)
CREDIT 2 – Renewable Energy (Max. 3 Points)
CREDIT 3 – Additional Commissioning (Max. 1 Point)
CREDIT 4 – Ozone Depletion (Max. 1 Point)
CREDIT 5 – Measurement & Verification (Max. 1 Point)
CREDIT 6 – Green Power (Max. 1 Point)

[Table G 02] Achieved Points Distribution for Industrial/Warehouse: Official (20 ~ 29)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	-	-	1	-	-	-	**1**

[Table G 03] Achieved Points Distribution for Industrial/Warehouse: Official (30 ~ 39)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	7	-	1	1	-	-	**9**
Case 02	10	-	-	-	1	-	**11**
Case 03	6	-	1	1	1	-	**9**

[Table G 04] Achieved Points Distribution for Industrial/Warehouse: Official (40 ~ 49)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	6	3	-	1	1	1	**12**

PART 3-2. PUBLIC DEVELOPMENT
PART 3-2-1. INSTITUTIONAL/EDUCATIONAL

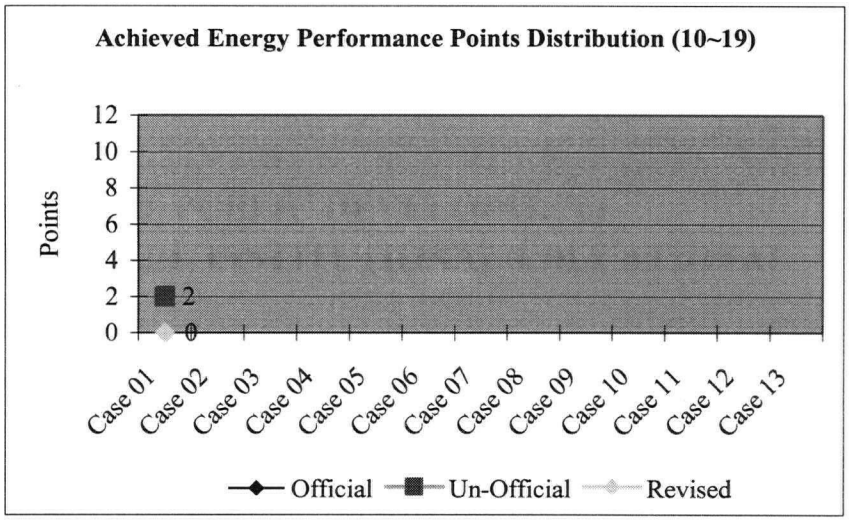


Fig. G 09

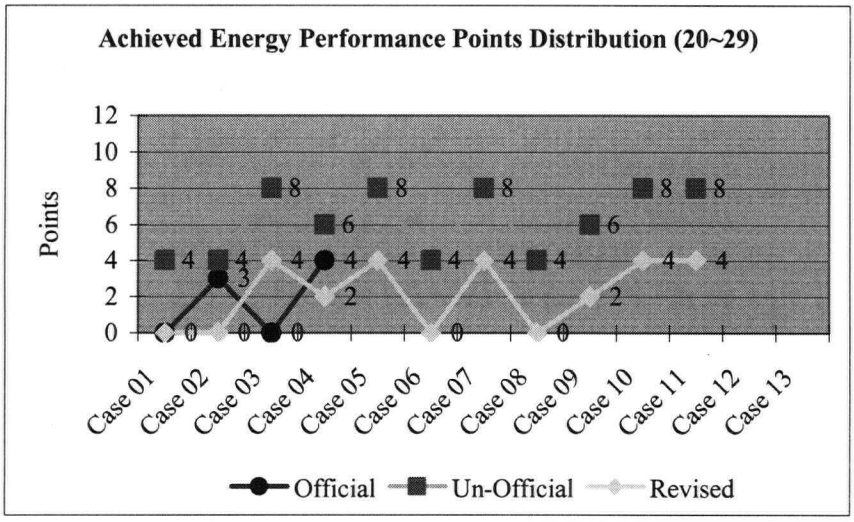


Fig. G 10

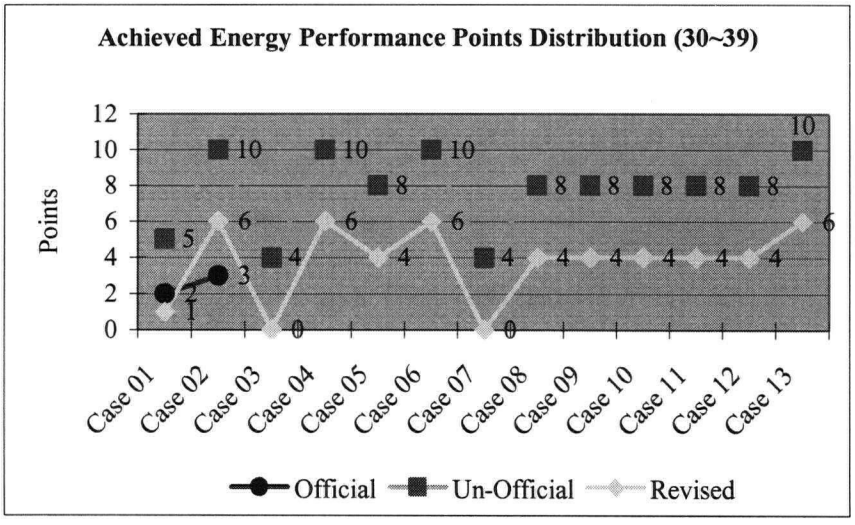


Fig. G 11

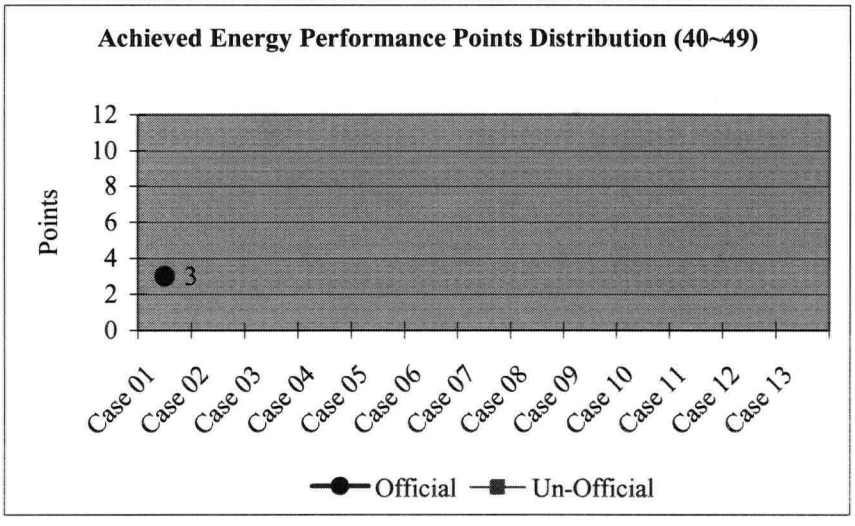


Fig. G 12

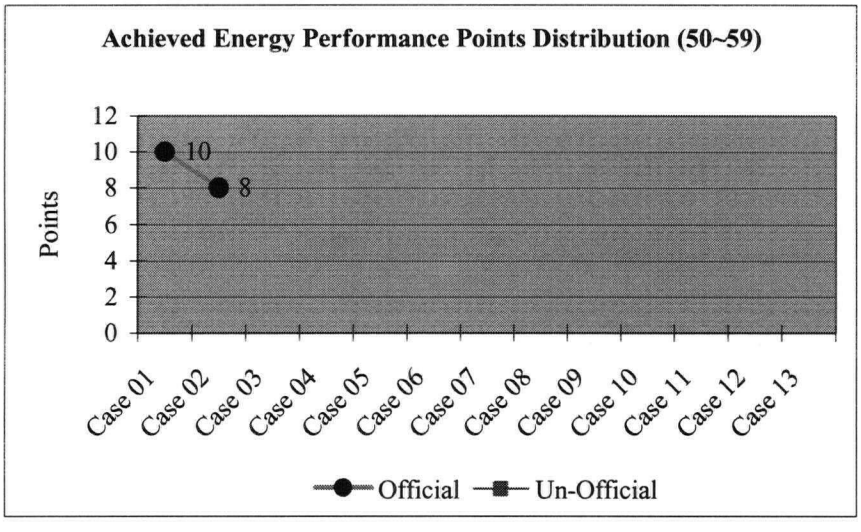


Fig. G 13

[Table H 01] Summary of Achieved Energy Performance for Institutional/Educational

		Level A (0 ~ 9)	**Level B** (10 ~19)	**Level C** (20 ~29)	**Level D** (30 ~39)	**Level E** (40 ~49)	**Level F** (50 ~59)	**Level G** (60 ~69)
Official	Min	-	-	0	-	-	-	-
	Max	-	-	4	-	-	-	-
	A.P	-	-	**3**	**2 ~ 3**	**3**	**8 ~ 10**	-
Revised	Min	-	-	0	0	-	-	-
	Max	-	-	4	6	-	-	
	A.P	-	0	**2~4**	**4~6**	-	-	-
Un Official	Min	-	-	4	4	-	-	-
	Max	-	-	8	10	-	-	
	A.P	-	2	**6**	**5 ~ 8**	-	-	-

Min: Minimum, Max: Maximum, A.P: Average Point

Achieved Points Distribution by Credits in Energy & Atmosphere

CREDIT 1 – Optimize Energy Performance (Max. 10 Points)
CREDIT 2 – Renewable Energy (Max. 3 Points)
CREDIT 3 – Additional Commissioning (Max. 1 Point)
CREDIT 4 – Ozone Depletion (Max. 1 Point)
CREDIT 5 – Measurement & Verification (Max. 1 Point)
CREDIT 6 – Green Power (Max. 1 Point)

[Table H 02] Achieved Points Distribution for Institutional/Educational Buildings: Official (20 ~ 29)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	-	-	-	1	-	-	**1**
Case 02	3	-	-	1	1	-	**5**
Case 03	-	-	-	-	1	-	**1**
Case 04	4	-	-	-	1	-	**5**

[Table H 03] Achieved Points Distribution for Institutional/Educational Buildings: Official (30 ~ 39)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	2	-	1	1	1	-	**5**
Case 02	3	-	-	-	1	-	**4**

[Table H 04] Achieved Points Distribution for Institutional/Educational Buildings: Official (40 ~ 49)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	3	-	-	1	-	-	**4**

[Table H 05] Achieved Points Distribution for Institutional/Educational Buildings: Official (50 ~ 59)

	Credit 1/10	Credit 2/3	Credit 3/1	Credit 4/1	Credit 5/1	Credit 6/1	Total
Case 01	10	3	1	-	1	1	**14**
Case 02	8	2	1	-	1	1	**13**

CHAPTER V CONCLUSION A

PART 1. Establishing Reasonable Green Performances for both Public and Private Developments

As intended at the outset of this thesis, the reasonable green buildings – reasonable green performances – for both types of financing are established through the analysis of the following stages:

1. Analyzing the implications of the green performances and energy performances resulted in Chapter IV for both types of financing.
2. Analyzing the experiences of case studies' construction costs for each project type at each green designation level.

PART 1-1. PUBLIC DEVELOPMENT

PART 1-1-1. Institutional/Educational

Classification	Occurred Performances	Cutting-Edge Performance	Reference
OFFICIAL	Level C (20 ~ 29 Points): **44%** Level D (30 ~ 39 Points): **22%** Level E (40 ~ 49 Points): **12%** Level F (50 ~ 59 Points): **22%**	Level F (50 ~ 59 Points): **22%**	Part 1-2 of Chapter IV
UN-OFFICIAL	Level B (10 ~ 19 Points): **4%** Level C (20 ~ 29 Points): **44%** Level D (30 ~ 39 Points): **52%**	Level D (30 ~ 39 Points): **52%**	Part 1-2 of Chapter IV

[Table I 01] Summary of Green Performances for Institutional/Educational Buildings

Classification	Average energy performance at each green designation level	Cutting-Edge Energy Performance	Reference
OFFICIAL	• Level C (20 ~ 29 Points): **3** points • Numerously Appeared Performance **0** Point(s): 2 of 4 cases	Level F (50 ~ 59 Points): **8~10** points	Part 3-2 of Chapter IV
	• Level D (30 ~ 39 Points): **2~3** points • Numerously Appeared Performance **Various**		

	• Level E (40 ~ 49 Points): **3** points • Numerously Appeared Performance **3** Point(s): 1 of 1 case		
	• Level F (50 ~ 59 Points): **8~10** points • Numerously Appeared Performance **Various**		
REVISED	• Level C (20 ~ 29 Points): **1~5** points • Numerously Appeared Performance **0** Point(s): 4 of 13 cases **2** Point(s): 2 of 13 cases **4** Point(s): 5 of 13 cases	Level D (30 ~ 39 Points): **2 ~ 6** Points	Part 3-2 of Chapter IV
	• Level D (30 ~ 39 Points): **2~6** points • Numerously Appeared Performance **4** Point(s): 7 of 13 cases **6** Point(s): 4 of 13 cases		

[Table I 02] The Summary of Energy Performances for Institutional/Educational Buildings

Green Designation Level	Declaration of any Additional Funds provided for Green Design Features?		Remark
Level C (20 ~ 29 Points)	YES	**NO**	***1**
Level D (30 ~ 39 Points)	**YES**	NO	***2**
Level E (40 ~ 49 Points)	YES	**NO**	***3**
Level F (50 ~ 59 Points)	**YES**	NO	***4**

[Table I 03] Establishing Green Designation Levels Imposing Additional Costs for Institutional/Educational

	Remark
***1**	None of the projects at Level C in Institutional/Educational buildings asserts that it is more expensive to build green than a conventional building.
***2**	Only the projects that reach more than **40%** of energy performance enhancement (**6 Points** in energy performance) experienced about additional **5%** of the total cost of the projects on green design features.
***3**	The only project at Level E never imposed any additional costs on green design features.
***4**	The projects that reach beyond **50%** of energy performance enhancement including **50%** (**8 Points** in energy performance) insist that they are looking at a fast payback in 5 years. Therefore, it is assumed that the energy performance beyond **50%** still imposes additional funds on green design features for Institutional/Educational buildings even if it guarantees a quick payback.

Through an analysis of the implications in the tables above – [Table I 01, I 02 and I 03], it is believed that the performance at Level E – 40 ~ 49 points of LEED™ Gold Rated – becomes the reasonable green performance by securing the following both critical concerns at once for Institutional/Educational buildings if the energy performance is targeted to design **6 points** (40% of energy performance enhancement) and less:

1. Keeping pace with cutting-edge green buildings to gain positive media exposure
2. Building a environmentally responsible building within economic feasibility

It is also believed that the inferior green buildings in energy performance should be relatively more stringent on the other four green design performances – Sustainable Sites, Water Efficiency, Materials & Resources and Indoor Environmental Quality – than other superior green buildings in energy performance.

Therefore, the possible green design performance intensities are shown in Table I 03 for Institutional/Educational buildings. The suggested Green Design Performance Intensities have been derived from the patterns of the actual projects in the database, and one of the models – Type C – is exemplified in Table I 05.

	SS/14	WE/5	MR/13	IEQ/15	Energy Performance
Type A	9 Points 64 %	5 Points 100 %	7 Points 54 %	12 Points 80 %	**6 of 10 Points**
Type B	10 Points 71 %	5 Points 100 %	5 Points 38 %	10 Points 67 %	**6 of 10 Points**
Type C	11 Points 79 %	5 Points 100 %	6 Points 46 %	11 Points 73 %	**6 of 10 Points**

[Table I 04] Suggested Green Design Performance Intensities for Institutional/Educational

Type C	Description
Project Name	School of Nursing & Student Center
Project Type	Educational
Building Type	New Construction
Project Size	194,000 SF
Owner	UT, HSCH
Contact	Rives Taylor

Completion Year	In Progress
City	Houston
State/Province	TX-Texas
Country	USA
Green Design Features	
Sustainable Sites	The new building will use the same building footprint as the current structure. Several bus transit lines connect to the site, and the area is also being designed for biking commuters. Green Roof
Water Efficiency	Rainwater is harvested through the roof and cisterns for storage. A future design for will include a black water living system. Waterless urinals and high efficiency fixtures also reduce overall water demand.
Materials & Resources	The existing building will be deconstructed. A construction waste minimization will be used during construction. "Baseline Green", a life-cycle analysis tool for material selection based on embodied energy and pollution, will be used. Concrete containing 51% minimum fly ash is to be used for the update of carbon. Many decisions are based on a 100-year life cycle cost analysis.
Indoor Environmental Quality	Daylighting and raised floors allow personal control of the work environment with operable windows. No polyvinyl chloride carpet or toxic materials will be used in the building.
LEED™ Evaluation Document	
Sustainable Sites	

Sustainable Sites		11
Prereq 1	**Erosion & Sedimentation Control**	Yes
Credit 1	**Site Selection**	0
Credit 2	**Urban Redevelopment**	1
Credit 3	**Brownfield Redevelopment**	0
Credit 4.1	**Alternative Transportation,** Public Transportation Access	1
Credit 4.2	**Alternative Transportation,** Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation,** Alternative Fuel Refueling Stations	0
Credit 4.4	**Alternative Transportation,** Public Transportation Access	1
Credit 5.1	**Reduced Site Disturbance,** Protect or Restore Open Space	1
Credit 5.2	**Reduced Site Disturbance,** Development Footprint	1
Credit 6.1	**Stormwater Management,** Rate and Quality	1
Credit 6.2	**Stormwater Management, Treatment**	1
Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands,** Non-Roof	1
Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands,** Roof	1
Credit 8	**Light Pollution Reduction**	1

Water Efficiency	**Water Efficiency**		**5**
	Credit 1.1	**Water Efficient Landscaping,** Reduce by 50%	1
	Credit 1.2	**Water Efficient Landscaping,** No Potable Use or No Irrigation	1
	Credit 2	**Innovative Wastewater Technologies**	1
	Credit 3.1	**Water Use Reduction,** 20% Reduction	1
	Credit 3.2	**Water Use Reduction,** 30% Reduction	1
Materials & Resources	**Materials & Resources**		**6**
	Prereq 1	**Storage & Collection of Recyclables**	Yes
	Credit 1.1	**Building Reuse,** Maintain 75% of Existing Shell	0
	Credit 1.2	**Building Reuse,** Maintain 100% of Existing Shell	0
	Credit 1.3	**Building Reuse,** Maintain 100% of Shell & 50% of Non-shell	0
	Credit 2.1	**Construction Waste Management,** Divert 50%	1
	Credit 2.2	**Construction Waste Management,** Divert 75%	1
	Credit 3.1	**Resource Reuse,** Specify 5%	0
	Credit 3.2	**Resource Reuse,** Specify 10%	0
	Credit 4.1	**Recycled Content,** Specify 25%	1
	Credit 4.2	**Recycled Content,** Specify 50%	1
	Credit 5.1	**Local/Regional Materials,** 20% Manufactured Locally	1
	Credit 5.2	**Local/Regional Materials,** of 20% Above, 50% Harvested Locally	1
	Credit 6	**Rapidly Renewable Materials**	0
	Credit 7	**Certified Wood**	0
Indoor Environmental Quality	**Indoor Environmental Quality**		**12**
	Prereq 1	**Minimum IAQ Performance**	Yes
	Prereq 1	**Environmental Tobacco Smoke (ETS) Control**	Yes
	Credit 1	**Carbon Dioxide (CO2) Monitoring**	1
	Credit 2	**Increase Ventilation Effectiveness**	1
	Credit 3.1	**Construction IAQ Management Plan,** During Construction	1
	Credit 3.2	**Construction IAQ Management Plan,** Before Occupancy	1
	Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants	1
	Credit 4.2	**Low-Emitting Materials,** Paints	1
	Credit 4.3	**Low-Emitting Materials,** Carpet	1
	Credit 4.4	**Low-Emitting Materials,** Composite Wood	1
	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
	Credit 6.1	**Controllability of Systems,** Perimeter	0
	Credit 6.2	**Controllability of Systems,** Non-Perimeter	1
	Credit 7.1	**Thermal Comfort,** Comply with ASHRAE 55-1992	1
	Credit 7.2	**Thermal Comfort,** Permanent Monitoring System	1
	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	0
	Credit 8.2	**Daylight & Views,** Daylight 90% of Spaces	0

[Table I 05] Project Description of Type C in Institutional/Educational Buildings

PART 1-2. PRIVATE DEVELOPMENT
PART 1-2-1. Commercial/Office

Classification	Occurred Performances	Cutting-Edge Performance	Reference
OFFICIAL	Level C (20 ~ 29 Points): **40%** Level D (30 ~ 39 Points): **36%** Level E (40 ~ 49 Points): **24%**	Level E (40 ~ 49 Points): **24%**	Part 1-1 of Chapter IV
UN-OFFICIAL	Level B (10 ~ 19 Points): **17%** Level C (20 ~ 29 Points): **60%** Level D (30 ~ 39 Points): **20%** Level E (40 ~ 49 Points): **3%**	Level E (40 ~ 49 Points): **3%**	Part 1-1 of Chapter IV

[Table J 01] Summary of Green Performances for Commercial/Office Buildings

Classification	Average energy performance at each green designation level	Cutting-Edge Energy Performance	Reference
OFFICIAL	• Level C (20 ~ 29 Points): **2~5** points • Numerously Appeared Performance **0** Point(s): 3 of 10 cases **2** Point(s): 3 of 10 cases **5** Point(s): 2 of 10 cases	Level E (40 ~ 49 Points): **5 ~ 9** points	Part 3-1 of Chapter IV
	• Level D (30 ~ 39 Points): **3~6** points • Numerously Appeared Performance **4** Point(s): 2 of 9 cases **5** Point(s): 3 of 9 cases		
	• Level E (40 ~ 49 Points): **5~9** points • Numerously Appeared Performance **Various**		
REVISED	• Level C (20 ~ 29 Points): **2~4** points • Numerously Appeared Performance **2** Point(s): 4 of 18 cases **4** Point(s): 6 of 18 cases **6** Point(s): 4 of 18 cases	Level D (30 ~ 39 Points): **4 ~ 6** Points	Part 3-1 of Chapter IV
	• Level D (30 ~ 39 Points): **4~6** points • Numerously Appeared Performance **2** Point(s): 3 of 6 cases **6** Point(s): 2 of 6 cases		

[Table J 02] Summary of Energy Performances for Commercial/Office Buildings

Green Designation Level	Declaration of any Additional Funds provided for Green Design Features?		Remark
Level C (20 ~ 29 Points)	YES	NO	***1**
Level D (30 ~ 39 Points)	YES	NO	***2**
Level E (40 ~ 49 Points)	YES	NO	***3**

[Table J 03] Establishing Green Designation Levels Imposing Additional Costs for Commercial/Office Buildings

	Remark
***1**	Only one project confessed green components imposed additional costs on the building. However, it is a contradiction to say that the building is within the current trend since the building was built in 1987. In the mean time, a number of projects experienced 10 to 15% below the average construction costs for comparable commercial/office buildings.
***2**	Only the projects that reach more than **40%** of energy performance enhancement (**6 Points** in energy performance) confessed they invested additional funds on green design features. In addition, a couple of projects experienced their construction costs came below the market rate.
***3**	Likewise at Level C and Level D, none of the projects that reach below **50%** of energy performance enhancement including **50%** (**8 Points** in energy performance) imposed additional costs on the buildings.

First of all, the results indicate that energy performance levels have a significant influence on construction costs, and also energy performance focused green buildings impose additional funds on green design features as predicted in part 3 of chapter III.

Accordingly, through an analysis of the implications in the tables above – [Table J 01, J 02 and J 03], it is believed that the performance at Level E – 40 ~ 49 points of LEED™ Gold Rated – represent the current reasonable green performance by securing the following both critical concerns at once for commercial/office buildings if the energy performance is targeted to design **6 points** (**40%** of energy performance enhancement) and less:

1. Keeping pace with cutting-edge green buildings to gain positive media exposure
2. Building a environmentally responsible building within economic feasibility

Additionally, it is also believed that the inferior green buildings in energy performance should be relatively more stringent on the other four green design performances – Sustainable Sites, Water Efficiency, Materials & Resources and Indoor Environmental Quality – than other superior green buildings in energy performance.

Therefore, the possible green design performance intensities are suggested as shown in Table I 02-2 for Commercial/Office buildings. The suggested Green Design Performance Intensities have been outputted from the patterns of the actual projects in the database, and one of the models – Type A – is exemplified in Table J 05.

	SS/14	WE/5	MR/13	IEQ/15	Energy Performance
Type A	10 Points 71 %	4 Points 80 %	7 Points 54 %	9 Points 60 %	**6 of 10 Points**
Type B	8 Points 57 %	4 Points 80 %	10 Points 77 %	9 Points 60 %	**6 of 10 Points**
Type C	10 Points 71 %	3 Points 60 %	7 Points 54 %	11 Points 73 %	**6 of 10 Points**

[Table J 04] Suggested Green Design Performance Intensities for Commercial/Office Buildings

Type A	Description
Project Name	Vancouver Island Technology Park
Project Type	Commercial/Office
Building Type	Major Renovation
Project Size	171,750 SF
Owner	BC Buildings Corporation
Contact	Idealink Architects; Bunting Coady Architects
Completion Year	2001
City	Vancouver
State/Province	BC-British Columbia
Country	Canada

Green Design Features	
Sustainable Sites	*Brownfield Redevelopment* Redeveloping this abandoned hospital facility involved checking for soil contamination and removal of asbestos and underground storage tanks. *Alternative Transportation* Negotiated extensions of several bus routes to site; bicycle parking and showers for 18% of users; negotiated reduction of municipal parking requirements by 50%; designated carpool parking. *Reduced Site Disturbance* 97.8% of degraded habitat was restored by allowing previously irrigated turf area to restore itself naturally and planting native plants and trees. A no-build covenant protects treed areas.
Water Efficiency	*Stormwater Management* 100% of stormwater is treated and infiltrated on site through use of grass swales, grass gravel pave system and stormwater treatment and retention ponds. *Water Efficient Landscaping* Native plants and natural meadows require no permanent irrigation. *Water Use Reduction* Water consumption reduced by 33% through use of dual flush toilets, waterless urinals, electronic sensors on faucets, and flow showerheads.

Materials & Resources	*Building Reuse* Reuse 100% of existing structure and 91% of existing shell. *Construction Waste Management* 99% of construction waste was salvaged or recycled, saving $600,000 and costing 60% less than other contractor bids. *Resource Reuse* Salvaged materials comprise 8% of total materials. *Recycled content* 33% of materials, measured by LEED's weighed cost value, contain post-consumer and/or post-industrial recycled content (e.g., rebar, millwork, insulation, aluminum panels and rubber flooring). *Local/Regional Materials* 31% materials were manufactured within 500 miles, including grass/gravel pavers, concrete, wood, aluminum panels, roofing, siding, windows, wallboard, carpeting and paint.
Indoor Environmental Quality	*Low-Emitting Materials* All adhesives, sealants, carpets and composite wood emit low or no VOCs

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Sustainable Sites

Sustainable Sites		10
Prereq 1	**Erosion & Sedimentation Control**	Yes
Credit 1	**Site Selection**	1
Credit 2	**Urban Redevelopment**	0
Credit 3	**Brownfield Redevelopment**	1
Credit 4.1	**Alternative Transportation,** Public Transportation Access	1
Credit 4.2	**Alternative Transportation,** Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation,** Alternative Fuel Refueling Stations	0
Credit 4.4	**Alternative Transportation,** Public Transportation Access	1
Credit 5.1	**Reduced Site Disturbance,** Protect or Restore Open Space	1
Credit 5.2	**Reduced Site Disturbance,** Development Footprint	1
Credit 6.1	**Stormwater Management,** Rate and Quality	1
Credit 6.2	**Stormwater Management, Treatment**	1
Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands,** Non-Roof	1
Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands,** Roof	0
Credit 8	**Light Pollution Reduction**	0

Water Efficiency	**Water Efficiency**		**4**
	Credit 1.1	**Water Efficient Landscaping,** Reduce by 50%	1
	Credit 1.2	**Water Efficient Landscaping,** No Potable Use or No Irrigation	1
	Credit 2	**Innovative Wastewater Technologies**	0
	Credit 3.1	**Water Use Reduction,** 20% Reduction	1
	Credit 3.2	**Water Use Reduction,** 30% Reduction	1
Materials & Resources	**Materials & Resources**		**7**
	Prereq 1	**Storage & Collection of Recyclables**	Yes
	Credit 1.1	**Building Reuse,** Maintain 75% of Existing Shell	1
	Credit 1.2	**Building Reuse,** Maintain 100% of Existing Shell	0
	Credit 1.3	**Building Reuse,** Maintain 100% of Shell & 50% of Non-shell	0
	Credit 2.1	**Construction Waste Management,** Divert 50%	1
	Credit 2.2	**Construction Waste Management,** Divert 75%	1
	Credit 3.1	**Resource Reuse,** Specify 5%	1
	Credit 3.2	**Resource Reuse,** Specify 10%	0
	Credit 4.1	**Recycled Content,** Specify 25%	1
	Credit 4.2	**Recycled Content,** Specify 50%	0
	Credit 5.1	**Local/Regional Materials,** 20% Manufactured Locally	1
	Credit 5.2	**Local/Regional Materials,** of 20% Above, 50% Harvested Locally	1
	Credit 6	**Rapidly Renewable Materials**	0
	Credit 7	**Certified Wood**	0
Indoor Environmental Quality	**Indoor Environmental Quality**		**9**
	Prereq 1	**Minimum IAQ Performance**	Yes
	Prereq 1	**Environmental Tobacco Smoke (ETS) Control**	Yes
	Credit 1	**Carbon Dioxide (CO2) Monitoring**	1
	Credit 2	**Increase Ventilation Effectiveness**	1
	Credit 3.1	**Construction IAQ Management Plan,** During Construction	0
	Credit 3.2	**Construction IAQ Management Plan,** Before Occupancy	0
	Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants	1
	Credit 4.2	**Low-Emitting Materials,** Paints	1
	Credit 4.3	**Low-Emitting Materials,** Carpet	1
	Credit 4.4	**Low-Emitting Materials,** Composite Wood	1
	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
	Credit 6.1	**Controllability of Systems,** Perimeter	0
	Credit 6.2	**Controllability of Systems,** Non-Perimeter	0
	Credit 7.1	**Thermal Comfort,** Comply with ASHRAE 55-1992	1
	Credit 7.2	**Thermal Comfort,** Permanent Monitoring System	0
	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
	Credit 8.2	**Daylight & Views,** Daylight 90% of Spaces	0

[Table J 05] Project Description of Type B in Commercial/Office Buildings

PART 1-2-2. Industrial/Warehouse

Classification	Occurred Performances	Cutting-Edge Performance	Reference
OFFICIAL	Level C (20 ~ 29 Points): **20%** Level D (30 ~ 39 Points): **60%** Level E (40 ~ 49 Points): **20%**	Level E (40 ~ 49 Points): **20%**	Part 1-3 of Chapter IV
UN-OFFICIAL	Level B (10 ~ 19 Points): **22%** Level C (20 ~ 29 Points): **56%** Level D (30 ~ 39 Points): **22%**	Level D (30 ~ 39 Points): **22%**	Part 1-3 of Chapter IV

[Table J 06] Summary of Green Performances for Industrial/Warehouse

Classification	Average energy performance at each green designation level	Cutting-Edge Energy Performance	Reference
OFFICIAL	• Level C (20 ~ 29 Points): **0** points • Numerously Appeared Performance **0** Point(s): 1 of 1 cases	Level E (40 ~ 49 Points): **6** points	Part 3-3 of Chapter IV
	• Level D (30 ~ 39 Points): **7** points • Numerously Appeared Performance **Various**		
	• Level E (40 ~ 49 Points): **6** points • Numerously Appeared Performance **6** Point(s): 1 of 1 case		
REVISED	• Level C (20 ~ 29 Points): **0~4** points • Numerously Appeared Performance **0** Point(s): 3 of 5 cases **4** Point(s): 2 of 5 cases	Level D (30 ~ 39 Points): **0~4** points	Part 3-3 of Chapter IV
	• Level D (30 ~ 39 Points): **0~4** points • Numerously Appeared Performance **0** Point(s): 1 of 2 cases **4** Point(s): 1 of 2 cases		

[Table J 07] Summary of Energy Performances for Industrial/Warehouse

Green Designation Level	Declaration of any Additional Funds provided for Green Design Features?		Remark
Level C (20 ~ 29 Points)	**YES**	NO	***1**
Level D (30 ~ 39 Points)	**YES**	NO	***2**
Level E (40 ~ 49 Points)	YES	**NO**	***3**

[Table J 08] Establishing Green Designation Level Imposing Additional Costs for Industrial/Warehouse

	Remark
***1**	Only one project confessed green components imposed additional costs on the building. However, it has been revealed that the project reaches **59%** of energy performance enhancement, and they are looking at more than **7.5**-year payback on the entire green design features.
***2**	Only the projects that reach more than **40%** of energy performance enhancement (**6 Points** in energy performance) confessed they invested additional funds on green design features.
***3**	The only project at Level E was built in market rate without imposing any additional costs on green design features.

Accordingly, through an analysis of the implications in the tables above – [Table J 06, J 07 and J 08], it is believed that the performance at Level E – 40 ~ 49 points of LEED™ Gold Rated – becomes the reasonable green performance by securing the following both critical concerns at once for Industrial/Warehouse if the energy performance is targeted to design **6 points (40%** of energy performance enhancement) and less:

1. Keeping pace with cutting-edge green buildings to gain positive media exposure
2. Building a environmentally responsible building within economic feasibility

Additionally, it is also believed that the inferior green buildings in energy performance should be relatively more stringent on the other four green design performances – Sustainable Sites, Water Efficiency, Materials & Resources and Indoor Environmental Quality – than other superior green buildings in energy performance.

Therefore, the possible green design performance intensities are shown in Table I 06-2 for Industrial/Warehouse. The suggested Green Design Performance Intensities have been outputted from the patterns of the existing projects in the database, and one of the models – Type B – is exemplified in Table J 09.

	SS/14	WE/5	MR/13	IEQ/15	Energy Performance
Type A	8 Points 57 %	3 Points 60 %	6 Points 46 %	10 Points 67 %	**6 of 10 Points**
Type B	7 Points 50 %	2 Points 40 %	8 Points 61 %	11 Points 73 %	**6 of 10 Points**

[Table J 09] Suggested Green Design Performance Intensities for Industrial/Warehouse

Type B	Description
Project Name	Herman Miller SQA
Project Type	Industrial/Warehouse
Building Type	New Construction
Project Size	290,000 SF
Owner	Herman Miller
Contact	William A. McDonough
Completion Year	1995
City	Zeeland
State/Province	MI-Michigan
Country	USA
Green Design Features	
Sustainable Sites	Site sensitivity in building placement. Used natural drainage, native plantings, and constructed wetlands to break down pollutants.
Water Efficiency	Water and sewer costs have decreased 65%.
Materials & Resources	Designated recycling areas. In manufacturing operations 85% of water is recycled. Striving to be a waste-free company.
Indoor Environmental Quality	Good indoor air quality. Strove for zero off-gassing materials.

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Sustainable Sites

Sustainable Sites		6
Prereq 1	**Erosion & Sedimentation Control**	Yes
Credit 1	**Site Selection**	1
Credit 2	**Urban Redevelopment**	
Credit 3	**Brownfield Redevelopment**	
Credit 4.1	**Alternative Transportation,** Public Transportation Access	
Credit 4.2	**Alternative Transportation,** Bicycle Storage & Changing Rooms	
Credit 4.3	**Alternative Transportation,** Alternative Fuel Refueling Stations	
Credit 4.4	**Alternative Transportation,** Public Transportation Access	
Credit 5.1	**Reduced Site Disturbance,** Protect or Restore Open Space	1
Credit 5.2	**Reduced Site Disturbance,** Development Footprint	1
Credit 6.1	**Stormwater Management,** Rate and Quality	1
Credit 6.2	**Stormwater Management, Treatment**	1
Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands,** Non-Roof	1
Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands,** Roof	
Credit 8	**Light Pollution Reduction**	

Water Efficiency

Water Efficiency		2
Credit 1.1	**Water Efficient Landscaping,** Reduce by 50%	0
Credit 1.2	**Water Efficient Landscaping,** No Potable Use or No Irrigation	0
Credit 2	**Innovative Wastewater Technologies**	0
Credit 3.1	**Water Use Reduction,** 20% Reduction	1
Credit 3.2	**Water Use Reduction,** 30% Reduction	1

Materials & Resources

Materials & Resources		8
Prereq 1	**Storage & Collection of Recyclables**	Yes
Credit 1.1	**Building Reuse,** Maintain 75% of Existing Shell	1
Credit 1.2	**Building Reuse,** Maintain 100% of Existing Shell	1
Credit 1.3	**Building Reuse,** Maintain 100% of Shell & 50% of Non-shell	
Credit 2.1	**Construction Waste Management,** Divert 50%	1
Credit 2.2	**Construction Waste Management,** Divert 75%	1
Credit 3.1	**Resource Reuse,** Specify 5%	0
Credit 3.2	**Resource Reuse,** Specify 10%	0
Credit 4.1	**Recycled Content,** Specify 25%	1
Credit 4.2	**Recycled Content,** Specify 50%	1
Credit 5.1	**Local/Regional Materials,** 20% Manufactured Locally	1
Credit 5.2	**Local/Regional Materials,** of 20% Above, 50% Harvested Locally	
Credit 6	**Rapidly Renewable Materials**	
Credit 7	**Certified Wood**	1

Indoor Environmental Quality	**Indoor Environmental Quality**		**11**
	Prereq 1	**Minimum IAQ Performance**	Yes
	Prereq 1	**Environmental Tobacco Smoke (ETS) Control**	Yes
	Credit 1	**Carbon Dioxide (CO2) Monitoring**	1
	Credit 2	**Increase Ventilation Effectiveness**	0
	Credit 3.1	**Construction IAQ Management Plan,** During Construction	1
	Credit 3.2	**Construction IAQ Management Plan,** Before Occupancy	0
	Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants	1
	Credit 4.2	**Low-Emitting Materials,** Paints	1
	Credit 4.3	**Low-Emitting Materials,** Carpet	1
	Credit 4.4	**Low-Emitting Materials,** Composite Wood	0
	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
	Credit 6.1	**Controllability of Systems,** Perimeter	1
	Credit 6.2	**Controllability of Systems,** Non-Perimeter	0
	Credit 7.1	**Thermal Comfort,** Comply with ASHRAE 55-1992	1
	Credit 7.2	**Thermal Comfort,** Permanent Monitoring System	1
	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
	Credit 8.2	**Daylight & Views,** Daylight 90% of Spaces	1

[Table J 10] Project Description of Type B in Industrial/Warehouse

As shown in [Table I 04], [Table J 04] and [Table J 09], the suggested green design performance intensities are somewhat different in each project type even if they are all at Level E. The difference is 3 ~ 6 points that influences about 4 ~ 8% on the entire green performance, and the green buildings for Institutional/Educational have the best performance among those three project types [Table K].

However, the differences are insignificant and it is believed that each project type has slightly different own targets to achieve for the needs in the marketplace. For example, the green buildings for Institutional/Educational beyond Level E reach 100% performance in the category of Water Efficiency. Not surprisingly, they assert that it is because of the needs for being a good example and educating the public.

Project Type		SS/14	WE/5	MR/13	IEQ/15	EP/10	Suggested Total Points
Commercial /Office	**Type A**	10 Points	4 Points	7 Points	9 Points	6 Points	**36**
	Type B	8 Points	4 Points	10 Points	9 Points	6 Points	**37**
	Type C	10 Points	3 Points	7 Points	11 Points	6 Points	**37**
Institutional /Educational	**Type A**	9 Points	5 Points	7 Points	12 Points	6 Points	**39**
	Type B	10 Points	5 Points	5 Points	10 Points	6 Points	**36**
	Type C	11 Points	5 Points	6 Points	11 Points	6 Points	**39**
Industrial /Warehouse	**Type A**	8 Points	3 Points	6 Points	10 Points	6 Points	**33**
	Type B	7 Points	2 Points	8 Points	11 Points	6 Points	**34**

[Table K] Suggested Green Design Performance Intensities for each Project Type

Consequently, as proved in Part 2, 3 of Chapter IV & Part 1 of Chapter V, it is very obvious that energy performance **10** of total 69 points (**15 %** of total contribution) has the most contribution to the entire green performance of environmentally responsible buildings and becomes a critical indicator to determine the whole construction cost because of the significant weight that could cause additional costs on green design features.

However, it has been also revealed that the energy performance elevation is not evident at all green designation levels (Level A ~ G) by an analysis of the results in Part 2, 3 of Chapter IV. For example, for Commercial/Office buildings, over **33%** of the official buildings within 20 ~ 29 points (LEED Certified) has **zero** energy performance elevation and **33%** of them has only **10%** of energy performance elevation, so about two third of them has only **0 ~ 10%** of energy performance elevation that surpasses ASHRAE/IESNA 90.1-1999, but they still shows **38 ~ 42%** (26 ~ 29 points) of enhanced green performance acquired from the other categories – Sustainable Sites, Water Efficiency, Materials & Resources and Indoor Environmental Quality – when compared to conventional commercial/office buildings. Moreover, even **67%** of the official buildings within the 30 ~ 39 points (LEED Silver Rated) has only **15 ~ 25%** energy performance elevation but shows significant **44 ~ 57%** (30 ~ 39) of enhanced green performance.

Therefore, the results suggest that "Green Buildings do not always mean cutting edge energy efficient buildings and nor do they cost more than Conventional Buildings.

CHAPTER VI CONCLUSION B

A Comparative Review of "The Costs and Financial Benefits of Green Buildings"

The report, "The Costs and Financial Benefits of Green Buildings", was developed for the Sustainable Building Task Force, a group of over 40 California state government agencies in October 2003. Funding for this study was provided by the Air Resources Board (ARB), California Integrated Waste Management Board CIWMB), Department of Finance (DOF), Department of General Services (DGS), Department of Transportation (Caltrans), Department of Water Resources (DWR), and Division of the State Architect (DSA). This collaborative effort was made possible through the contributions of Capital E, Future Resources Associates, Task Force members, and the United States Green Building Council. The cost analysis of 33 LEED project in this report is intended to counter the widespread perception in the real-estate industry that building green is significantly more expensive than traditional methods of development. A half dozen California developers interviewed in 2001 estimated that green buildings cost 10% to 15% more than conventional buildings.

The cost data was gathered on 33 individual LEED registered projects (25 office buildings and 8 school buildings) with actual or projected dates of completion between 1995 and 2004. Those 33 projects were chosen because relatively solid cost data for both actual green design and conventional design was available for the same building. See below for a complete list of 33 projects, their LEED levels and green premiums.

Project	Location	Type	Date Completed	Green Cost Premium	Green Standard
Energy Resource Center[1]	Downey, CA	Office	1995	0.00%	Level 1-Certified
KSBA Architects[1]	Pittsburgh, PA	Office	1998	0.00%	Level 1-Certified
Brengel Tech Center[1]	Milwaukee, WI	Office	2000	0.00%	Level 1-Certified
Stewart's Building[2]	Baltimore, MD	Office	2003	0.50%	Level 1-Certified
Pier One[3]	San Francisco, CA	Office	2001	0.70%	Level 1-Certified
PA EPA S. Central Regional[1]	Harrisburg, PA	Office	1998	1.00%	Level 1-Certified
Continental Towers[11]	Chicago, IL	Office	1998	1.50%	Level 1-Certified
Cal EPA Headquarters[3]	Sacramento, CA	Office	2000	1.60%	Level 1-Certified
EPA Regional[4]	Kansas City, KS	Office	1999	0.00%	Level 2-Silver
Ash Creek Intermed. School[10]	Independence, OR	School	2002	0.00%	Level 2-Silver
PNC Firstside Center[1]	Pittsburgh, PA	Office	2000	0.25%	Level 2-Silver
Clackamas High School[10]	Clackamas, OR	School	2002	0.30%	Level 2-Silver
Southern Alleghenies Museum[2]	Loretto, PA	Office	2003	0.50%	Level 2-Silver
DPR-ABD Office Building[5]	Sacramento, CA	Office	2003	0.85%	Level 2-Silver
Luhrs Univ. Elementary[2]	Shippensburg, PA	School	2000	1.20%	Level 2-Silver
Clearview Elementary[2]	Hanover, PA	School	2002	1.30%	Level 2-Silver
West Whiteland Township[2]	Exton, PA	Office	2004	1.50%	Level 2-Silver
Twin Valley Elementary[2]	Elverson, PA	School	2004	1.50%	Level 2-Silver
Licking County Vocational[2]	Newark, OH	School	2003	1.80%	Level 2-Silver
3 Portland Public Buildings[17]	Portland, OR	Office	since 1994	2.20%	Level 2-Silver
Nidus Center of Science[1]	Creve Coeur, MO	Office	1999	3.50%	Level 2-Silver
Municipal Courts[1]	Seattle, WA	Office	2002	4.00%	Level 2-Silver
St. Stephens Cathedral[12]	Harrisburg, PA	School	2003	7.10%	Level 2-Silver
4 Times Square[6]	New York City	Office	1999	7.50%	Level 2-Silver
PA DEP Southeast[4]	Norristown, PA	Office	2003	0.10%	Level 3-Gold
The Dalles Middle School[10]	The Dalles, OR	School	2002	0.50%	Level 3-Gold
Dev. Resource Center[8]	Chattanooga, TN	Office	2001	1.00%	Level 3-Gold
PA DEP Cambria[2]	Ebensburg, PA	Office	2000	1.20%	Level 3-Gold
PA DEP California[2]	California, PA	Office	2003	1.70%	Level 3-Gold
East End Complex-Blk 225[7]	Sacramento, CA	Office	2003	6.41%	Level 3-Gold
Botanical Garden Admin[9]	Queens, NY	Office	2003	6.50%	Level 4-Platinum

[Table L] Complete List of 33 projects, their LEED Levels and Green Premiums

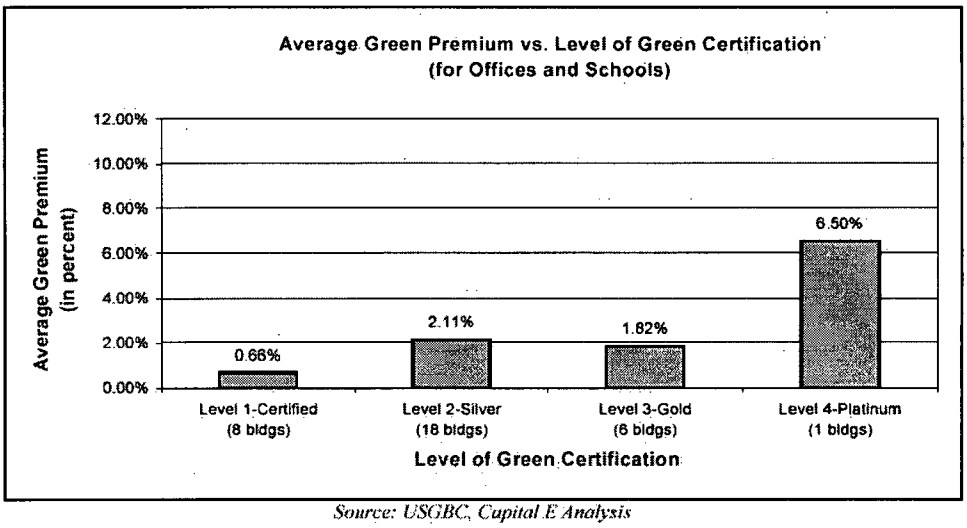
PART 1. Is the Premium for Green Buildings about 2%?

According to the report, on average, the premium for green buildings is about 2%. The eight rated Bronze level buildings had an average cost premium of less than 1%. Eighteen Silver-level buildings averaged a 2.1% cost premium. The six Gold buildings had an average premium of 1.8%, and the one Platinum building was at 6.5%. The average reported cost premium for all 33 buildings is somewhat less than 2% as shown in Figures H 01 and H 02.

Level of Green Standard	Average Green Cost Premium
Level 1 – Certified	0.66%
Level 2 – Silver	2.11%
Level 3 – Gold	1.82%
Level 4 – Platinum	6.50%
Average of 33 Buildings	1.84%

Source: USGBC, Capital E Analysis

[Fig. H 01] Green Designation Level and Average Green Cost Premium



Source: USGBC, Capital E Analysis

[Fig. H 02] Average Green Premium vs. Level of Green Certification

The conclusion and figures above indicate that while green buildings generally cost more than conventional buildings, the "green premium" is lower than is commonly perceived. As expected, the cost of green buildings generally rises as the level of greenness increases. However, the data anomaly is that averaged cost levels for LEED Gold buildings are slightly lower than for Silver buildings, whereas the higher performance level requirements to achieve Gold would be expected to cost more than Silver levels. At the same time, 5 of 16 LEED Silver buildings have higher cost premiums than the average green premium for LEED Gold buildings, and East End Complex Block 225 is considerably more expensive than the other Gold buildings.

If that was the case, one could argue that the average premium for green buildings is about 2%? Because of the following troublesome facts, the assertion from the report is controversial:

1. The averaged cost level cannot represent the definitive cost for green buildings.
2. The costs for green buildings are various on applied green design features and the intensities.

Furthermore, a cost analysis of green buildings should not be assumed by measuring the average costs for green buildings, but disclosed by finding out the green design components (Analogs) that impose additional costs on a green building or reduce capital costs. For example, when PA DEP Cambria – a LEED Gold building that imposed 1.20% of additional costs from Table L – is dug up to find out what could have been the factors that added costs on the building, an analysis has been attempted below through a detailed review of its green performance intensity.

	SS/14	WE/5	MR/13	IEQ/15	EA/17
PA DEP Cambria	6 Points 43 %	4 Points 80 %	5 Points 38 %	13 Points 87 %	14 Points 82 %
Official (40 ~ 49) See Fig. F 04	58 %	70 %	47 %	73 %	56 %
Increase & Decrease	⇓ 15 %	⇑ 10 %	⇓ 9 %	⇑ 14 %	⇑ 26 %

[Table M] Green Design Performance Intensities for PA DEP Cambria

The table above indicates that the green performance intensities increase in the categories of Water Efficiency, Indoor Environmental Quality and Energy & Atmosphere, whereas decline in the categories of Sustainable Sites and Materials & Resources. Especially, considering the contribution level to the entire green performance, the performance increase is considerable in the category of Energy & Atmosphere.

As identified in Conclusion A, the green buildings that reach more than **40%** of energy performance enhancement (**6 Points** in energy performance) impose additional funds on green design features, but Cambria building surpasses the LEED™ requirement as reaching dramatic **66%** of energy performance enhancement and achieves the full mark of 8 points in energy performance.

Currently, waste reduction strategies such as reuse and recycling, as promoted in the category of Materials & Resources, help to divert waste from being disposed of in landfills. Diversion strategies result in savings associated with avoided disposal costs as well as in reduced societal costs of landfill creation and maintenance. Nevertheless, the performance intensity of Materials & Resources in Cambria would rather decline than the average performance intensity of

Materials & Resources for LEED™ Gold Commercial/Office buildings in spite of the saving potential. Therefore, in Part 2 of Conclusion B, the alternatives that embody highly environmentally responsible and reasonable, or even cheaper green buildings will be introduced through tuning the green performance intensities of green buildings.

PART 2. Building a Green Building With No Added Cost

As of July 2003, Green Database Version 1.0 under the criteria below was searched to find comparable projects containing the analogs that include the potential of cost savings.

1. Commercial/Office Building
2. LEED™ Gold Rated Building for maintaining high green performance
3. Recently completed building since 2000 for the trend
4. No additional cost on green design features or below conventional

Consequently, two projects below were selected from the Green Database Version 1.0 to indicate the alternatives for tuning the green performance intensities of green buildings, and their detailed previews have been displayed in Table N 01, Table N 02.

- Ecotrust-Jean Vollum Natural Capital Center
- Vancouver Island Technology Park

Case Study A	Description
Project Name	Vancouver Island Technology Park
Project Type	Commercial/Office
Building Type	Major Renovation
Project Size	171,750 SF
Owner	BC Buildings Corporation
Contact	Idealink Architects; Bunting Coady Architects
Completion Year	2001
City	Vancouver
State/Province	BC-British Columbia
Country	Canada

Green Design Features	
Sustainable Sites	*Brownfield Redevelopment* Redeveloping this abandoned hospital facility involved checking for soil contamination and removal of asbestos and underground storage tanks. *Alternative Transportation* Negotiated extensions of several bus routes to site; bicycle parking and showers for 18% of users; negotiated reduction of municipal parking requirements by 50%; designated carpool parking. *Reduced Site Disturbance* Allowing previously irrigated turf area to restore itself naturally and planting native plants and trees restored 97.8% of degraded habitat. A no-build covenant protects treed areas.
Water Efficiency	*Stormwater Management* 100% of stormwater is treated and infiltrated on site through use of grass swales, grass gravel pave system and stormwater treatment and retention ponds. *Water Efficient Landscaping* Native plants and natural meadows require no permanent irrigation. *Water Use Reduction* Water consumption reduced by 33% through use of dual flush toilets, waterless urinals, electronic sensors on faucets, and flow showerheads.
Materials & Resources	*Building Reuse* Reuse 100% of existing structure and 91% of existing shell. *Construction Waste Management* 99% of construction waste was salvaged or recycled, saving $600,000 and costing 60% less than other contractor bids. *Resource Reuse* Salvaged materials comprise 8% of total materials.

	Recycled content 33% of materials, measured by LEED's weighed cost value, contain post-consumer and/or post-industrial recycled content (e.g., rebar, millwork, insulation, aluminum panels and rubber flooring). *Local/Regional Materials* 31% materials were manufactured within 500 miles, including grass/gravel pavers, concrete, wood, aluminum panels, roofing, siding, windows, wallboard, carpeting and paint.
Energy & Atmosphere	*Optimize Energy Performance* Exceeds ASHRAE/IESNA 90.1-1999 by 28%; strategies include occupancy sensors to control lighting, CO2 demand ventilation control and Optimal Start system to control fan start times.
Indoor Environmental Quality	*Low-Emitting Materials* All adhesives, sealants, carpets and composite wood emit low or no VOCs

Green Performance Intensities

SS/14	WE/5	EA/17	MR/13	IEQ/15
10 Points	4 Points	6 Points	7 Points	9 Points
71 %	80 %	35 %	54 %	60 %

[Table N 01] Project Description of Vancouver Island Technology Park

In addition to the general project descriptions above, for the process of finances, the original budget and project timing for *Vancouver Island Technology Park* was set before the decision to build green was made. Renovation projects are often problematic due to unexpected costs because of pre-existing building conditions. Yet despite these costs, the project was built on budget and on time. Not only had the environmental techniques and not cost more, the savings from construction waste reduction helped cover unexpected costs. Further, several green building initiatives undertaken at VITP have generated economic opportunity to the local economy from new manufacturing opportunities to the generation of electricity from landfill gas utilization.

Case Study B	Description
Project Name	Ecotrust-Jean Vollum Natural Capital Center
Project Type	Commercial/Office Building
Building Type	Major Renovation
Project Size	70,000 SF
Owner	Ecotrust
Contact	Diane Dalcon
Completion Year	2001
City	Portland
State/Province	OR-Oregon
Country	USA
Green Design Features	
Sustainable Sites	*Site Selection* Reused a warehouse built in 1895 *Urban Redevelopment* Part of revitalization effort in Portland's historic Pearl District. *Alternative Transportation* Portland streetcar and seven bus stops within ¼ mile of building; bicycle parking available for 47% of building occupants, showers for 27% and lockers for 60%; two alternative fuel car-sharing vehicles located on site with corresponding refueling stations. *Reduced Heat Islands* Fast growing native trees provide shading of impervious surfaces; light colored paving.

Water Efficiency	*Stormwater Management* Impervious area of the site reduced by 26% by adding planters, landscaping islands, porous pavement, vegetative swales and a roof garden; infiltration swale recharges groundwater while removing 100% TSS and 100% TP. *Water Efficient Landscaping* Native plantings adapted to local conditions; no irrigation required after one year. *Water Use Reduction* 33% reduction.
Materials & Resources	*Building Reuse* Over 75% of exterior structure and shell and interior non-shell elements of original building retained; deconstructed materials reused in rehabilitation of building; reused all flooring. *Construction Waste Management* 98% of constructed materials recycled/salvaged. *Resource Reuse* Salvaged materials comprised 10% of total. Included stone, brick, lumber, paneling, moldings, heavy timbers and doors. *Recycled Content* Over 50% of materials, as calculated by USGBC's weighted cost value, contain recycled content. Includes concrete mixed with fly ash, steel (90-96% recycled content), insulation, resilient flooring, carpeting and interior paint (100% recycled latex). *Local/Regional Materials* 34% of materials were manufactured locally, including salvaged materials, lumber, concrete, structural steel and doors. *Certified Sustainably Harvested Wood* 66% of new wood was from forests certified by the Forest Stewardship Council, including nominal lumber, plywood, decking and windows.

Energy & Atmosphere	*Optimize Energy Performance* Exceeds ASHRAE 90.1-1999 by 21.4% using a VAV system for common areas only, wider indoor temperature range for summer/winter, operable windows with HVAC overrides, daylighting and additional roof insulation.
Indoor Environmental Quality	*Construction IAQ Management Plan* HVAC system protected during construction and flushed out after construction, before occupancy. *Indoor Chemical & Pollutant Source Control* Natural fiber mats provided at all entrances; janitors closets independently ventilated and isolated with deck-to-deck walls. *Daylight & Views* Daylighting reaches more than 75% of occupied spaces; more than 90% of spaces have access to outside views.

Green Performance Intensities

SS/14	WE/5	EA/17	MR/13	IEQ/15
8 Points	4 Points	5 Points	10 Points	9 Points
57 %	80 %	30 %	77 %	60 %

[Table N 02] Project Description of Ecotrust-Jean Vollum Natural Capital Center

In addition to the general project descriptions above, for the process of finances, the building has not experienced any cost increases because of their green building efforts. Most of the added cost is in the design fees at about an 8 % increase, whereas the Green Cost Premiums of the equally scored projects on green design features are 4% to 6% of the total construction costs.

For the purpose of establishing what are the factors that add costs on high performance green buildings, comparisons of Green Performance Intensities with the same level of projects that achieve the same LEED™ Score (**41 Points**) have been displayed in Table N 03.

Project	SS/14	WE/5	EA/17	MR/13	IEQ/15
Vancouver Island	10 Points	4 Points	**6 Points**	**7 Points**	9 Points
Technology Park	71 %	80 %	**35 %**	**54 %**	60 %
Ecotrust-Jean Vollum	8 Points	4 Points	**5 Points**	**10 Points**	9 Points
Natural Capital Center	57 %	80 %	**30 %**	**77 %**	60 %
Equally Scored Projects	9 Points	3 Points	**9 Points**	**5 Points**	10 Points
	64 %	60 %	**53 %**	**38 %**	67 %

[Table N 03] Comparisons of Green Performance Intensities with the Same Level of Projects

As described above, the two projects – Vancouver Island Technology Park, Ecotrust-Jean Vollum Natural Capital Center – and the equally scored projects have the same fundamental profiles because of the identical criteria (*Commercial/Office Building, LEED™ Gold Rated Building for maintaining high green performance, Recently completed building since 2000 for the trend*). If that was the case, what are the concealed factors that impose additional costs on the buildings or not?

Firstly, as indicated in Table N 03, the green performance intensities of the equally scored projects are different from the first two buildings. In the case of the other equally scored projects, they are Energy & Atmosphere intensified buildings, and also their energy performances – in other words, Energy Efficiency – reach 45 to 60% (5 ~ 8 points in LEED Score System). On the other hand, considering the contribution level to the entire green performance, the first buildings – Vancouver Island Technology Park, Ecotrust-Jean Vollum Natural Capital Center – are very Materials & Resources oriented buildings. Furthermore, their energy performances are 28% and 21.4% but 6 and 4 Points in LEED Score System due to 10% incentive in the credit of Optimize Energy Performance for major renovation.

The strategies from the first two buildings – Vancouver Island Technology Park, Ecotrust-Jean Vollum Natural Capital Center – that promote reuse and recycling strategies are shown in Table N 04.

Category	Strategy	
Building Reuse	*VTIP*	Reuse 100% of existing structure and 91% of existing shell.
	JVNCC	Over 75% of exterior structure and shell and interior non-shell elements of original building retained; deconstructed materials reused in rehabilitation of building; reused all flooring.
Construction Waste Management	*VTIP*	99% of construction waste was salvaged or recycled, saving $600,000 and costing 60% less than other contractor bids.
	JVNCC	98% of constructed materials recycled/salvaged.
Resource Reuse	*VTIP*	Salvaged materials comprise 8% of total materials.
	JVNCC	Salvaged materials comprised 10% of total. Included stone, brick, lumber, paneling, moldings, heavy timbers and doors.
Recycled Content	*VTIP*	33% of materials, measured by LEED's weighed cost value, contain post-consumer and/or post-industrial recycled content (e.g., rebar, millwork, insulation, aluminum panels and rubber flooring).
	JVNCC	Over 50% of materials, as calculated by USGBC's weighted cost value, contain recycled content. Includes concrete mixed with fly ash, steel (90-96% recycled content), insulation, resilient flooring, carpeting and interior paint (100% recycled latex).
Local/Regional Materials	*VTIP*	31% materials were manufactured within 500 miles, including grass/gravel pavers, concrete, wood, aluminum panels, roofing, siding, windows, wallboard, carpeting and paint.
	JVNCC	34% of materials were manufactured locally, including salvaged materials, lumber, concrete, structural steel and doors.
Certified Wood	*VTIP*	N/A
	JVNCC	66% of new wood was from forests certified by the Forest Stewardship Council, including nominal lumber, plywood, decking and windows.

[Table N 04] Detailed Description of Reuse and Recycling Strategies

Nevertheless, the equally scored green buildings newly constructed still record 5 Points in average from the category of Materials & Resources as adopting strategies such as Construction Waste Management, Recycled Content, Local/Regional Materials and Certified Wood. This does not imply that 2 ~ 5 points of the performance improvement in Materials & Resources offsets 4 to 6% of the total construction cost and maintains the high green performance by itself. The first two buildings – Vancouver Island Technology Park, Ecotrust-Jean Vollum Natural Capital Center – had been built through a major renovation. That distinction offers the privileges that benefit the renovated green buildings as identified below.

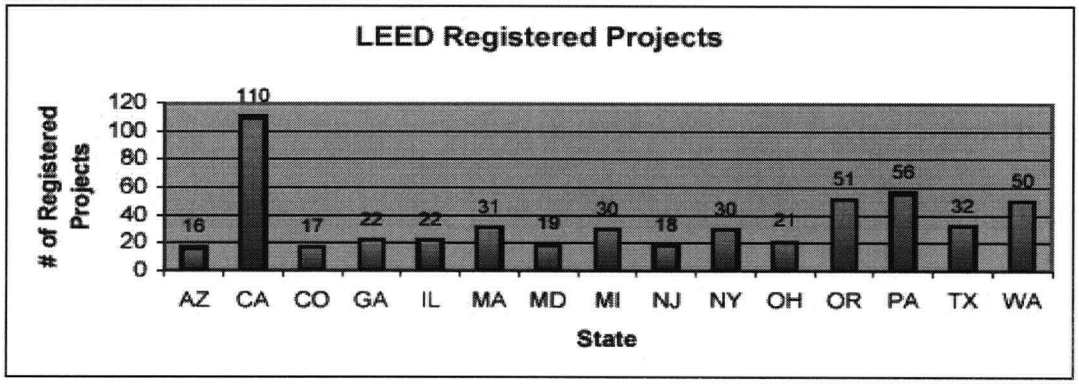
1. Reducing the construction cost by retaining exterior structure, shell and interior non-shell elements of original building and reusing deconstructed materials in rehabilitation of building.

2. Acquiring additional **2 points** in energy performance and possible **4 points** in total along with the credit of Building Reuse. LEED™ Rating System offers **10%** of the energy efficiency incentive for renovated green buildings. Therefore, renovated green buildings can avoid being an energy efficiency oriented building to become green, and boast their same high green performance at once.

Consequently, not just because of helping to divert some waste from being disposed of in landfills and catalyzing further economic growth in industries that reprocess diverted waste and use recycled raw materials, building reuse should be promoted and seriously considered from the beginning because of embodying not an expensive green building. Moreover, building reuse is a key environmentally responsible strategy.

Establishing the Geographic Influence on Green Designation Level & Intensity by Analyzing the Implications of Energy-Industry Structure

There are more LEED registered projects within California – Over 110 as of August 2003 – than in any other state [Fig. I 01] along with five certified LEED projects as of July 2003 [Fig. I 02]. In 2001, in support of state greening efforts, California's Sustainable Building Task Force developed the LEED supplement for California State Facilities. This regionalized supplement to LEED 2.0 is intended for guidance purposes and is not required for use in state projects. It provides information on California codes, policies and practices and is hosted on the CIWMB's website[6] for public use, though it has not been officially adopted.



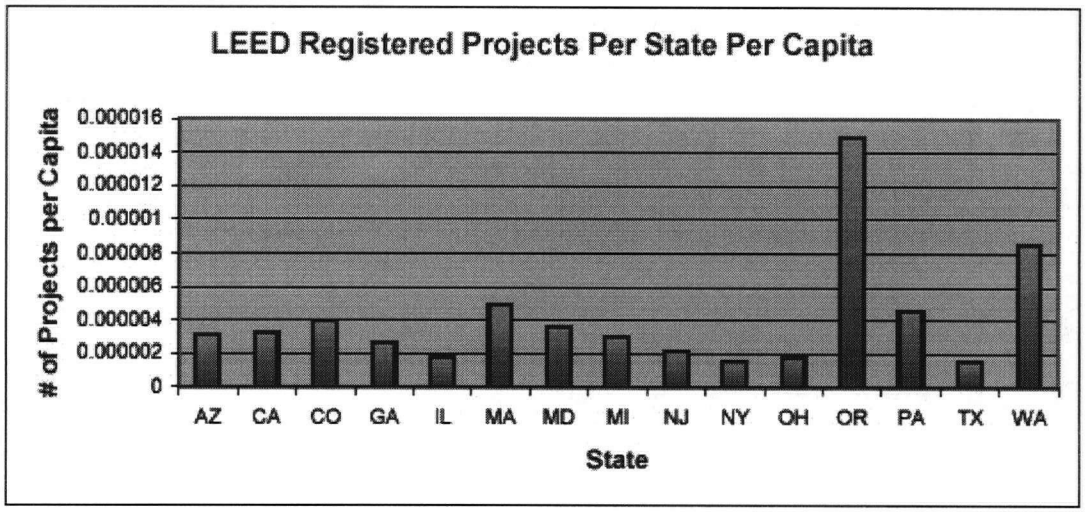
[Fig. I 01] LEED Registered Projects in the United States of America, Source: U.S. Green Building Council

[Fig. I 02] LEED Certified Projects Distribution in the United States of America

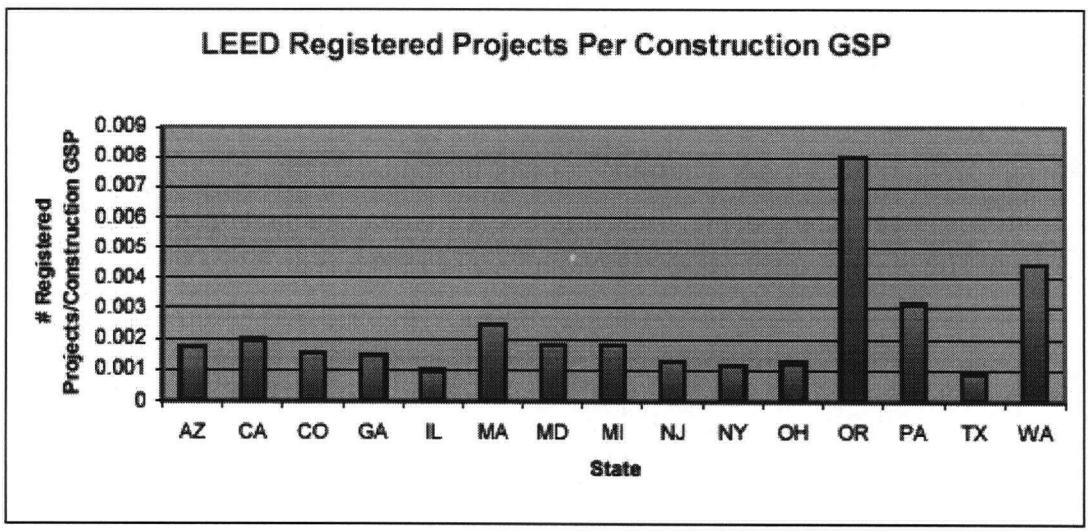
[6] **See: http://www.ciwmb.ca.gov/GreenBuilding/.** California Integrated Waste Management Board Green Building Website

On the local level, LEED has been adopted in a number of California municipalities. The city of San Jose, San Francisco city and county, the city of San Diego, the city of Santa Monica, San Mateo County, and Los Angeles city and county all made commitments to LEED. The city of Oakland and Alameda County and have developed their own LEED-based green building guidelines. The city of Pleasanton recently passed an ordinance requiring both public and private buildings to meet the standards of LEED Certified level, subject to a few modifications.

However, although more registered projects are located in California than any other state, Pennsylvania, Massachusetts, Washington and Oregon have the most extensive, documented experience with green building and LEED. Particularly, in Oregon, there are most LEED registered projects Per Capita and Per Construction GSP, as shown in figures I 03, 04.



[Fig. I 03] LEED Registered Projects Per State Per Capita, Source: U.S. Green Building Council



[Fig. I 04] LEED Registered Projects Per Construction GSP, Source: U.S. Green Building Council

Therefore, for the purpose of establishing the geographic influence on green designation level and intensity, their efforts of eco-industry on building green and the implications have been analyzed in Chapter VII.

PART 1. Green Performance Level & Intensity Distribution of National Green Building Leaders

To indicate the green performance level and intensity distribution in each state, only certified LEED commercial/office projects in California, Oregon and Pennsylvania from Green Database Version 1.0 were considered and analyzed due to the momentous meaning to the states as national dominant green building leaders and for the reliance of statistics.

	Performance	SS/14	WE/5	EA/17	MR/13	IEQ/15
California	**41.7** (Pts)	**8.3 (Pts)** **59 %**	**3.0 (Pts)** **60 %**	**9.4 (Pts)** **55 %**	5.7 (Pts) 44 %	**10.7 (Pts)** **71 %**
Oregon	34.5 (Pts)	**7.8 (Pts)** **55 %**	**3.0 (Pts)** **60 %**	6.3 (Pts) 37 %	**7.5 (Pts)** **57 %**	6.8 (Pts) 45 %
Pennsylvania	29.5 (Pts)	6.5 (Pts) 46 %	2.0 (Pts) 30 %	6.5 (Pts) 38 %	3.3 (Pts) 25 %	6.8 (Pts) 45 %
Certified Projects Average	**33.1** (Pts)	(30~39 Pts) **51 %**	(30~39 Pts) **55 %**	(30~39 Pts) **38 %**	(30~39 Pts) **42 %**	(30~39 Pts) **55 %**

[Table N 05] Green Designation Levels & Performance Intensities in California, Oregon, Pennsylvania

From the green designation levels and performance intensities indicated in Table N 05, resourceful facts are established as following:

1. The certified buildings in California are more aggressive by achieving 41.7 points of green performance than in any other state.

2. All performance intensities of the certified projects in California surpass them of the certified projects average. Especially, the performance intensities are remarkable in the category of Energy & Atmosphere and Indoor Environmental Quality compared to them of the certified projects average by surpassing 17 and 16% (about 3 and 2 Points more).

3. The certified buildings in Oregon have slight performance difference with the certified projects average by achieving 34.5 points of green performance.

4. The performance intensities of the certified buildings in Oregon are within the range of the certified projects average. However, the performance intensity in the category of Materials & Resources has better performance than the certified projects average by surpassing 15% (about 2 points more).

5. The certified buildings in Pennsylvania have relatively inferior green performance and green performance intensities than the certified projects average.

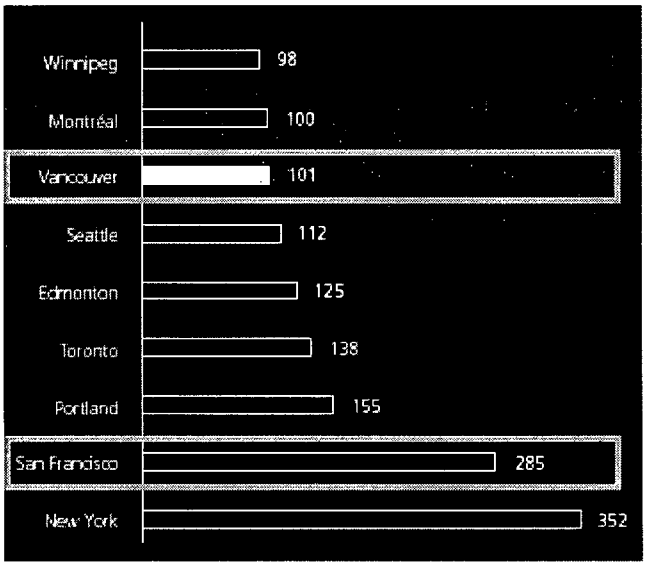
Therefore, California and Oregon were selected for national green building leaders in terms of satisfying both sustaining high green performance and more number of completed certified buildings than other states.

PART 2. Analyzing the Implications of Green Performance Level & Intensity in California and Oregon

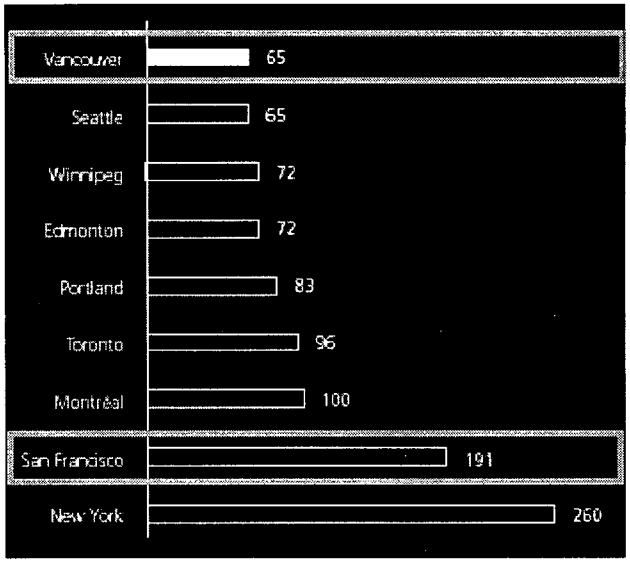
In part 2 of Chapter VII, the factors and implications of the green performance levels & intensities in California and Oregon are revealed out by analyzing the energy-industry structure.

PART 2-1. Energy Cost in California

The energy performance standard in California is Title 24. Since Title 24 is more rigorous than the prevailing ASHRAE standard, it might be expected that energy reduction efforts in California green buildings would be less than for LEED buildings nationally. However, this does not appear to be the case. In fact, the performance intensities are significantly higher in the category of Energy & Atmosphere and Indoor Environmental Quality compared to the average of certified projects by surpassing the average by 17 and 16% (about 3 and 2 Points) respectively. The reasons for this may include relatively high California energy prices [Fig. I 05], [Fig. I 06] (and recent price increases) that would tend to increase incentives for more aggressive energy reduction measures, and the existence of California standards in areas other than energy – such as indoor environmental quality – that provide a higher baseline for non-energy performance for California sustainable buildings, and that may make energy improvements below the Title 24 baseline not more costly relative to other dimensions of green design.



[Fig. I 05] Comparative Index of Electricity Prices (Residential), Source: The annual report from B.C. Hydro



[Fig. I 06] Comparative Index of Electricity Prices (Commercial), Source: The annual report from B.C. Hydro

As a result of the energy crisis in California and various Flex-Your-Power energy efficiency campaigns, the State has already reduced electricity use in most buildings by close to 20%. Absolute energy savings typical of green buildings will be lower for energy efficient state buildings, which have already realized much of the benefit associated with energy efficiency.

PART 2-2. Incentive Programs for Energy Savings in California and Oregon

Higher up-front costs have often prevented consumers from purchasing energy-efficient products and design services. In an attempt to overcome this price barrier, several legislatures

have established funds to assist consumers. The funds are awarded in the form of a grant or loan. Grants are one-time funding packages, while loans must be repaid, with interest, over a certain time. Many states offer these loans at low interest rates between 3 percent and 5 percent. Often, a consumer can repay its loan using the funds it would have otherwise spent on energy. At least eight states have established a grant or loan program for equipment for improvements such as more-efficient lighting, boilers, heating/ventilating/air conditioning systems, and control systems to manage energy use.

For instance, the California Energy Commission is the state's primary energy policy and planning agency. Created by the Legislature in 1974 and located in Sacramento, the Commission has five major responsibilities:

- Forecasting future energy needs and keeping historical energy data
- Licensing thermal power plants 50 megawatts or larger
- Promoting energy efficiency through appliance and building standards
- Developing energy technologies and supporting renewable energy
- Planning for and directing state response to energy emergency

With the signing of the Electric Industry Deregulation Law (Assembly Bill 1890), the Commission's role includes overseeing funding programs that support public interest energy research; advance energy science and technology through research, development and demonstration; and provide market support to existing, new and emerging renewable technologies. In the mean time, the California Energy Commission is providing low-interest loans to cities, counties and special districts for energy saving projects. Loans are offered at 3.95 percent interest for the installation of energy management systems, renewable energy projects and energy-saving lighting, heating, ventilating and air conditioning systems. The Energy Commission will lower the interest rate to 3.85 percent for projects that are completed and invoiced within nine months.

In addition, the California Energy Commission is offering a variety of incentive programs to promote energy efficiency in two broad sectors:

"Time-Limit" Solicitations

- Energy Cooperative Development Program Grant Funding
- Energy Efficiency Programs Funding Solicitations
- Energy Technology Export Program
- Public Interest Energy Research (PIER) Program Funding Solicitations

- Energy Innovations Small Grant Program
- Renewable Energy Rebate Program

"No Time-Limit" Solicitations

- Low-Interest Loans for Energy Efficiency Projects (The maximum loan amount per application has been increased to $3 million)

In Oregon, Oregon's Energy Loan Program was established in 1980. The program offers low-interest loans to promote energy conservation, renewable energy, alternative fuels, and recycled products. In addition to school districts, these loans are available to individuals, businesses, nonprofit organizations, tribes, special districts, and local and state governments. General obligation bonds provide funds for the loans. Between 1985 and September 2001, the Oregon Energy Office states that $18 million has been loaned to support energy-efficient measures in 90 school districts and community colleges. In addition to low-interest loans, there are numbers of incentives for renewable energy such as:

- Business Energy Tax Credit & Residential Energy Tax Credit
- Photovoltaic Electricity Production Incentive
- New Renewable Energy Resources Grants
- Small Scale Energy Loan Program (SELP)
- Solar Electric Buy-down Program
- Solar Water-Heating Buy-down Program

Especially, the Energy Trust of Oregon (Energy Trust), a nonprofit organization created to invest public purpose funding for energy efficiency and renewable energy in Oregon, began accepting applications for its Solar Electric Buy-down Program in May 2003. The program is available to customers of Pacific Power and PGE who install new photovoltaic systems on their new or existing homes, commercial and community buildings, farms, and municipal facilities.

Buy-down amounts for residential customers are currently $4.25/Watt DC installed, with a $12,750 cap per site. This incentive rate is good until at least 115 kW have been committed. At that time the incentive may be reassessed and further reduced over time to as low as $3.50/Watt.

Buy-down amounts for commercial customers are currently $2.25/watt DC installed, with a $35,000 cap per site. This incentive rate is good until at least 75 kW have been committed, and may decrease over time to as low as $2.00/Watt. When the buy-down program began in May 2003, buy-down amounts for residential customers were $2.50/watt DC installed, with a $7,000

cap per site. Buy-down amounts for commercial customers were $1.75/watt DC installed, with a $20,000 cap per site. These amounts were increased in August of 2003.

All PV systems must be grid-tied and net metered and no larger than 25 kW. Pre-approval of projects is required. The Energy Trust will provide referrals to contractors from their Trade Ally Network (self-installed systems will not qualify). The solar contractor you select will advise you on installation options and best siting designs to obtain the maximum performance and satisfaction from your solar electric system. The contractor will provide a system quote that estimates your PV system annual performance, installation date, and the cost after Energy Trust incentive deductions. After installation, the contractor will walk you through the system maintenance and operations, emergency contacts, system warranty and specifications, and will provide information on how to apply for the state tax credit. Once the Energy Trust approves your PV system, the buy-down incentive will be paid to your solar contractor and deducted from your final cost.

Other available incentives include a residential tax credit through the Oregon Office of Energy of $3.00/Watt, up to $1,500 maximum, and a business tax credit through the Oregon Office of Energy of approximately 35% of installed system cost applied over 5 years.

CHAPTER VIII CONCLUSION D

Green Performance Difference Between Public and Private Developments

Part 1 of Chapter IV illustrated the cutting edge green performance for public development is in the range of 50 ~ 59 points corresponded to LEED™ Platinum while the cutting edge performance for private development is in the range of 40 ~ 49 points corresponded to LEED™ Gold. This suggests that public development is in the position of leading the technology and educating the public. For that reason, they push the projects to the cutting edge with less anxiety of economic feasibility and marketability in contrast to private development. Moreover, even the suggested green design performance intensities are somewhat different in public and private development even if both developments are at the same level. The difference was 3 ~ 6 points that influence about 4 ~ 8% on the entire green performance, and the green buildings for public development have the superior green performance than private development as described in Part 1-2 of Chapter V. However, the difference of the cutting edge green performance between public and private developments leads another implication in terms of the types of financing sources for both developments.

Generally speaking, while public developments seek after federal or state funding, organization or individual donations and grants, private developments go after the sources of financing such as bank loans, venture capital, and private investment and the like.

For private developers, although green buildings do not have to cost more than conventional projects, and even if the market is willing to pay the premium price, they are facing another problem that lenders may not be willing to provide more financing. This is a problem the private developers face. Lenders are often presented with concepts they neither understand nor care about – they have heard too many oddball ideas and have seen too many architectural renderings. What they want to know are the projected cash flows, revenues, and expenses.

Lenders will better understand the benefits of resource efficiency if they see how it will reduce operating costs and affect net operating income, cash flow, and debt service mostly advantageous just for energy efficient buildings. Those trying to get financing for green buildings often miss the mark by failing to get financiers to understand the benefits of these projects in the financiers' own terms – not sustainability, diversity, or ecology, but return on investment, bottom line, and cash flow.

In general, the financial industry does not yet include the long-term economic implications of energy-saving design and other environmentally responsible measures in its definition of fiduciary responsibility. Energy is fairly easy to quantify, but such advantages as productivity and health are more difficult to put into dollar terms. In time, it is likely that financial tools will be developed that better account for life-cycle costs, resource depletion as a form of capital depletion, and the many benefits of green buildings that are described in this study. But for now, most of private green developers will have to pitch their arguments in ways that lenders relate to. This obstacle is one of the biggest reasons why the private developments are several steps behind the public development in terms of green performance at present.

While many private green developers have faced serious challenges in financing their projects in the marketplace, it is important to note that this is not always the case. Some financiers have been impressed by a project's attention to environmental and community issues. Inn of the Anasazi – **Case No. 72** in database – developer Robert Zimmer obtained his initial construction loan (a three-year construction/mini-permanent loan) from the Bank of America based on his track record and the bank's belief that Santa Fe – **Case No. 100** in database – represented a viable investment. In late 1994, though, when the developers refinanced their permanent loan through ITT Real Estate Financial Services, ITT's vice president noted that ITT wanted to be associated with this project because of its authentic commitment to environment and community, as well as the developer's track record.

While some current aspects of green buildings are perceived by lenders as negatives (lack of comps, untested markets, costs associated with land protection, etc), other features can be advantageous in seeking financing. Some of green buildings' advantages presented in this study accrue to future occupants, helping to ensure strong demand; others reduce project costs or reduce the likelihood of lawsuits.

In addition to the case studies exemplified above, some creative financing strategies for private green developers are introduced below to get lenders convinced with.

Reduced Capital Costs

Lower capital costs mean that the private developer does not need to borrow as much as money, which means lower exposure for the lender and less risk of default. There are many ways in which environmentally responsible planning, design, and construction can lead to lower capital costs. One of the most obvious is that careful energy design can permit downsizing – or even elimination – of mechanical equipment. Construction costs can be reduced through more

efficient use of materials, and waste minimization. And cost savings can accrue from more rapid construction schedules, which can result from careful front-end planning.

Reduced Operating Costs

Energy, water, maintenance, and disposal costs can all be dramatically reduced by using green design features. Not only will this benefit occupants, but also the savings can flow directly to the bottom line by providing more net operating income for the developer/owner and leading to higher building valuation.

A building's value relates to financing, because the building is used as collateral by the lenders. When operating costs drop, the value increases. Since loans are based on a percentage of a building's value, a building that is worth more should be able to receive a higher loan amount. While a larger loan means higher payments, these higher payments will be more offset by the income increase resulting from efficiency improvements. If lenders refuse to recognize this fact and give a borrower less money than desired, at least the owner will have a higher cash flow to direct back to the building.

Preferential Leases and Higher Occupancy Rates

One way to appeal to financiers is to show them how green buildings can capture a market advantage or cost benefit through green design and construction. For example, in a tight market, owners/developers can charge more for space with lower operating costs. In a softer market, they can gain a market advantage by passing savings on to tenants. To date, green buildings in the commercial arena have generally enjoyed higher occupancy and absorption rates because of this competitive advantage.

Reduced Liability

Lenders are not comfortable with risky projects. However, there are many other faces of risk in the building industry including those that involve people's health, safety, and welfare. The current litigious climate has financiers increasingly concerned, yet they have generally failed to make the connection that green buildings are in fact less risky developments because they pay closer attention to such issues as environmental protection, occupant health, and building and materials quality.

Therefore, before long, lenders will look back with retrospective wisdom and wonder why they had been so reluctant to finance the sort of environmentally responsible projects stored in

the database. Green buildings, after all, are providing less expensive places to live in and operate; they are providing more attractive, more popular communities; they are producing healthier, more productive and profitable work places; and they are less expensive to build as a result of finding out the reasonable green performance.

On the other hand, I have realized the fact that incentive programs for energy savings and green features can stimulate consumers and give a motive to build green through this study. However, architects, developers, contractors and anyone related to the business of development also have a responsibility to give desirable suggestions to build green for their own success and consumers as resulted below from this study.

1. Design the green performance at Level E (A LEED Gold Building of 40~49 Points)
2. Build a Materials & Resources oriented building by reusing a building
3. Optimize the energy performance within 6 points and less (40% of better energy efficiency than conventional buildings)

APPENDICES

A. PROJECT LIST

ID	PROJECT NAME	COUNTRY	PROJECT TYPE	BLDG TYPE	OWNER	POINTS
92	2211 West 4th	Canada	Mixed use	New Construction	Harold Kalke	23
1	901 Cherry, GAP Inc. Office Building	USA	Commercial/Office Building	New Construction	GAP Inc.	24
2	AAAS Building	USA	Commercial/Office Building	New Construction	American Association for the Advancement of Science	19
101	ACT2 House	USA	Residential	New Construction		14
44	Adam J. Lewis Center for Environmental Studies	USA	Educational	New Construction	Oberlin College	51
64	Amandari	Bali	Hotel/Resort	New Construction	Adrian Zecha	12
65	Anaconda Old Works Golf Course	USA	Hotel/Resort	New Construction	Anaconda Deerlodge	11
81	APS Manufacturing Facility	USA	Industrial/Warehouse	New Construction	BP Solar	14
66	Arbor House	USA	Hotel/Resort	Renovation	John	29
3	Audubon House	USA	Commercial/Office Building	Renovation	National Audubon Society	28
150	Balfour - Guthrie Building	USA	Commercial/Office Building	Renovation	Balfour - Guthrie LLC	33
110	Banana Republic	USA	Retail	Renovation	GAP Corporation	21
152	Barrel Aging Cellar	USA	Industrial/Warehouse	New Construction		34
102	Battery Park City	USA	Residential	New Construction	Albanese Development	28
111	Ben & Jerry's Scoop Shop	USA	Retail	Renovation	Franchisees	6
103	Benedict Commons	USA	Residential	New Construction	City of Aspen	11
45	Bincentennial Hall, Middlebury College	USA	Educational	New Construction	Middlebury College	16
67	Boston Park Plaza	USA	Hotel/Resort	Renovation	Boston Park Plaza	14
4	Burke Building	USA	Commercial/Office Building	Renovation	Western Pennsylvania Conservancy	12

46	Buxton Public School	Austrailia	Educational	New Construction	NSWDET	28
120	C.K. Choi Building	Canada	Institutional	New Construction	The University of British Columbia	22
5	Cambria Building	USA	Commercial/Office Building	New Construction	Miller Brothers Construction, Inc	45
145	Capitol Area East End Complex Block 225	USA	Commercial/Office Building	New Construction	State of California Department of General Services	43
47	Center for Energy and Environmental Educational	USA	Educational	New Construction	University of Nothern Iowa	22
6	Center for Indigenous Environmental Resources	Canada	Commercial/Office Building	Renovation	CIER	22
121	Center for maximum potential building systems	USA	Institutional	New Construction	Pliny Fisk, Gali Vittori	29
112	Centerra Marketplace Lebanon Food Co-op	USA	Retail	New Construction	Dartmouth College Real Estate	12
82	Chatham Plant (Interface)	USA	Industrial/Warehouse	Renovation		11
7	Chesapeake Bay Foundation	USA	Commercial/Office Building	New Construction	Chesapeake BF	38
104	Civano	USA	Residential	New Construction	Civano Development	21
93	Cleveland EcoVillage	USA	Mixed use	New Construction		13
8	Commerzbank	Germany	Commercial/Office Building	New Construction	Commerzbank	23
68	Concordia	US Virgin Islands	Hotel/Resort	New Construction	Stanley Selengut	15
9	Conde Nast Building at Four Times Square	USA	Commercial/Office Building	New Construction	Durst Organization	26
10	Conservation Consultants Inc. Center	USA	Commercial/Office Building	Renovation	CCI	44
105	Conservation Co-op	Canada	Residential	New Construction	Conservation Co-operative Homes Inc.	22
11	Conservation Law Foundation	USA	Commercial/Office Building	Renovation	CLF	22
122	Contact Theatre	United Kingdom	Institutional	New Construction		23

12	Crestwood Corporate Centre	Canada	Commercial/Office Building	New Construction	Bentall Development	17
48	Dana Building, University of Michigan	USA	Educational	Renovation	UM	22
123	David L. Lawrence -- Pittsburgh Convention Center	USA	Institutional	New Construction	Sports & Exhibition Authority	31
94	Denver Dry Goods Building	USA	Mixed use	New Construction	Affordable Housing Development Corporation	11
154	Detroit Lions HQ and Training Facility	USA	Commercial/Office Building	New Construction	Ford Motor Land Services	26
49	Earth Centre	United Kingdom	Educational	New Construction		31
106	Ecolonia	Netherlands	Residential	New Construction	Bouwfonds Woningbouw by, Delft	15
13	Ecotrust-Jean Vollum Natural Capital Center	USA	Commercial/Office Building	Renovation	Ecotrust	41
83	Ecover	Belgium	Industrial/Warehouse	New Construction	Ecover	25
14	Emerald People's Utility District Headquarters	USA	Commercial/Office Building	New Construction	EPUD	19
15	Energy Resource Center	USA	Commercial/Office Building	Renovation		31
156	Federal Building U.S. Courthouse	USA	Institutional	New Construction	U.S. General Services Administration	27
16	Federal Reserve Bank of Minneapolis	USA	Commercial/Office Building	New Construction	FRBM	33
149	Ford Rouge Visitor Center	USA	Commercial/Office Building	New Construction	Ford Motor Company	39
146	French Wing Additon to Conservation Center	USA	Commercial/Office Building	New Construction	SPNHF	44
124	Gilsland Farm Environmental Center	USA	Institutional	New Construction	Maine Audubon Society	34
157	Goodwillie Environmental School	USA	Educational	New Construction	Forest Hills School District	29

69	Grand Wailea Resort and Spa	USA	Hotel/Resort	New Construction	Takeshi Sekiguchi	13
84	Greater Pittsburgh Community Food bank	USA	Industrial/Warehouse	New Construction	GPCFB	31
17	Green on the Grand	Canada	Commercial/Office Building	New Construction	Ian Cook Costruction	26
18	Greenpeace USA Headquarters	USA	Commercial/Office Building	Renovation	Greenpeace USA	25
70	Harmony	US Virgin Islands	Hotel/Resort	New Construction	Stanley Selengut	23
85	Hennepin County Public Works Facility	USA	Industrial/Warehouse	New Construction	Hennepin County	20
86	Herman Miller SQA	USA	Industrial/Warehouse	New Construction	Herman Miller	41
135	Hewlett Foundation Headquarters	USA	Commercial/Office Building	New Construction	The William and Flora Hewlet Foundation	43
158	Ice Mountain Bottling Plant	USA	Industrial/Warehouse	New Construction	Nestle Waters North America	27
19	Inland Revenue Centre	United Kingdom	Commercial/Office Building	New Construction	UK IR	22
71	Inn at Spanish Bay	USA	Hotel/Resort	New Construction	Pebble Beach	5
72	Inn of the Anasazi	USA	Hotel/Resort	Renovation	Aspen Design	15
20	International Netherlands Group Bank	Netherlands	Commercial/Office Building	New Construction	ING	22
147	IslandWood: A School in the Woods	USA	Educational	New Construction	Islandwood	40
107	Jackson Meadow	USA	Residential	New Construction	Harold Teasdale and Bob Durfey	17
73	Jean-Michel Cousteau Fiji Island Resort	Fiji Islands	Hotel/Resort	Renovation	Mike Freed	26
50	John Heinz National Wildlife Refuge	USA	Educational	New Construction	US Fish	32
51	John T. Lyle Center for Regenerative Studies	USA	Educational	New Construction	CSUP	17
74	Kandalama Hotel	Sri Lanka	Hotel/Resort	New Construction	Kandalama Hotel	30
143	KSBA Architects Office Building	USA	Commercial/Office Building	Renovation	Lawrenceville Development Corporation	27

125	Lady Bird Johnson Wildflower Center	USA	Institutional	New Construction	Lady Bird Johnson Wildflower Center	33
21	Lucasfilm, Letterman Digital Center@Presidio	USA	Commercial/Office Building	New Construction	George Lucas	37
155	Lynn Business Center	USA	Educational	New Construction	Stetson University	26
159	Magnolia Administration Building	USA	Commercial/Office Building	New Construction	InterGen	26
75	Maho Bay	US Virgin Islands	Hotel/Resort	New Construction	Stanley Selengut	20
52	McLean Environmental Living & Learning Center	USA	Educational	New Construction	Northland College	25
126	MCPON Plackett Manor Bachelor Quarters	USA	Institutional	New Construction	US Department of Navy	24
95	Middleton Hills	USA	Residential	New Construction	Marshal Erdman and Associates	9
22	Monsanto A-3 Building	USA	Commercial/Office Building	Renovation	Monsanto	22
127	Mont Cenis Academy	Germany	Institutional	New Construction		33
53	Montana State University EPICenter	USA	Educational	New Construction	MSU	32
113	Mountain Equipment Co-op	Canada	Retail	New Construction	Mountain Equipment Co-op	36
23	Natural Resources Defense Council Headquarters	USA	Commercial/Office Building	Renovation	NRDC	20
24	New Offices for Parliament	United Kingdom	Commercial/Office Building	New Construction	UK Government	8
25	New York Life Building	USA	Commercial/Office Building	Renovation	UtiliCorp United	
136	New York State Department of Environmental Conserv	USA	Commercial/Office Building	New Construction	Picotte Companies	33
141	Nidus Center for Scientific Enterprise	USA	Laboratory	New Construction	Monsanto Company	31
26	Norm Thompson Outfitters Headquarters	USA	Commercial/Office Building	New Construction	Trammel Crowe	24

164	North Boulder Recreation Center	USA	Commercial/Office Building	Renovation		33
27	Northwest Federal Credit Union	USA	Commercial/Office Building	New Construction	NW FCU	15
54	Oakes Hall, Vermont Law School	USA	Educational	New Construction	Vermont Law School	25
96	Old Elm Village	USA	Residential	New Construction		9
55	Ostratorn School	Sweden	Educational	New Construction	ML	31
87	Patagonia	USA	Industrial/Warehouse	New Construction	Patagonia	20
28	Peace River Presbytery	USA	Commercial/Office Building	New Construction	PRP	22
76	Petit Byahaut	West Indies	Hotel/Resort	New Construction	Byahaut Gardens	18
118	Pharmacia Building Q-Lab	USA	Laboratory	New Construction	Pharmacia	41
88	Phillips Eco-Enterprise Center	USA	Industrial/Warehouse	New Construction	The green institute	34
97	Playa Vista	USA	Residential	New Construction	Maguire Thomas Partners	12
29	PNC Firstside Center	USA	Commercial/Office Building	New Construction	PNC	33
128	Portland City Hall Renovation	USA	Institutional	Renovation	City of Portland, Oregon	23
77	Post Ranch Inn	USA	Hotel/Resort	New Construction	Post Ranch	11
98	Potsdamer Platz	Germany	Mixed use	Renovation	Various, City of Berlin	20
108	Prairie Crossing	USA	Residential	New Construction	Prairie Holdings Corporation	16
137	Premier Automotive Group North American Headquarter	USA	Commercial/Office Building	New Construction	Ford Motor Company	26
89	Prince Street Technologies-Interface	USA	Industrial/Warehouse	New Construction	Inerface Inc.	30
99	Prisma	Germany	Mixed use	New Construction	Kalsruker Insurance Company	21
56	Queens Building, DeMonfort University	United Kingdom	Educational	New Construction	DU	23
160	Redbud Administration Building	USA	Commercial/Office Building	New Construction	InterGen	27
114	REI Denver Flagship Store	USA	Retail	Renovation	REI	27

30	Reichstag	Germany	Commercial/Office Building	New Construction	FRG	23
119	Research Triangle Park	USA	Laboratory	New Construction	Environmental Protection Agency	34
31	Ridgehaven Green Building Demonstration Project	USA	Commercial/Office Building	Renovation	City SDESD	28
32	Rocky Mountain Institute	USA	Commercial/Office Building	New Construction	Hunter and Armory Lovins	27
33	S.C. Johnson Worldwide Headquarters	USA	Commercial/Office Building	New Construction	S.C. Johnson	33
151	Sabre Corporate Campus	USA	Commercial/Office Building	New Construction		34
115	Sainsbury Grocery	United Kingdom	Retail	Renovation	Sainsbury's Supermarkets	14
57	School of Nursing & Student Center	USA	Educational	New Construction	UT, HSCH	52
100	Second Street Studios	USA	Mixed use	New Construction	Affordable Housing Development Company	14
129	Seneca Rocks Discovery Center	USA	Institutional	New Construction	USDA Forest Service	33
34	Seventh Generation Systems Center	USA	Commercial/Office Building	New Construction	Jim Sackett	31
78	Sleeping Lady Resort	USA	Hotel/Resort	Renovation	Harriet Bullitt	22
161	Social Security Administration Annex Building Reno	USA	Commercial/Office Building	Renovation	U.S. General Services Administration	26
35	Sonoma County Integrated Waste Division	USA	Commercial/Office Building	New Construction	Sonoma	19
36	South-central Regional Headquarters Pennsylvania	USA	Commercial/Office Building	New Construction	New Morgan Municipal Authority	27
130	Southface Energy Institute Resource Center	USA	Institutional	New Construction	Southface	31
162	SSA Child Care Center	USA	Commercial/Office Building	New Construction	U.S. General Services Administration	28

142	Steelcase Wood Furniture Manufacturing Plant	USA	Industrial/Warehouse	New Construction	Steelcase Inc. Randy Bolser, LEED Cordinator	34
79	Sundeck Restaurant	USA	Hotel/Resort	New Construction	Skiing Company	29
58	Swindells Hall, University of Portland Science Lab	USA	Educational	New Construction	UT,HSCH	31
37	Telus-William Farrell Office Building	Canada	Commercial/Office Building	Renovation	Telus	25
90	The Body Shop Headquarters	USA	Industrial/Warehouse	Renovation	The Body Shop	20
140	The Donald Bren School of Environmental Science &	USA	Laboratory	New Construction	University of California -- Santa Barbara	39
38	The Nature Conservancy International	USA	Commercial/Office Building	New Construction	TNC	33
80	The Orchid Hotel	India	Hotel/Resort	New Construction	Kamat Hotels	23
163	The Russell Family Foundation	USA	Commercial/Office Building	New Construction		27
59	The University of Victoria	Canada	Educational	New Construction	TUV	
61	The Way Station	USA	Health Care	New Construction	TWS	27
148	Third Creek Elementary School	USA	Educational	New Construction	Iredell - Statesville schools	39
131	Thoreau Center for Sustainability	USA	Institutional	Renovation	National Park Service	30
39	Tuthill Corporate Center	USA	Commercial/Office Building	New Construction	Tuthill Corporation	34
62	United Indian Health Services Potawot Health	USA	Health Care	New Construction	UIHS	16
40	United Parcel Service Headquarters	USA	Commercial/Office Building	New Construction	UPS	15
60	University of Nottingham, Jubilee Campus	United Kingdom	Educational	New Construction	UNJC	30
41	Utah Department of Natural Resources	USA	Commercial/Office Building	New Construction	State of Utah	20
144	Utah Olympic Oval	USA	Commercial/Office Building	New Construction	Salt Lake Organizing Committee for the Olympic Win	20

42	Van Atta Design Studios	USA	Mixed use	New Construction	Wendall and Mona Van Atta	26
134	Vancouver Island Technology Park	Canada	Commercial/Office Building	Renovation	BC Buildings Corporation	41
91	VeriFone Worldwide Distribution Center	USA	Industrial/Warehouse	Renovation	VeriFone Corporation	24
109	Village Homes	USA	Residential	New Construction	Village Homes	16
139	Viridian Place	USA	Commercial/Office Building	New Construction	RTJ Partnership	30
116	Wal-Mart Demonstration Store	USA	Retail	New Construction	Wal-Mart Stores Inc.	20
132	Wampanoag Tribal Headquarters	USA	Institutional	New Construction	Wampanoag Tribe of Gay Head	22
153	Whitehead Biomedical Research	USA	Institutional	New Construction	Emory University	34
117	Whole Foods Market	USA	Retail	Renovation	Whole foods	18
63	Women's Humane Society Animal Shelter	USA	Health Care	New Construction	WHS	35
43	World Resources Institute	USA	Commercial/Office Building	New Construction		26

B. WORLD WIDE WEBSITES AND RESOURCES

Note: While this is not an exhaustive list, many of these addresses are linked to other informative sites.

Green Building Administrator Log in – http://www.66.51.163.160/green_login.cfm
Green Building Projects Log in – http://66.51.163.160/
Rocky Mountain Institute – http://www.rmi.org
U.S. Green Building Council (USGBC) – http://www.usgbc.org
Green Building B.C – http://www.greenbuildingsbc.com
BC Hydro – http://www.bchydro.bc.ca
Center of Excellence for sustainable Development – http://www.sustainable.doe.gov
Center for Renewable Energy and Sustainable Technology (Crest) / Sustainable Energy & Development Online (Solstice) – http://solstice.crest.org/
Environmental Building News – http://ebuild.com/index.html
Environmental Organization Web Directory – http://webdirectory.com/
Indoor Air Quality Page – http://ttsw.com/AirJT.html
Iris Communications (Resources for Environmental Design Index) – http://www.oikos.com/redi/index.html

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