Commercial Green Building:
The value added gap perspective

Author: Amaravadee Vinyangkoon
Supervisor: Abukar Warsame

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**ABSTRACT**

Recently, green building has become globally vital for commercial building development, especially in the United States where the United States Green Building Council (USGBC), a national non-profit membership organization has developed the Leadership in Energy and Environmental Design (LEED) System to provide a guideline and rating system for green buildings. The building focused on using green efficiency methods and materials in the design and construction of new properties (or in existing properties renovation) which scope to lower operations and maintenance costs. It increase the rent or value for a green building while lowering energy cost. However, there is limited empirical evidence published to affect the green building valuation method and the value of property. Thereof, the aim of this paper is to consider issues regarding commercial green building and value added gap, where the factors that affect energy expenses are investigated. The value added gap show the difference between high value of construction cost and energy expenses, where a positive difference could be defined as green profit. The methodology of this research will involve the clarification of the problems, objectives, theoretical, and empirical research through qualitative means by conducted via send out the survey to real estate specialist and then thru conclusion, by value added gap is exist but in the small different gap which results from too high construction cost and high maintenance cost. In order to achieve lower energy expenses, increase clarity in communication and understanding of the building’s features are needed form team design spread to building users for achieve in maximize energy efficient.
ACKNOWLEDGEMENT

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Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the project.
### DEFINITIONS OF KEY TERMS

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1. INTRODUCTION

Nowadays, the world faces many environmental crises such as increased threat of climate change, the depletion of key natural resources, increasing air and water pollution and growing levels of solid wastes (Kilbert et al., 2006). These issues are becoming the major aspects of value in real estate and a key driver in the decision making processes. The strategic sustainability process as called “the halo effect” was more worldwide which is affected by the popularity in environmental actions criteria (Mansfield, 2009).

Mansfield (2009) showed consequence that green concept has not only focused on technical or moral issue but also need to base more on the economic and financial imperative. There has many evidence essential to clarify these problems in the built environment and plenty of its show responsible in current planning, design, construction and property management in natural environment and the ongoing depletion of nonrenewable resources. Many governments have more participate in environment responsibilities by signatories to international treaties and protocols regarding issues such as carbon emission, and greenhouse gas.

Property perception has been changed in the past 10 years. Green building has become major topic for the property industry (Robinson, 2007). Thus, they have many terms of real estate overview for called “sustainable development” such as “green building” (US term), “sustainable building” (UK and Australia term), “sustainable architecture” and “sustainable construction” (Mansfield, 2009; Sayce, 2010). As property perspective changed, the major perspective of sustainable property will concern in building characteristics and performance as affected on property’s worth and market value (Lorenz, 2007). The main three focused point of sustainability protection are economic prosperity, social advancement, and environmental protection. The commercial property market that attempt to complete in sustainability agenda and reducing in any incurred additional build costs called ‘green’ buildings (Francesco, 2008).
What is sustainability? There have large of definitions from different point of view. According from Francesco et al. has mentioned definition from Responsible Property Investment (RPI)\(^1\) as:

“[. . .] maximizing the positive effects and minimizing the negative effects of property ownership, management and development on society and the natural environment in a way that is consistent with investor goals and fiduciary responsibilities.”

Another most prominent and universal definition lies in the Brudtland Report (1987) where environmental sustainable development is defined as “…development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This was a result of four years of study and debate and provides emphasis upon the need to satisfy human quality of life and the respect for others particularly future generations.

Pearce et al. (1989) has said “implies using natural resources in a way which does not eliminate or degrade them or otherwise decrease their usefulness to future generations, and implies using nonrenewable natural resources at a rate slow enough as to ensure a high probability of an orderly societal transition to new alternatives”. The World Bank has used the phrase “development that lasts” in this context (World Bank, 1992; Robinson, 2005; Robinson, 2007; Wiley, 2008).

One of the reasons for not buying or renting a commercial or residential property responds from increasingly poor environmental and social performance. Thus, this will affect the building life cycle (treated for valuation, insurance, lending and other decision making purposes) and increase pressure on values and professional property advisors on finding the real benefit and economic value of green building development which can reflect the estimation of worth and market value (Lorenz, 2007).

Green building has become the major perspective for the development of commercial building in recent years, especially in the United State where United States Green Building Council (USGBC), a national non-profit membership organization, developed the system called

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\(^1\) Responsible Property Investment. http://www.responsibleproperty.net. RPI, the real estate investment center in U.S., that provide consult tool to potential investor for competitive advantage short-term and long-term. It also diversities cover in social and environmental dimensions.
Leadership in Energy and Environmental Design (LEED) to provide guidelines and rating system for green buildings (Kats, 2003; May et al., 2007).

Furthermore from the appraisals perspective, the profession has been criticized of “green” building value. Some profession said “There is no difference in valuing a sustainable building and I would use the same market evidence”. However, six green star rates would estimate a higher value than four green star building (Warren, 2009). Green building focused on using sustainable methods and materials in the design and construction of new properties (or in existing properties renovation) where the scope is to lower operations and maintenance costs (Kats, 2003; Myers et al., 2007; Wiley, 2008) but the construction cost are usually too high with less profit gained by developers.

Thereof, the true reason for ineffective lowering of operations and maintenance cost is still unclear as studies on the issue is lacking. Therefore this research sought to investigate the current characteristic of this thesis will compare green buildings and typical building. Green building focused on using sustainable methods and materials in the design and construction of new properties (or in existing properties renovation) which scope is lower operations and maintenance costs (Kats, 2003; Wiley, 2008). It cause rent or value for a green building increased and lower lifetime cost (Chan et al., 2009).

However, there is a lack of empirical evidence existing in literature to date (Lutzkendorf et al., 2005) which can contribute to the green building valuation method. Therefore, this thesis will try to search for the answer based on literature review, survey and case study example to confront green aspect contributed.

1.1 Aim

The aim of the research this to figure out the value added gap between commercial green building and commercial conventional building by using survey. The specific objectives are the following:

- To identify what have been done in Green building area
- To examine what can be done in Green building area

For finding the real reason and problem why green building is not increases larger profit as expected.
1.2 Research question

The research question for the thesis is:

“Does the added gap value exist between a typical commercial building and a green commercial building as seen in graph (a) or graph (b)?”

Sub-questions which will be examined in both theoretical and survey part will be;

- The reason why after started operate the building, the energy cost of green building does not low as expected and what is the impact factor behind?
- How come green building earning more profit even start with higher construction cost than conventional building after period has passed for a while?
- Why should preferred green perspective?

1.3 Limitations

This paper is based only on commercial building study. In general, the property valuation will concern in many factors and will not focus only energy use reduced. However, to accomplish the research question, this research will only relevant in the financial relevant as energy expense which is basically used in Discounted Cash Flow (DCF) valuation approach. And also this research is limited by lack of real practical knowledge from Real Estate Company.
1.4 Disposition

This paper first introduces about green in general area and then explains what the thesis proposes and question in detail. The second section will explain more knowledge about green which focuses on literature review from empirical study and research. This section starts from green background then narrow to real estate area as green building. And finish with green commercial building, which is follow by the research methodology in section three.

Then theoretical part at section four, explain about green building valuation method and valuation factors which will focus in this paper in detail, which are construction cost, and energy expense. Continue to section five that provided the survey result and study of green building example cases in U.S. Thereof, based on the research from New Building Institute (NBI), which has necessary data of green commercial building that useful for this paper and then summarize whilst to defined the answer for research question. Finally, the last section will present the conclusions and the final answer to the thesis question.
2. LITERATURE REVIEW

2.1 ‘‘Green’’ Background
Real estate has consumed 70% of the U.S. nation’s electricity which also exploit large part of the materials, water, waste and other resources used in the economy. Buildings experience a relatively static sector of the economy which has a dynamic technology or resource consumption patterns. Today, “Green” building has gained popularity in environmental and health perspective which consumes major resources like energy, water, materials, and land more efficiently than traditional buildings.

Green buildings involves using sustainable methods and materials in the design and construction of properties (or in existing properties renovation) and operations, where the aim is to lower operations and maintenance costs including energy efficiency in lighting technologies and air quality, redeveloping brown field sites, or using green roofs that allow for runoff water to be recycled and also contribute to improved employee and student health, comfort, and productivity. However, the benefits of green buildings estimation are approximately ten times larger than the average additional cost of building it. (Kats, 2003; Wiley, 2008; Wiley et. al, 2010)

From the increasing environmental concerns, organizations dealing with sustainability issues have establish commercial measures of “green” building level standard, e.g. Building Research Establishment Environmental Assessment Method (BREEAM), Australian Building Greenhouse Rating tool (ABGR) and the United States’ Green Building Council (USGBC). USGBC is a national non-profit membership organization that has developed the Leadership in Energy and Environmental Design (LEED) System™ 2 to provide guidelines and rating systems for green building developments. There still have issue in measure green building because substantial standard still different in each country. The standard will show green efficient level of that building. (Robinson, 2007; May et al., 2007; Sayce 2010; Shimizu, 2010)

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2 LEED system are separated into four levels; Certified, Silver, Gold and Platinum.
2.2 Green Building & Real Estate

Furthermore, the one largest obstacle for more green building widespread that is substantially more costly than conventional design and may not be justified as a cost benefits perspective. Otherwise, the developer perspective is focused on profit margin. Anyway, there has been some research show even green building has risen but in contrast the cost of green design has dropped in the last few years which affected from increased in designers, builders experience and developed of technologies (Chan et al., 2009). Sustainable buildings projects team has provided information on cost that with little or no added cost from budget well constructing traditionally in similar program (Davis Langdon, 2007; Mansfield, 2009). There still lack of data and market evidences to prove that the construction cost has really decreased or really benefits of it (Robinson, 2007).

Boyd (2006) refers that green building also demonstrate into the “Circle of Blame”, used to understand the situation in real estate industry. The occupier will effect to increase develop in real estate industry and cause it shift upward/downward. However, Lutzkendorf et al. (2005) argued that investors are the main driver for green building industry. Otherwise, there appear to be the combination of factors that the develop effected from investors knowledge in green financial as investment perspective as well as occupier demand for more green space (Myers et al, 2007).

Other important aspect of eco-efficiency is an energy cost which is a direct benefit that exceeds marginal costs of green design. Energy, waste, and water savings are fairly predictable data that can predicted with precision, measured, and monitored over time (Kats, 2003). As the largest and most manageable saving in operating expense for commercial properties, typically representing about 30% of operating costs and Commercial buildings
with the Energy Star label use less energy that nearly 40% which decrease from typically building operating costs (Wiley, 2008). However, not all buildings that have the Energy Star label will have position gains on building values.

Thus, the energy saving profit criteria, a ten percent decrease in energy consumption leads to an increase in value of about one percent (Wiley, 2008), which this value more than the rent and value premium for a labeled building. The other important aspect of the intangible effects about worker productivity or improved corporate image, however, this seem to play a role in determining green buildings value in the marketplace.

Green building seems to be more concentrated in the present period. The trend in year 2011 shows that many countries as U.S., Canada, Europe, Asia, the Middle East and Australia have developed further in Green commercial building and start-up rate for new green projects seem to increase due to supporting regulations from the Government. For example, state and local governments in U.S. have provided more green buildings projects’ for themselves and the private sector. Green movement continues to accelerate as some countries start to create their own green building incentive and councils.

2.3 Commercial “Green” Building

Commercial property refers to the building used for commercial use and building itself merits to generate profit from capital gain or rental income, which categorized into Office building, Retail building (i.e. hotels, medical centers, retail stores, shopping centers, etc.) and Industrial building (i.e. warehouses, garages), however, commonly be mixed function used in same building.

Tenure rights for commercial space are considered as freehold or leasehold. Freehold has the security property possess right and also involved in investment opportunity, that has full reinforced in design, arrangement, and operation and obtain augment for capital benefit appreciation. Owner, also, associated to face the building obsolescence risks factor. Leasehold

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3 In U.S., Green building executive policy from President Obama, the commitment for all new federal projects and major renovations complete at least LEED Gold.
4 Kyoto protocol aimed to reduce and stabilize greenhouse gas emission to which provide by the international environmental treaty, United Nations Framework Convention on Climate Change (UNFCCC, 1977).
inquired limited rights of ownership, including opportunity from leased to acquire high environmental and ecological standards but however, depend entirely on landlord environmental dimensions.

The transaction of commercial real estate market by nature composes with two or more parties arranging into agreement and also exchange goods and services (David et al., 2010). Transactions may be in the form of property right document, leases agreement, property management agreements, building sales, service contracts, loan & mortgage and among others. The transaction will be significant, if each party has agreement to influence building in the role of energy incentive.

Some research clarify the market rent and commercial space of commercial building which obtain LEED or Energy Star label which add premium properties to green buildings, increase value and higher occupancy rate. Previous witness suggest green design cause increased value for green buildings in smaller or lower cost regions or in less expensive parts of metropolitan areas (Kats, 2003). Some tenants believe that it could be benefit for business appeal as gain in reputation and marketing which show social awareness, and superior social responsibility of the occupants.

As a result, tenants may be willing to pay higher rents or selling prices for green buildings. Therefore, if tenants prefer sustainable buildings that might cause sustainable buildings have longer economic lives than conventional ones and effect as a lower volatility in market value which due to less environmental risk and better marketability. That will lead to reduced risk premiums and increase in value of the properties. Anyway, higher rental rate may not always cause to increase in building value. (Kats, 2003; Wiley, 2008; Eichholtz, 2009; Chan et al., 2009).
Table 1: Summary of green commercial building in U.S. from literature studies:

<table>
<thead>
<tr>
<th>Source</th>
<th>Rent Premium</th>
<th>Sales Price Premium</th>
<th>Vacancy Rate Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy Star</td>
<td>LEED</td>
<td>Energy Star</td>
</tr>
<tr>
<td>Fuerst &amp; McAllister</td>
<td>4%</td>
<td>5%</td>
<td>26%</td>
</tr>
<tr>
<td>(2011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eicholtz et. al (2010)</td>
<td>3.3%</td>
<td>5.2%</td>
<td>19%</td>
</tr>
<tr>
<td>RICS (2010)</td>
<td>2.1%</td>
<td>5.8%</td>
<td>13%</td>
</tr>
<tr>
<td>Pivo et. al (2010)</td>
<td>2.7%</td>
<td>-</td>
<td>8.5%</td>
</tr>
<tr>
<td>Wiley et. al (2010)</td>
<td>7-9%</td>
<td>15-17%</td>
<td>-</td>
</tr>
<tr>
<td>Miller et. al (2008)</td>
<td>9%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>


However, there still no substantive enough evidence that points the achieved higher rent in LEED and Energy Star accredited buildings compared with similar non-accredited buildings connection which increased capital values achieved on sale. In uncertain open market situations, Jones Lang LaSalle survey in 2005 specify that the current climate tenants “would not be willing to pay a premium rental” for buildings with sustainable features (Robinson, 2007; Sayce 2010) and sustainable buildings are not claiming higher rentals as claimed by various pieces of research, in particular the RICS Green Value investigation project (RICS, 2006, Robinson 2007).

Commercial office building commonly provide parking space for attracting tenant, which depend on facilities management regulations of each building. Those provide specific space for every employee (merits to salary level) or limit for senior management whist importantly based on office space lease contract agreement. Sometime the number of parking space base on lease office area. To persuade tenant, more rental area benefit to parking space added. Usually managers and employee may respond for monthly or yearly parking fee by themselves.

Location is the important factor for commercial building. This factor determinant rental rate to be in higher or lower rate either settle rental rate from property economy market. It also affect to building design and decoration, high-rise level, building facilities, occupancy rate, and type of tenant. The building may locate at central business district or suburban area. More facilities in the area or closer to public transport access, result to, higher rental value, which

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5 As "effective rent" of premium overall
6 As "effective rent" of premium overall
value also upon to subject premise (Aye et al., 1999). However, location will not research in-depth in this study.

Commercial financial viability either according to main development as investment cost in the premise project for building quality and internal fit-out. Otherwise, it also includes rental value and operating expense after development finished. For taking consideration in commercial green building as others benefit, is not always be energy or water expenses efficient green buildings would also be indoor environmental quality, recycling programs, use of materials, sourcing of materials, etc. which could affect in reduce energy and facility expenses of commercial building. The others commercial green building benefit as divided into the following table:

Table 2: Commercial green building benefit for owners and tenants

<table>
<thead>
<tr>
<th>Owners</th>
<th>Tenants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competitive differentiator</strong></td>
<td><strong>Higher operating costs and increase environment indoor quality</strong></td>
</tr>
<tr>
<td>Lower operating costs &amp; Increase environment indoor quality</td>
<td>Happier employees and occupants</td>
</tr>
<tr>
<td><strong>Mitigate risk</strong></td>
<td><strong>Public relations and community benefits</strong></td>
</tr>
<tr>
<td>Compare with conventional building, green for sales and lease has more easier and faster transaction</td>
<td>Shows the organisation respond for environmental</td>
</tr>
<tr>
<td><strong>Attract new tenants</strong></td>
<td><strong>Lower operating costs</strong></td>
</tr>
<tr>
<td>Trend for environment responsible increase</td>
<td>Also benefit to tax incentives</td>
</tr>
<tr>
<td><strong>Cost Effective</strong></td>
<td><strong>Immediate and measurable results</strong></td>
</tr>
<tr>
<td>Investing for higher construction cost but in contrast investor will get more higher rent in return</td>
<td>Green provide immediate result from energy and water benchmarking expense which differ from other cost</td>
</tr>
<tr>
<td><strong>Increase rental rates</strong></td>
<td><strong>Building green saves energy</strong></td>
</tr>
<tr>
<td>Higher rent premium and occupancy rate</td>
<td>Refer to “Positive life-cycle cost” investment</td>
</tr>
</tbody>
</table>
3. RESEARCH METHODOLOGY

The research process begins by clarifying the thesis problem and then explains the objective of this study. In response to the thesis question, this research will conduct a quantitative study to synergistically view evidence provided by literature coupled with conducting surveys to identify the research answer.

![Research Constructed Diagram](image)

**Figure 2: Research Constructed**

Grooves R. et al. (2009) had mentioned survey definition as “Survey is a systematic\(^7\) method for gathering information from (a sample of\(^8\)) entities for the purposes of constructing quantitative descriptors of the attributes of the larger population of which the entities are members.” When the interviewer chooses the target population, it is useful to use the “sampling frame” method to identify all the elements list of a target population such as professional areas, suitable survey period, business located in particular city or country, type of business, association members, type of property, or specific address or person.

In the theoretical study with the literature review that mainly focus on green background then the relationship between green building and real estate commercial green building potentials and trends then continue to explanation part about green building valuation, operating & maintenance expenses in terms of energy and construction cost.

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\(^7\) Grooves R. et al. (2009) said “Systematic is deliberate and meaningfully distinguishes surveys from other ways of gathering information”

\(^8\) Sometime survey might measure for whole population or “A sample of” that only the sample population.
To build strong knowledge base within the study area, therefore, this research has divided into two section as “Literature review” and “Theoreticle”. The topic of each section is related to each other that begin with general overview and will support by indepth topic. The conceptual framework\(^9\) of each section is provided by following:

![Figure 3: Conceptual model of “Literature review” section](image)

The objective of analytical section is to define the research answer by focus on the result from survey. Because of the research question is about commercial green building perspective then the questions of survey is also relate with research question. It has divided into 4 parts; part A to D and 18 questions which is about general information of respondent (question 1-4), green building valuation (question 5-7), green commercial building valuation: office or retail type (question 8-15) and others which for present the opinion about valuation standard practice (question 16-18).

Thereof, it will distribute thru an online survey website\(^10\) (surveymonkey.com) to the real estate specialist like developer, valuer, advisory and building owner which mainly based on Sweden area. And also infers green building example case from “the New Building Institute (NBI)” to extent the green details. It was gathered from commercial green buildings in U.S. that have floor area more than 10,000 square meters. Finally, the conclusion shows the risks and negative impacts from the research study as well as review further area of study. Research constraints, barriers and obstacles also coverage.

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\(^9\) The conceptual framework is the pattern for shows clear structure of the research process.

\(^10\) Couper et al. (1998) called Computer-assisted self-interviewing (CASI)
4. THEORETICAL

4.1 Green Building Investment Case
   – Split Incentive (on capital improvement)

As traditional leases by Loeser et al. mentioned building owners will be responsible for the upfront cost of energy efficiency improvements while the tenants receive the benefits of reduced energy cost. The owner, however, did not share this benefit, causing less incentive to invest in initial energy upgrade as. In order to increase the incentives, Mayor of New York City, Michael Bloomberg had split these incentives for green lease to overcoming the unnecessary barrier for owner’s reinvestment while creating mutual benefits for both the tenant and owner.

The consensus-based solution model is called the Energy Aligned Lease (EAL). The EAL was first launched on April 5, 2011 as lease agreement contract between Silverstein Properties Inc. (SPI) and WilmerHale (Law firm) as owner and tenant, respectively. The EAL between SPI and WilmerHale involved the renting of a section in the reconstructed World Trade Center’s 7th tower where the reconstruction have considered environmental designs that would allow substantial potential energy savings, i.e. ultra-clear exterior glass technology, and high-efficiency air filtration.

The new split incentive as well as new commercial lease language, propose for commercial leases agreement upgrade, as a pioneer model, the tenant and owner will share the costs; incurred capital improvements, and the benefits of energy efficiency improvements. These have resulted in increased investments on energy efficient skyscrapers across the U.S. nation (Loeser et al., 2011).

The new leased agreement allowed lease payment counts savings over the length of a projected payback period\textsuperscript{11}, which, therefore, supports owner’s savings more due to the shortening of time. Otherwise, based on current commercial office space lease, in real situation, time for recouping cost is too long if landlord allowed tenant to share costs of

\textsuperscript{11} “Simple payback period” means the length of time (in months) obtained by dividing the aggregate costs of any such Capital Improvement (x), by the Projected Annual Savings (y). For example, the Capital Improvements aggregate costs are $2,000,000 and the Projected Annual Savings are $500,000, and the simple payback period for Capital Improvement is 48 months, then, $400,000 of aggregate Capital Improvements cost may be included in operating expenses to tenant.
capital improvements. Due to a lack of understanding (or knowledge), they are subjected to further investigation.

4.2 Valuation Method

There are three basic valuation methodologies for “real” properties which include the Cost Approach, Market Approach (Sales Comparison Approach), and Income Approach (Discounted Cash Flow (DCF)). The cost approach measures the value of an asset by the cost required for the reproduction or replacement of the assets. The market approach measures the value of an asset through an analysis of recent sales or offerings of comparable property. The income or investment approach measures the value of an asset by assessing the present value of its future economic benefits. However, in order to conclude the final value of the property, the professional valuers’ need to consider the “Highest and Best uses”\(^{12}\) (RICS Red Book, 2009).

Often it is required to apply a standardized methodology for the determination of a property’s market value. To determination buildings value especially it’s generate income by lease term, e.g. commercial building, therefore, the appropriate methods are the direct capitalisation and discounted cash flow approaches (Myers et al., 2007). The registered valuers’ have responsible to show updated value in valuation report. By using the present value to calculate for future income streams and it cause influences in investment and development decisions. (Robinson, 2007; Myers et al., 2007; Mansfield, 2009; Eichholtz, 2009; Sayce, 2010)

Direct capitalization method used for determined building value that building itself is capable to generate an annual income from leasing. Sometime, it used dually with discounted cash flow approach. This method may inappropriate to used when it turn to assume or project income, outgoings (as operating expenses), or yields ongoing by current market level (Myers et al., 2007).

\(^{12}\) Highest and Best uses (HBUs), “The reasonable probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value”, according to The Appraisal of Real Estate, Tenth edition.
The Discounted Cash Flow (DCF) is one of the basic valuations that necessary and applicable for building valuation, in case of building can generate income by itself. It estimates the present value from a future cash flow estimate that is derived from an investment in a capital asset over a given period of time. DCF may also consider the technique for analyzing the variability of a capital investment project by discounting all budgeted, or projected, income and expenditure flows of a project, including the initial outlay and any residual value. (RICS Red Book, 2009; Sayce, 2010)

In order to clarify the data for DCF method, property valuers’ have to analyses and interpret current sales, lease transactions and the characteristics of comparable buildings data, using the data that are similar to the subject buildings to attain accurate market assumptions. Anyway, the global lack of sales and lease transactions lead to difficulty in the appraisal and comparison of green market values (Robinson, 2007; Sayce, 2010). An alternative is to perform the valuation methods based on historical data but such alternative can be lead bias in the determination of property’s exchange price or market value. (Lutzkendorf et al., 2005)

Figure 5: Direct Capitalization Method

\[
\text{Net Income (NI)} \times \text{Year's Purchase (YP)} = \text{Capital Value (CV)}
\]

The annual rent or annual income from property generated thru lease. Net rent excludes outgoing cost.

The multiplier is the inverse of capitalization rate. The capitalization rate is determined by the property’s annual net income as percentage. It analyze from comparable property transaction.

The building price that hypothetical buyer would pay for own it.
Operating & Maintenance Expenses is a factor that is used in the DCF approach. It means all costs, expenses, disbursements, and expenditures also include taxes, if any. The building cost, such as Salaries & Wages expenses, Maintenance expenses, Energy expenses (i.e., electricity, gas, water, waste removal, Heating), Building management expenses, and other expenses. The major green purpose is to reduce energy costs. For continuing to green building study, therefore, this report will mainly focus on Energy expenses. The detail will merit in further investigation in this report (Scen et al., 2011)

Figure 6: Discounted Cash Flow (DCF) Approach
Operating expenses divided into three categories as fixed, variable and semi-variable. The first, “fixed expense” infers to static, constant and unaffected by a building’s occupancy, fixed energy expenses such as, exterior lighting, base building HVAC\textsuperscript{13} operation, elevators, escalators, lobby lighting, and etc. and other fixed expense also included insurance and taxes. When the landlord made agreement with tenant to charged fixed energy base expense (i.e 10%) and landlord will absorb the balance, therefore, fixed is fixed even the building occupancy decrease or fully occupied. This could reduce risk from expenses escalation as well as added more incentive (Eichholtz et.al, 2009)

\textit{Figure 7: Operating Expenses categories}

The second, “variable expenses” are fluctuation and proportionately affected by a building’s occupancy, some of energy expenses are variables in nature, such as, tenant electricity, increased HVAC demand from tenants, and etc. The last, “semi-variable expenses”, the combination between two categories, which refer to utility expenses and upon on contract term, such as, vending contract or outsource cleaning service. Landlord’s and/or property manager’s, however, will respond for the establishing or estimating proportional expenses judgment and the settle values should base on whether the building occupancy, as fully occupied or vacant.

\textsuperscript{13} HVAC implies to Heating, Ventilation, and Air Conditioning System in the building
For determination of market value by Income Approach\(^{14}\) which requires accurate market data for correctly ascertain the market value of a building (Armitage, 1997). ‘Market value’ is defined by the International Valuation Standards Committee (IVSC) as

> “the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arms’ length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion” (IVSC, 2005).

In contrast, the current green building commercial market, this empirical evidence is limited empirical data into sales and lease transactions as difficult to find as the current market for these buildings is still developing stage (Martinaitisa, 2005; Robinson, 2007; Myers et al., 2007; Mansfield, 2009; Sayce, 2010). Green building valuation also related on factors in income approach such as rental growth, depreciation, risk premium and cash flow (Myers et al., 2007).

Other approach, the cost approach is commonly used to determine valued for finding cost value and potentially insurance valuation. The Australian Property Institute (2006) defined the cost approach as “a set of procedures through which a value indication is derived for the fee simple interest in a property by estimating the current costs to construct a reproduction of, or replacement for, the existing structure plus any profit or incentive; deducting depreciation from the total cost; and adding the estimated land value”. This is not the current practice when determine income producing of commercial building market value which treated as an investment vehicle in property market (Robinson, 2007).

Myers et al. (2007) has mentioned hedonic pricing method whilst often involved in ecosystems or environmental services that used to estimated economic value of house prices. The model has attributed for variety of sustainable characteristics and also useful in real estate dimension. This method based on actual market value, choices and perception. The value of

\(^{14}\) Income approach, the present value of the future benefits of property ownership is measured. A property’s income streams and resale value upon reversion may be capitalized into a current, lump-sum value. The income approach initially determines the income-producing capacity of a property by comparing market rent from comparable rentals. Deductions then are made for vacancy, operating expenses as well as fixed charges and costs. The resulting streamline of net operating income is discounted to arrive at an indication of value.
specific property, therefore, determined by willing to pay price for property changes from buyers.

Such as, changes in number of rooms, balcony size, toilet facilities, kitchen facilities, fire protection, or other attributes. It will relate with attributed changes in individual building (Shimizu, 2010). However, this method required issue of data and volume for analysis which are less available in property green market and also need expertise for statistic research. Due to these criteria, it seems not easy for professional valuer to adapt this method into their valuation process.

Valuation in general based on principle and theory. The green assessment, however, will concern the factors of environmental conditions, economic circumstances and social trends for major judgment of assessment value, whilst contrast to valuation in conventional building. Lutzkendorf et al. (2005) said that it needs more advanced method for green valuation such as hedonic method which contrasts with Boyd (2006). He argued that the traditional method is already enough for valued. It criteria is least complex which is easier to gathering data for valuation. Therefore, income or investment approach is the appropriate judgment approach in the sense of qualitative information of sustainability such as pubic benefit (Myers et al., 2007).

4.3 Commercial Green building: Construction cost and Energy Expenses

From unstable in economic situation, increase taxes, higher living cost may cause this expense tend to be continuing increase as year passed by. Therefore, the present trend, building owner and management try to seeking way to reduce its Operating & Maintenance Expenses while continue to provide high reliability and service quality to their customer. The solution which seems very popular in past few years is focused on green building. However, construction cost of green might be increasing higher when compare with traditional building, effected from more complexity in construction and design. Furthermore, after building finished, energy expenses may not lower as it expected.
4.3.1 Construction Cost

RICS research has showed many interest reasons, which could block idea about green project. Like this obvious one as new construction or renovation, while, beyond from the current lack of sustainable measures knowledge that always occur with the idea of much higher investment in the green project than typical office building project. Effected from investors’ opinion, green building has required more delicate and complicated in constructed process and need to incorporate with special material and equipment in construction.

Other reasons such as building’s users resist about change, structure and physical of existing building is not suitable and difficult for reconstruct even change in dimension and appearance, disturbance levels during construction, maintenance care and costs are ongoing require, high costs of installation and constraints when compared to saving cost and take process for planning and approval.

Kats (2003) have suggested about construction cost between Green and conventional building, ‘Green buildings cost roughly 2% more to build than conventional buildings’. From the report which represented by Langdon to the Urban Green Council, by collected construction costs for 38 high-rise multifamily buildings and 25 commercial interiors in New York City. It has been shown that construction cost differential for new buildings is less than 1% and for commercial interiors, the cost for LEED construction is actually 6% lower than for non-LEED15.

If in case, the cost differential to construct or renovate for better building is acceptable and/or modest. This should be really attractive to management or investor to stock percentage of green buildings for overall offices and other property types. But why green real estate still low in market – affected from fact that real estate lasts a long time. However, it has some case shown after building has been retrofits then percentage grow rapidly. For example, case of Empire State Building is receiving $20 million energy efficiency retrofit, they expected to save $4.4 million in annual energy costs and reduce energy consumption by close to 40%, forecast repay for next extra cost in about three years, and benefit to zero carbon output16.

15 Source: www.costar.com retrieved on 1 October 2011.
16 Source: www.cbre.com retrieved on 1 December 2011.
Another interested example, Philip Merrill environmental center building, “the greenest building in the world", located at Maryland, USA. The two-story office and conference building was finish in year 2001, the area was 3000 m2 (32,000sq.ft.) and total project cost excluding the land was $7.5 million. This was the first Leadership in Energy and Environmental Design (LEED) Platinum building, as certified by the U.S. Green Building Council. The best performance was too reducing energy demand due to 40% and water consumption was 94% less than conventional building. Approximately water savings were 7,600 m3 for average four-year (or 2 million gallons) whilst saving about $8,000 per year in water and sewer costs (Mills, 2010).

4.3.2 Energy Expenses

An energy expense is the most significant and largest portion when compare with overall operating expenses. Energy expenses are often defined as electricity expenses, which is often greater than the other expenses, i.e. property taxes. When attaining Green certificates in energy efficiency, the common targets for owners are not only limited to energy efficient construction processes but also attaining awareness on operating expenses and/or electricity charges of existing buildings.

Miller (2010) examines 139 green buildings in the United States where the operations and management perspectives were considered. The study also included 103 buildings that do not have green label. The result had shown green buildings are more energy efficient when compare with non-green buildings; as more saving on electricity, gas, and water costs. Miller (2010) has shown that green buildings’ operating expenses are higher than the non-green buildings due to additional non-energy related expenses, i.e. intensive management required for sophisticated building systems.

Other suggestion to reduce Operating & Maintenance Expenses by Condition-Based Maintenance, the new interesting solution program, which based on hardware and software tools, the benefit is to reduce maintenance activity, avoided catastrophic losses, and extended equipment service life. Expected major benefit could provide into two categories as Monetary and Soft benefits (reliability or availability and safety). This study will not focus in detail of this program but for more in additional information may find in future research (John, 2001)
For best practice on overall building energy efficient, therefore, it required the combination between operation, maintenance and tenant behavior practices. Miller had suggested green building operation procedures which included “(1) an integrated pest management program to reduce/remove toxic chemical pesticides; (2) a no-cost/low-cost best practices plan to conserve energy and water; and (3) a recycling program.” These are also similar to comparative analyses of green cleaning and energy-saving devices (Miller et al., 2010). The answer will be support in the conclusion part.

The occupant and operator behavior practices are less significant when involved with the climate. Especially, in the cold climate needed loaded of energy for heat the building. It contrasts in warm and cooling climate, whilst these practices are important. For example, increase lighting will affect HAVC energy to be additional require. The tenant and building operations effects, if together, it will influence building energy use increase from 80-140%, or can reduce energy use about 30% by compare with the typical building. However, to answer the research question, analyze of problems and solutions will provide later on.
5. EMPIRICAL STUDY

From literature review, now continue to review the external source as survey data. It is to discover answers in order to support research question, “Does the added gap value exist between a typical commercial building and a green commercial building as seen in graph (a) or graph (b)?”\(^{17}\) The main objective is to explore green commercial building benefits and there are many factors that could affect green value. As mentioned in the previous section, this study will mainly focused on construction costs and energy expenses since these are the main factors impacting the green value costs and benefits. The questionnaire is divided into 4 parts; A to D. Evaluation will be made from results within each part, with conclusion drawn in the end.

Survey questions examples:

- Job specification
- Experience in Green building
- The difference in valuation value between GCB and conventional building (with similar characteristic building)
- Any experience or have been involved in Green commercial building (GCB) valuation?
- Which of the following Approaches have been used in valuing GCB?
- During construction period, why the construction cost of GCB is expected to be higher?
- During the building operating, why energy expense of some GCB could not lower than expect?
- Valuation standard opinion

Otherwise, the formal paper of survey questions will be present in Appendix A. This survey is entailed to support the earlier theory, with the purpose of acknowledging and expanding areas of study.

\(^{17}\) See graph on page 8
5.1 Analysis of Survey

5.1.1 Part A: About general information of respondent

The questionnaire was sent to real estate specialists whilst respondents in this research have different specific services: valuer, developer, consultant/advisory, researcher, building owner, corporate finance and agent. The positions include company owner, CEO, vice-president, director, head of valuation, head of research, head of transaction and valuation, property manager, environmental manager, advisor, surveyor, agent and associate. The respondents firm are from Europe, North America, Africa and Asia which all related to real estate criteria. The highest majority of respondents by job specification are valuer and the second is consultant/advisory and mainly are from Sweden and followed by U.S. which are 50 specialists have respond the survey and 80% are finished the survey.
5.1.2 Part B: Green building valuation

Regardless of the results, survey show more than half of the respondents has experience in green buildings with coverage less than 10 buildings except one respondent that has experience with more than 25 buildings. About the profit turnovers, after comparison between typical building and green building, the respondents partly agree about higher return in green building as well as partly agree about green building turnover as high as expected. Through survey raw data, it occurs that inexperience respondents have ended the survey after answering 'No' in question about green experience, which helps increase the accuracy of this analysis.

Figure 11: Respondents experiences in Green buildings

Besides that, the final value seem to be similar between these two type of buildings. This may be because respondents' majority are Swedish, so the answers are based on the Swedish Land Code. It is mandatory regulations for the benefit of the tenant by confront that the rent levels must be set at a reasonable rental market value, comparing to similar premises in similar locations. Up to date, there is no specific green market value in the market, plus there is less green building in the market, making it difficult to obtain green datas. Results are used from market values of typical buildings instead. But if commercial leases agreement are entered into for a term of three to five years, the rental rate is needed to change by following the Swedish CPI (Consumer Price Index).

Either way, after infer from the theory section, these can be the effects from higher repair & maintenance cost of green than typical buildings that result in decrease of building value or may occur from many reasons such as constuction cost, experience of constructor and designer, known-how of building users, sales and marketing potential of location, or other factors. Otherwise, further investigate will be provided later on.
5.1.3 Part C: Green commercial building valuation: office or retail type

This part is divided into three sub-categories, which are questions about valuation premise, advantages/disadvantages after comparison between green commercial building (GCB) with typical building, and reasons behind why GCB is too high during construction period or could not be as low as expected during building operation.

Valuation premise

Previous survey part shows that more than half of the respondents have participated in green building premises before. However, when asked about experience in GCB valuation, more than half of all respondents do not have the experience and knowledge background in this. Nevertheless, about 80% of those who have experience in green building is involved with GCB. Besides that, all experts who continue to participate in survey respond from their knowledge and working experience.

On GCB approach for valuation, the results show preference of using Market Approach, Income Approach (DCF method) and Cost Approach. Most respondents tend to choose only Income Approach (DCF method), with some prefer both approaches to make decision for final judgement value. Except for one respondent prefer to add Cost Approach as well. These support what have been said in the theoretical section. There is no different in valuation process between both types of buildings, whilst added remark to valuation report should be required. It should be about “this subject property is green building” in professional sentence.

Despite the difference in valuation value between both green and conventional buildings (comparison between buildings with similar characteristics), all respondents said there is small difference in valuation value and green is mostly higher than typical ones. Even though, rental rate has been adjusted at average around 2-4% plus from market value of typical building and if recall to Swedish Land Code, GCB rental rate needs to be based on market rental rate basis from typical one. Then GCB rental rate will not bubble from market value.

Because of small difference, it takes higher construction cost to incorporate green mission and buildings need to use specific machine equipment which affects repair and maintenance expense increase. These will cause less value added in profit (valuation value) after deducting costs and expenses from revenue. Even though green buildings have higher construction costs
and the profits may fail short of expectations, the positive effects they have on the environment are invaluable for both nature and human.

*When compare between Green commercial buildings (GCB) with typical buildings*

Between both green and conventional types of buildings, results show specialists partly agree in higher valuation value. This also related to what had been said in Valuation premise about small gap between these two types of building in which GCB value is generally higher than typical building value. Because of GCB has lower operating expense, lower energy expenses, higher occupancy rate, higher rental rate, less repair and maintenance cost and lower capital and discount rate.

However, when forecasting on long term value, valuation value will be higher but not necessarily always. These shall up to additional efficiency in characteristics, machinery and performance of building. One notable problem that arises in both theoretical section and the survey is that comparable data of GCB is difficult to obtain. Because GCB is still new premise in the market, it can be hard to find comparable data for appraisal especially for market approach mentioned in theoretical section and Valuation premise section. There are more discussions about green benefits in the following table:

**Table 3: The results after compare between GCB with typical building**

<table>
<thead>
<tr>
<th>Green Advantages</th>
<th>Fully Agree</th>
<th>Partly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>More efficiency in saving operating expenses</td>
<td>Higher valuation value</td>
<td>Higher valuation value in long term forecast</td>
</tr>
<tr>
<td>Lower energy expenses</td>
<td>Higher rental rate</td>
<td>Higher in occupancy rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower maintenance expenses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less repair and maintenance cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower capital and discount rate.</td>
</tr>
</tbody>
</table>

**Green Disadvantages**

| Comparator data is more difficult to obtain | Higher construction cost |

Respondents partly agree that GCB have to rely on lower maintenance expenses, less repair and maintenance cost and lower capital & discount rate. Assuming that it does not decrease energy expenses as expected, while higher construction costs are taken into account, the final
value will be lower from forecasted value, resulting in smaller differences. In another word, CGB final value depends on the construction cost in order to widen the difference gap from the typical buildings.

But the results show that all experts have agreed on energy statistics that GCB are more efficient in saving operating expenses and that total operating energy expenses is lower. But how come there is only small difference in the final value gap? This could occur from GCB over construction cost, or that energy expenses are not as low as it should be, resulting from the lack of green material development, inadequate knowledge and known-how. Up to date, green repair & maintenance cost is not as low as expect. It seem that high rental rate, high occupancy rate and lower energy expense are not significant enough to result in larger difference gap.

**Reasons behind green commercial building that value does not seem as forecast**

This topic concentrates on the process from buildings development to building operation. These two processes normally generate costs and expenses which will affect the present and future final valuation value. This study is to reassure and support answers about small difference of valuation value between GCB and typical building in 'Valuation premise' section as well.

**a. During construction period, construction cost is higher than expected**

There are many reasons behind why construction cost of GCB is expected to be more expensive than typical building or in some cases, the cost is over the budget. From what have been said in the 'Theory' section, it can divide into four major problems and respondents all agreeing with these factors. The top two actual reasons are too expensive green material cost and too high cost of green design then followed with the need of CGB specialists and last reason is less experienced engineers and constructors. However, some respondents had suggested other problems such as the case of inexperience in redesigning to improve the level of greenness of the building, more complexity in construction and the cost cannot be generalised because it depends on how the building performs.

**b. During building operation, energy expense is not lower than expected**

When operating GCB, all specialists agreed that the major problem is from “users” having less or lack of know-how to use the building in full benefit. As mentioned before, users are not only landlords and tenants but also include two operative units: one as 'building...
operator' such as facility manager or machinist, and the other as 'office staff' such as cleaning staff or office operator. Next reason – the material problem. It seems that green material does not work as it advertises and maintenance cost is too high. And the least chosen reason is the need of specialist to operate in GCB. Additionally, one expert had given a comment about problem of additional features, as in some cases, they may be introduced to the building that weren't anticipated in the design process.

These results are the main problems that occur nowadays. To achieve more profit to GCB, green material and design cost need to be decreased. Green material development and GCB study are required. Knowledge spillover is entailed from real estate specialists who have experience in green thus during construction period and during building operation. Building manual and seminar is a necessity for GCB users. If all users follow the correct instructions then it will lead to maximum GBC efficient. Thereof, GCB value will increase and could lead to larger difference in value gap.

5.1.4 Part D: Other information about valuation standard practice

For the valuation standard, the majority respondents preferred Royal institute of chartered surveyors (RICS) from Britain and SFF (Swedish Society of Financial Analysts) from Sweden to apply for GCB and green building valuation. Other standards are also included from Sweden appraisal organization as Miljöbyggnad (Sweden Green Building Council), ASPECT (Association for Surveying, Property Evaluation and valuation), and ASREA (Association of Swedish Real Estate Agents) and from U.S. and Canadian appraisal organization as USPAP (Uniform Standards of Professional Appraisal Practice).

Normally, the valuation standard is required for property appraisal and it will be different in each continent or country. It depends on organizations that they rely on. The latest standard mainly focuses on typical building, hence it may prove obstructive to valuer to do appraisal of green building and GCB valuation because valuation standard entailed in valuation report and useful information about green building valuation is not adequate. Regarding lack of green information in the survey, 60% said they never received any information related to green building valuation standard practice.
Half of the specialists said valuation standard needs to be adjusted and improved by adding green details. However, some respondents have mentioned that current valuation standard is already acceptable. They think it possible to adapt current valuation standard practice to green building purpose, claiming it is unnecessary to create different valuation methods and valuation reports between green and conventional building, yet remark is still necessary. As specialists believe that different type of building, building material and building benefits are about more revenue and less expense, it should not reflect to transform valuation method and report.

About the remark that should be added in green building valuation report, it should mention that “the subject property is green building” and provides an explanation about green building in the professional sentence. Normally to appraisal building, market comparable data of other similar green buildings are demanded. But it is difficult to obtain it currently. Because researches show there is not much difference gap between these two types of buildings, the valuers have suggested that it is possible to use market comparable data of typical building into the valuation process.

5.1.5 Summary of the survey

The goal of green building is to lower energy expense but normally it comes with higher construction cost than typical building. Besides, to limit construction cost to not exceed over the budget, specialists with experience and knowledge in green premise are needed. However, the specialists who met these requirements are not enough in the market. Furthermore, projects then will need to change the constructor's, architect's and designer's practices. They may not have enough or no experience in green premise causing the lack of known-how to control the budget or use green materials appropriately.

There is added gap exist between two type of building but occurred in small different as small gap case in graph (b)\(^{18}\). While the major role of GCB is to save energy expense, but if users do not have enough repair & maintenance knowledge, while specialists providing mentioned services can be costly, the energy expense will not be as low as it should. And because this reasons out weights from the increase rental rate, increase occupancy rate and decrease in energy expense combined, the difference in valuation gap is small.

\(^{18}\) See graph on page 8
Effected from green building vision is very new to the market. In between, most real estate specialists have less or no knowledge in GCB or even in normal green building. Real estate market lacks green information especially in the valuation standard and comparable data are difficult to search for. The valuation method and valuation report are seen unnecessary to change. Therefore, it is crucial to add green real estate premise into valuation standard for more understanding in green valuation. Knowledge spillover is required to promote green and to increase potential to real estate specialist.
5.2 Example Cases of Green Buildings in U.S.

This part will base on the case studies of green commercial buildings, in order to reassure the survey results and adds more knowledge to the research question. The case study was provided by the New Building Institute (or NBI), where 13 projects on mid-size commercial buildings in the U.S. were selected for investigation. These 13 projects have accomplished green vision goals and some have attained ratings by famous energy institutions. These also include new construction green building and renovated buildings with aims to achieve green status.

This investigation only considered the latest renovations made on the building of study. The renovation took place during 1989-2010. The least floor areas at 2.5 stories with 10,100 square meters and the most area is at 1 story with 106,000 square meters. The scopes of buildings are floor levels between 2.5 till 19 stories with floor area more than 10,000 square meters.

It also considered the causes of the problems as well as provided the solutions, where the processes involved from planning to construction were also considered. It should to be noted that not every buildings considered in this study have reached the construction phase. Problems and solutions are divided into several categories, including ‘Barriers and resolutions to energy efficiency measures’, ‘Competitive positioning in market’, ‘Tenant’, and ‘Staff Education/User Satisfaction’. The impact of individual measures may be relative to each other and also be useful to consider the cumulative impacts of variables within the control of different building performance participants. The detailed of study is continued in follow section.

Regarding “the New Building Institute (NBI)\textsuperscript{19}”, it is non-profit organizations founded in 1998 with goals improve the energy performance of commercial buildings. The office located in Washington State, U.S.A. To accomplish the goal of removing energy efficiency barrier, the institution has cooperated with building market’s stakeholders including: governments, utilities, energy efficiency advocates and building professionals.

The institution has been funders and project partners with the Energy Foundation, U.S. Green Building Council, American Institute of Architects, U.S. Department of Energy, Environmental Protection Agency, and leading electric utilities and public benefits administrators. Its responsible for introducing and promoting the advanced design practices, improving energy efficient program and technologies by doing research, launching public policies, invented guidance to individuals and organizations on designing and constructing energy-efficient buildings, and also guidance the project management services to create energy efficiency.
### 5.2.1 Green Building Cases in U.S. in year 2011

<table>
<thead>
<tr>
<th>Building</th>
<th>Location</th>
<th>Building Type</th>
<th>Usage size</th>
<th>Floor Area (m²)</th>
<th>Year of Occupancy/Completion</th>
<th>Year of last renovation</th>
<th>Recent Project Retrofit Cost excl. Land ($)</th>
<th>Occupancy</th>
<th>Annual Energy Purchased (MJ/m²)</th>
<th>Energy Cost Reduction</th>
<th>Simple Payback Period</th>
<th>Energy Efficient (compare with conventional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Rosslyn, WA</td>
<td>Commercial office</td>
<td>12 stories</td>
<td>29,100</td>
<td>1987</td>
<td>2010</td>
<td>1,100,000</td>
<td>100%</td>
<td>727</td>
<td>25%</td>
<td>&lt; 2 years</td>
<td>35%</td>
</tr>
<tr>
<td>B</td>
<td>Portland, OR</td>
<td>Commercial office</td>
<td>19 stories</td>
<td>36,100</td>
<td>1973</td>
<td>1989</td>
<td>26,191,000</td>
<td>98%</td>
<td>738</td>
<td>30%</td>
<td>5 years</td>
<td>30%</td>
</tr>
<tr>
<td>C</td>
<td>Overland, MO</td>
<td>Commercial office</td>
<td>2 stories with mezzanine</td>
<td>10,100</td>
<td>2004</td>
<td>2010</td>
<td>20,100,000</td>
<td>90%</td>
<td>353</td>
<td>-</td>
<td>7.5 years</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>Seattle, WA</td>
<td>Commercial office and Retail</td>
<td>6 stories</td>
<td>17,200</td>
<td>2006</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>591</td>
<td>43%</td>
<td>-</td>
<td>50%</td>
</tr>
<tr>
<td>E</td>
<td>La Jolla, CA</td>
<td>Commercial office</td>
<td>11 stories</td>
<td>23,500</td>
<td>1990</td>
<td>2008</td>
<td>801,540</td>
<td>-</td>
<td>261</td>
<td>63%</td>
<td>4 to 6 years</td>
<td>63%</td>
</tr>
<tr>
<td>F</td>
<td>Atlanta, GA</td>
<td>Commercial office and Public order &amp; Safety</td>
<td>13 stories</td>
<td>32,900</td>
<td>2006</td>
<td>-</td>
<td>115,000,000</td>
<td>100%</td>
<td>253</td>
<td>-</td>
<td>15 years</td>
<td>20%</td>
</tr>
<tr>
<td>G</td>
<td>Sacramento, CA</td>
<td>Commercial office, retail and Day care</td>
<td>6 stories</td>
<td>31,200</td>
<td>2002</td>
<td>-</td>
<td>75,000,000</td>
<td>100%</td>
<td>494</td>
<td>-</td>
<td>Non-profit organization</td>
<td>43%</td>
</tr>
<tr>
<td>H</td>
<td>Kansas City, MO</td>
<td>Commercial office and Industrial</td>
<td>1 story</td>
<td>106,000</td>
<td>2006</td>
<td>-</td>
<td>254,000,000</td>
<td>100%</td>
<td>610</td>
<td>-</td>
<td>Non-profit organization</td>
<td>53%</td>
</tr>
<tr>
<td>I</td>
<td>Sunnyvale, CA</td>
<td>Commercial office</td>
<td>5 stories</td>
<td>54,300</td>
<td>1983</td>
<td>2010</td>
<td>50,000,000</td>
<td>-</td>
<td>227</td>
<td>50%</td>
<td>4 years</td>
<td>-</td>
</tr>
</tbody>
</table>

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20 State abbreviation: VA(Virginia), OR(Oregon), MO(Missouri), WA(Washington), CA(California), GA(Georgia)

21 Million Joule per square meter
5.2.1 Green Building Cases in U.S. in year 2011 (Continued)

<table>
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<tr>
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<th>Annual Energy Purchased (MJ/m²)</th>
<th>Energy Cost Reduction</th>
<th>Simple Payback Period</th>
<th>Energy Efficient (compare with conventional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>Oak Ridge, TN</td>
<td>Commercial office and Laboratory</td>
<td>5 stories</td>
<td>18,100</td>
<td>2006</td>
<td>-</td>
<td>41,777,417</td>
<td>100%</td>
<td>2,750</td>
<td>-</td>
<td>Non-profit organization</td>
<td>25%</td>
</tr>
<tr>
<td>K</td>
<td>Arlington, VA</td>
<td>Commercial office and Retail</td>
<td>12 stories each</td>
<td>60,800</td>
<td>2000</td>
<td>2006</td>
<td>3,956,100</td>
<td>65% by Federal government</td>
<td>422</td>
<td>20%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L</td>
<td>Seattle, WA</td>
<td>Commercial office</td>
<td>14 stories</td>
<td>12,400</td>
<td>1929</td>
<td>2007</td>
<td>3,500,000</td>
<td>90%</td>
<td>443</td>
<td>24%</td>
<td>-</td>
<td>58%</td>
</tr>
<tr>
<td>M</td>
<td>Stanford, CA</td>
<td>Commercial office and Laboratory</td>
<td>4 stories</td>
<td>15,500</td>
<td>2008</td>
<td>-</td>
<td>120,000,000</td>
<td>100%</td>
<td>719</td>
<td>-</td>
<td>6.5 years</td>
<td>57%</td>
</tr>
</tbody>
</table>

5.2.2 Green Building Cases Analysis

To study the impacts which are affected to the building energy uses and expense level of green building after construction finished. Thereof, the study will identify the causes of unexpectedly high expenses. The study result also reflects on perception of how buildings work. This analysis has designed for taking consideration from case study of building A till building M by analyze from external/internal factors such as location, region, weather, type of building, building characteristics; size, floor area, age of building, energy purchased and so on.

Why should considered the weather? The weather also affected to the energy purchased such like the building has used more energy for heater in the winter or more air conditioner used in the hot climate zone. Especially, climate in U.S. will different in each region. And the location is the most important factor for real estate. It could cause to higher or lower in building value. Construction cost in different areas and year of...
buildings completion are related to price flexibility in building value, such as higher construction cost if buildings are in prime location that leads to higher in building value and in some cases, more recently completed buildings could also increase building value. However, the study shows that climate, usage size and floor area does not reflect energy purchased much.

The main focus is based on how buildings are organized and process control in energy is used, which was different in each one. Like the age of building, fewer years will lead to less deduction in building depreciation and cause to have more building value. On energy saving premise, newer generation buildings will turn out to save more energy because of technological advance and experience gained in management team, design team as well as construction team.

For example, “Building I” is the most successful in energy potential premise. This result from its characteristic in construction and design that use passive solar daylight strategies and in the main hall, the large central atrium utilized tall exterior windows, light shelves, and slope ceilings. These were achieved through adequate designers and architect’s known-how to maximize building energy from natural lighting to reduce the use of electrical lighting.

If building shows experience in energy saving, this does not mean it will receive maximize profit from energy saving. The type of buildings are also effect on how increase or decrease in energy purchased such as high energy purchased in building H that has usage area for commercial and industrial. Follow by building J and building M that have purpose for commercial and laboratory. These two buildings have low building profit return and have less experience in saving energy.

From these analyses, major contributors to energy efficiency can be categorized into two groups: design teams and building users. The study result also reflects on building management perspective.
**Design Team -- Architect and Interior designer**

The study shows that the design team has the most impact on energy building which also influences building management perspective. The team is responsible for deciding on building features and system designs. Design team also interprets requirements from developers (owners) and tenants. Design team may also calculate the initial construction budget as well as creates and controls the design to comply with project budget.

In order to achieve energy efficiency, it is essential to create cooperation between the design team and the construction team (e.g., between civil engineer and constructor team). Lack of successful team collaboration and negotiation may lead to higher construction cost, longer time schedule for constructing, or even unsuccessful green perception plan. Teams’ experience seems to be less important, especially to having knowledge about green-characteristic concept. For example, a simple action to reduce energy use from lighting by painting the light color on walls and ceilings or in a more complex work, like installing enhanced glazing into the design process.

**Building Users -- Operation (Building Management, Facilities control and Maintenance staff), Landlord (Owner) and Tenants**

Operation's and tenants' behavior is the other effect that impacts energy use. The study has shown the building management who has energy usage knowledge will tend to achieve in efficient building performance. Especially when the construction of the building is completed, the impact of energy uses from design improvements will adversely be transferred to building users. In this participation, these users not only referring to operation and maintenance staffs, owner, and tenants but also including everyone who has happened to use the facilities in the building. Tenant has the most direct impact on building energy use. The practice for reducing energy consumption such as organizing schedule for plug-load density and night use should become tenant habits, while setting temperature control and lighting control level is operation's responsibility.
If Design Team and Building Users have cooperated

“Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organizational objectives. It is the fuel that allows common people to attain uncommon results.”

Prioritization of energy strategies through cooperation between design team and building users is significant. Design team needs to spread know-how on how buildings work and communicate to building users about building performance information and its operation. It will be more practical if the design team invites the building operation and maintenance staff into the design process. And the design team could also provide or create building operation manuals, training programs or initiate building operation procedures.

Another suggested plan for reducing energy use by installing means of monitoring electricity consumption (e.g. meters, gauges and energy dashboards). In order to address for the better result, matrices should be given for packages of measures to represent the range of performance that might be expected from the combination of design, operating, and/or tenant behavior decisions. However, energy consumption behaviors are the main driving mechanism for energy use and completely independent from building design. To achieve energy efficiency for GCB, it is not only buildings designer who are main responsible but it rather involves with buildings users (as non-design aspect) like building operators and occupants as well.

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23 Andrew Carnegie (November 25, 1835 – August 11, 1919), Scottish-American, was the success industrialist who held the enormous expansion of the American steel industry in the late 19th century and was one of the most important philanthropists.
5.3 Discussion

According to survey results and supported information from case study, green building is still truly advantageous in lower energy expenses. However, in order to lower expenses even further, it is up to design team experience and building users' know-how. Experiences of constructor also affect the appropriate value of construction cost. If the constructors can figure out the issue on higher construction, repair and maintenance cost, this will be superlative beneficial to GCB's value increase. This will generate more income to the building and will be like an invitation for new developers to join this practice.

Not only inexperiences that lead to higher in construction cost but type of building, different location, renovate/redesign and year of buildings completion are related to price flexibility in building value, such as renovating 30 years typical building to green purpose, redesigning to improve the level of greenness of the building or take more construction cost for the commercial and hospitality purpose. Even cost of green materials and equipments price are high but the price will be different from each location and is include labor cost as well. Thereof, location as Asia has lower construction cost than europe or U.S. In contrast, europe and U.S. have cheaper price in green equipments because they are quite accomplish on know how of it.

The latest generation building completed would cause to increase in building value by new technologies have been introducing into the construction process and existing knowledge have been spreading, implying and improving. Force to gaining experience to management team, design team as well as construction team. All buildings are unique not even building characteristics but also different in the way of organized and process control. It is importane to generate clear and specific process to easy understand and less confuse, especially for control in energy used premise. And specialist can be involving in GCB to solve the problems.

In order to achieve lower energy expenses, clear communication is needed for buildings users. Each building is unique. The usage patterns may differ in each building. Knowledge spillover is entailed from real estate specialists who have experience in green thus during construction period and during building operation. To maximize efficient energy use in existing buildings, users need to understand the uniqueness of their own building, transparent cost saving
comparisons, proper energy plans, building manual and so on. The smallest change like improvements in building performance could turn to have huge effects on the environment, especially in energy consumption. There are substantial potentials for energy expense reductions in commercial building practices.
6. CONCLUSIONS

Nowadays, every occupations involved with real estate have less practical knowledge in general green building or even more in green commercial building, albeit a small group. But not all specialists will make a breakthrough in green premise. Lack of green building information is entailed to improve especially adjusted valuation standard by adding green detail. To success in pursue of green, spread of knowledge and continuation to material development is needed especially to the major components to accomplish green vision; design team and building user.

Furthermore, after comparisons between a typical commercial building and a green commercial building, we can conclude that there is added value gap existing but it only occurs as small difference. It appears that high rental rate, higher occupancy rate and lower energy expense are not enough to widen the added gap. Moreover, the construction cost still tends to be over budget due to specific materials used and constructor's lack of experience with them. Buildings also required specific mechanical equipment in which special care is needed, and that also affects the repair and maintenance expenses.

As time passes, green commercial building will earn more profit than typical commercial building even it started off with higher construction cost. This is achieved by lowering the energy expenses. However, small difference in added gap still occurs, due to high repair and maintenance cost and also final construction cost in the beginning may still affect its value. The appropriate way to increase building value or maximizing energy efficient then heavily relies on design teams and building users. It is essential for design team (architects and constructors) to have knowledge in green premise to reduce construction cost and maximize efficiency for construction process.

Building users (maintenance staffs and office staff) require understanding the uniqueness of their building to lower energy usage and expenses. During building operation, the lack of ability to operate green commercial building would lead to higher-than-expected energy consumption. It is important for design team to spread the knowledge on how the buildings function and communicate to building users to make them understand how to manage them properly. Inviting building users to participate in the design process if possible is even better. Design team may also introduce building operation manuals and training programs. Even
though green buildings have higher construction costs and the profits may fail short of expectations, still, the positive effects they have on the environment are invaluable for both nature and human.

Moreover, commercial green buildings are relatively new in the market and still exist in small number in the commercial market. Too little data is making it difficult to collect and do proper research in the area. However, the green trend tends to be increasing and when the green data is adequate for proper marketing research, it will contribute to rapid growth and accomplishments in improving energy saving and lowering construction cost. I am deeply hopeful that this development will continue to grow and achieve the ultimate green building's goals – to create net-zero energy consumption buildings.
7. REFERENCES AND ATTACHMENTS


Appendix A: *Survey*

**Green Commercial Building (GCB) - Value added gap perspective**

**Introduction**

The propose of questionnaire is to get information which will be useful in research on Commercial green building value for defining potential and real value in green building whilst compare with conventional building. The questions are constructed in such a way that easily to be answered and are about among others, the company, Green building general information and valuation as well as Commercial green building valuation. The questionnaire requires between 10-15 minutes and has divided into 4 parts as A to D.

Your input will be greatly appreciated. Thank you!

**A: The Company and the respondents**

1. Name's of your company

2. The Company specification service

3. Your position in the company

4. Your job specification
   - Valuer
   - Consultant / Advisory
   - Developer
   - Other (please specify)

**B: Green Building Valuation**

5. Have you had experience in Green Building?
   - Yes
   - No

6. If yes; Experiences in Green building (please, select the years)
   - < 10 Buildings
   - 10 to 25 Buildings
   - > 25 Buildings
Green Commercial Building (GCB) - Value added gap perspective

7. Profit turnovers

<table>
<thead>
<tr>
<th></th>
<th>Fully agree</th>
<th>Partly agree</th>
<th>Fully disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher return in green than in conventional building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green buildings turnover has high value as expected</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C: Green commercial building valuation (Office or Retail)

Green commercial building (refers to GCB) compared with conventional commercial building

8. Do you have any experience or have you been involved in GCB valuation?
   - Yes
   - No

9. Which of the following Approaches have you used in valuing GCB?
   - Market Approach
   - Cost Approach
   - Income Approach (as DCF method)

10. Which of the following Approaches is the best for GCB final judgment?
    - Market Approach
    - Cost Approach
    - Income Approach (as DCF method)

11. Valuation process is different from conventional building
    - Fully agree
    - Partly agree
    - Fully disagree

12. How much the difference in valuation value between GCB and conventional building? (with similar characteristic building)
    - Large different
    - Small different
**Green Commercial Building (GCB) - Value added gap perspective**

### 13. GCB (compare with conventional building)

<table>
<thead>
<tr>
<th></th>
<th>Fully agree</th>
<th>Partly agree</th>
<th>Fully disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has higher Valuation value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The comparable data is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>more difficult to obtain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has higher Construction cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has higher Rental rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has higher Occupancy rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has more efficient to save</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating expense</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has lower Energy expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has lower Maintenance expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is less repair &amp;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has lower Capital and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>discount rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When forecast in long term,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>there still has higher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>valuation value</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 14. During construction period, why the construction cost of GCB is expected to be higher

- [ ] High cost of green material
- [ ] High cost of green design
- [ ] No experience enough; engineer, constructor
- [ ] Specialist need
- [ ] Other (please specify)

### 15. During the building operating, why energy expense of some GCB could not lower than expect

- [ ] Green material doesn’t work as it advertise
- [ ] Higher maintenance cost
- [ ] Users’ have less know how to use in full building benefit; facility manager, machinist
- [ ] Specialist need
- [ ] Other (please specify)
16. Which of the following Standards do you apply for green valuation?

- [ ] ASREA (Association of Swedish Real Estate Agents)
- [ ] RICS (Royal Institution of Chartered Surveyors)
- [ ] SFF (Swedish Society of Financial Analysts)
- [ ] Other (please specify)

17. Have you received any information related to green valuation standards before?

- [ ] Yes
- [ ] No

18. Valuation Standard opinion

<table>
<thead>
<tr>
<th>Present green building valuation standard need to be approve</th>
<th>Fully agree</th>
<th>Partly agree</th>
<th>Fully disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is important to make the difference in valuation methods between green and conventional building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is important to make the difference in valuation report between green and conventional buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Regards to Respondents

i Footnote I: Rating Explanation

The leading organization for setting standards for sustainable buildings is the U.S. Green Building Council’s (USGBC) LEED Green Building Rating System™—one of the most widely recognized sustainable building resources in the building industry. LEED (Leadership in Energy and Environmental Design), is a comprehensive set of voluntarily applied standards that designers, builders, and building owners can use to maximize both the economic and environmental performance of buildings. LEED for New Construction provides guidance for designing and constructing new sustainable buildings, while LEED for Existing Buildings provides guidance for upgrading existing buildings to a sustainable level of performance and operating these buildings sustainably over the long term.

Comfortable, healthy learning environments contributing to academic success and the achievement of each student’s maximum potential, necessary to be responsible and productive citizens and life-long learners beyond the classroom

Leadership in Energy and Environmental Design (LEED) is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies intended to improve performance in metrics such as energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Developed by the U.S. Green Building Council (USGBC), and spearheaded by LEED founding chairman Robert K. Watson, LEED is intended to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

Since its inception in 1998, the U.S. Green Building Council has grown to encompass more than 7,000 projects in the United States and 30 countries covering over 1.501 billion square feet (140 km²) of development area. The hallmark of LEED is that it is an open and transparent process where the technical criteria proposed by USGBC members are publicly reviewed for approval by the almost 20,000 member organizations that currently constitute the USGBC.

The Green Building Certification Institute (GBCI) was established by USGBC to provide a series of exams to allow individuals to become accredited for their knowledge of the LEED rating system. This
is recognized through either the LEED Accredited Professional (LEED AP) or LEED Green Associate (LEED Green Assoc.) designation. GBCI also provides third-party certification for projects pursuing LEED.

In LEED 2009 there are 100 possible base points plus an additional 6 points for Innovation in Design and 4 points for Regional Priority. Buildings can qualify for four levels of certification:

<table>
<thead>
<tr>
<th>Levels of certification</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified</td>
<td>40 - 49 points</td>
</tr>
<tr>
<td>Silver</td>
<td>50 - 59 points</td>
</tr>
<tr>
<td>Gold</td>
<td>60 - 79 points</td>
</tr>
<tr>
<td>Platinum</td>
<td>≥ 80 points</td>
</tr>
</tbody>
</table>
Footnote II: *Average Construction Cost (U.S dollars per square meter)*

*by type of structure in year 2011*

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Cities</th>
<th>Level of Office Building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 to 4 Stories</td>
</tr>
<tr>
<td>1</td>
<td>Atlanta</td>
<td>$1,653</td>
</tr>
<tr>
<td>2</td>
<td>Baltimore</td>
<td>$1,738</td>
</tr>
<tr>
<td>3</td>
<td>Boston</td>
<td>$2,209</td>
</tr>
<tr>
<td>4</td>
<td>Chicago</td>
<td>$2,199</td>
</tr>
<tr>
<td>5</td>
<td>Cleveland</td>
<td>$1,871</td>
</tr>
<tr>
<td>6</td>
<td>Dallas</td>
<td>$1,603</td>
</tr>
<tr>
<td>7</td>
<td>Denver</td>
<td>$1,764</td>
</tr>
<tr>
<td>8</td>
<td>Detroit</td>
<td>$1,929</td>
</tr>
<tr>
<td>9</td>
<td>Houston</td>
<td>$1,629</td>
</tr>
<tr>
<td>10</td>
<td>Kansas City</td>
<td>$1,927</td>
</tr>
<tr>
<td>11</td>
<td>Los Angeles</td>
<td>$2,012</td>
</tr>
<tr>
<td>12</td>
<td>Miami</td>
<td>$1,683</td>
</tr>
<tr>
<td>13</td>
<td>Minneapolis</td>
<td>$2,111</td>
</tr>
<tr>
<td>14</td>
<td>New Orleans</td>
<td>$1,638</td>
</tr>
<tr>
<td>15</td>
<td>New York City</td>
<td>$2,496</td>
</tr>
<tr>
<td>16</td>
<td>Philadelphia</td>
<td>$2,145</td>
</tr>
<tr>
<td>17</td>
<td>Phoenix</td>
<td>$1,661</td>
</tr>
<tr>
<td>18</td>
<td>Pittsburgh</td>
<td>$1,894</td>
</tr>
<tr>
<td>19</td>
<td>Portland</td>
<td>$1,875</td>
</tr>
<tr>
<td>20</td>
<td>St. Louis</td>
<td>$1,925</td>
</tr>
<tr>
<td>21</td>
<td>San Diego</td>
<td>$1,952</td>
</tr>
<tr>
<td>22</td>
<td>San Francisco</td>
<td>$2,320</td>
</tr>
<tr>
<td>23</td>
<td>Seattle</td>
<td>$1,971</td>
</tr>
<tr>
<td>24</td>
<td>Washington, Dc</td>
<td>$1,837</td>
</tr>
<tr>
<td>25</td>
<td>Winston-Salem</td>
<td>$1,419</td>
</tr>
</tbody>
</table>

*Source: RSMeans cost data publications for the A/E/C industry (www.rsmeans.com)*
Footnote III: Census Bureau-designated areas

Regional divisions used by the United States Census Bureau:

![Regional divisions map](source: Wikipedia, 2006)

U.S. has decentralize into 4 regions and it sub into 9 division by following:

<table>
<thead>
<tr>
<th>No.</th>
<th>Region</th>
<th>Division</th>
</tr>
</thead>
</table>
| 1   | Northeast | Division 1 (New England)  
- Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut  
Division 2 (Mid-Atlantic)  
- New York, Pennsylvania, New Jersey |
| 2   | Midwest  | Division 3 (East North Central)  
- Wisconsin, Michigan, Illinois, Indiana, Ohio  
Division 4 (West North Central)  
- Missouri, North Dakota, South Dakota, Kansas, Minnesota, Iowa, Nebraska |
| 3   | South   | Division 5 (South Atlantic)  
- Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida  
Division 6 (East South Central)  
- Kentucky, Tennessee, Mississippi, Alabama  
Division 7 (West South Central)  
- Oklahoma, Texas, Arkansas, Louisiana |
| 4   | West    | Division 8 (Mountain)  
- Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico  
Division 9 (Pacific)  
- Alaska, Washington, Oregon, California, Hawaii |

-59-
The weather in U.S. will different in each region, according from example “case of green building”, there are only three regions in this cases by following detail;

- The Midwest of U.S. (West north central): The region is *moderately dry in late spring and early summer*. It has a humid continental climate with thunder storm sometime in summer vice versa in the winter, *with heavy winds and snowfall*. The average of snowfall is more than 100 inches. The lowest temperature could be minus 46 degree C.

- The West of U.S. (Pacific): The rain shower climate all year round. The average temperature is around 32.2 degree C. In the coastal area, has *drier climate in summer than mild winter*. However, *summer is pleasantly warm*. It also has fogs along the coast during the warmer condition but the fog is less dense during midday. Especially in California that has nice weather all the year round which only few places in the northern part of the state that chilly cooler and experience snow.

- The South of U.S. (South Atlantic & East South Central): *Moderate rains* all the area through year round and *always pleasant in spring, summer and fall*. There has short lived and quite mind winter but also has snow and freezing rain in some area.