

EarthCraft Homes Costs more than Conventional Homes

Garg Gunjan, B.Arch., and Khalid Siddiqi, Ph.D.

Kennesaw State University

Marietta, Georgia

The objective of this study was to identify the construction cost differential between EarthCraft and conventional homes within Atlanta Region. The study included comparable projects completed by the EarthCraft homebuilders and conventional builders. The survey method included collecting data through a specially designed structured questionnaire and some face-to-face interviews. The respondents to the survey included EarthCraft homebuilders operating in Atlanta region, and some were randomly selected for face-to-face interviews. The intent for the survey was to identify strategies and associated costs involved in EarthCraft homes. The intended audiences are potential homebuyers and conventional homebuilders who might invest in EarthCraft homes. The result from the study provides a cost comparison of EarthCraft and conventional single-family homes of the same size. The projects analyzed in this study were similar in terms of type, use and location attributes. The study concluded that most of the features of Earthcraft homes costs in a range of 1-5% more than conventional homes if all other factors are kept constant.

Key Words: EarthCraft House, Green homes, Sustainable Construction, Construction Costs, Cost Differential

Introduction

The objective of this study was to identify the construction cost differential between EarthCraft and conventional homes within Atlanta Region. It is hypothesized that Earthcraft homes costs almost 20% more than conventional homes just in terms of construction cost assuming that rest all other factors are constant. The primary purpose of this study was to do a cost analysis and provide more information to homebuilders and potential buyers regarding Earth Craft certification for single-family homes within Atlanta region. The scope of the study included only construction of new single-family residential homes and not renovated homes. The study aims to improve the management & Business practices; Public & Government policies in construction Industry. The analysis provides figures that are more realistic and shows an inclination of people towards green practices. The contribution to this research was production of the data through a specially designed structured survey questionnaire conducted among EarthCraft homebuilders and non-EarthCraft builders in order to interpret findings that results in a conclusion.

Background

Construction sector presents a large opportunity to reduce society's energy consumption and environmental impact. As noted by the United Nations Environmental Program, buildings have a disproportionately large environmental footprint, "the buildings sector is the single largest contributor to global greenhouse gas emissions, with approximately one third of global energy end use taking place within buildings" (United Nations Environmental Program, 2011). The United States exemplifies this issue, accounting for only 4.5% of world population but 19% of global energy consumption, with the energy consumed by buildings representing 41% of the U.S. total. Breaking this down further, energy use in residential structures makes up a majority of energy use attributable to the U.S. buildings sector at 22% of the nationwide total (United States energy consumption, 2011). Buildings also account for over a third of global resource consumption, and their construction and renovation generates 30 to 50% of solid waste in industrialized nations (United Nations Environmental Program, 2003)

Green building can be differentiated from conventional construction practices in that it produces buildings with improved indoor environments that have reduced environmental impacts (Luciuk, 2005).

As per USEPA i.e. United States Environmental Protection Agency, primarily responsible for promoting and protecting a strong and healthy environment, “Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high-performance building.”

Over half (51%) of builders expect that more than 60% of the homes that they build will be green by 2020, and over one third (36%) of remodelers expect the same level of green in their projects (NAHB, 2015). EarthCraft homes are energy efficient can conserve water and promote use of recycled & renewable construction materials. All EarthCraft Homes average a 30% reduction in energy usage compared to a typical code built home which can result in a reduction of over 1100 pounds of greenhouse gases introduced into the atmosphere each year. In addition to their outstanding energy performance, EarthCraft homes are durable, comfortable, and both water-and resource-efficient.

The 2015 NAHB survey shows that the construction cost of a home was 61.8% of the total value of any home (Taylor, 2015). This research focuses on residential housing units certified under the EarthCraft House regional green building program and that too specifically on construction costs.

Green homes are drawing attention in the market because of their distinct benefits including health benefits like improved indoor environment quality and energy efficiency, as energy companies are increasing the prices and power is getting expensive day by day.

This research focuses on residential housing units certified under the EarthCraft House regional green building program. A summary of the requirements for EarthCraft House certification, and the features that differentiate certified homes from those built to the base building and energy codes follows.

EarthCraft House

Started in the Atlanta metropolitan area as a partnership between the Greater Atlanta Homebuilders Association and the SouthFace Energy Institute in 1999, the EarthCraft House green building program provides certification to homes that meet increased performance standards that are targeted towards the environmental issues found in the southeastern United States. EarthCraft Builders serves the following southeastern states - Alabama, Missouri, North Carolina, South Carolina, Tennessee, Virginia and Georgia. Since its inception, EarthCraft has expanded to a suite of programs targeted at specific construction types, including single family, multifamily, community development, and light commercial, certifying over 40,000 homes and buildings to date.

Beyond the basic code and ENERGY STAR certification requirements, homes wishing to earn EarthCraft certification during the study period were required to earn a minimum level of points in 10 environmental impact categories.

- Site Planning,
- Construction Waste Management,
- Resource Efficiency,
- Durability and Moisture Management,
- Indoor Air Quality,
- High Performance Building Envelope,
- Energy Efficient Systems,
- Water Efficiency,
- Education and Operations,
- Innovation

Each of these categories contain a number of optional measures with different point weightings, and a project had to earn a minimum of 100 total points through the implementation of these measures in order to earn basic EarthCraft certification, with 150 points earning gold level certification and 200 points earning platinum certification.

Table 1

Various strategies used in EarthCraft house in 10 different EarthCraft categories

Category	Strategies/Features Involved
Site Planning	Passive Solar Design & Orientation for Natural Heating and/or Cooling, Location of site (distance form municipal recycling center), Connectivity, no use of invasive plants, leave site undisturbed, etc.
Construction Waste Management	Material reuse, post plan to divert material from site to recycle yards
Resource Efficiency	Advanced framing techniques (like California corners) to reduce studs, Advanced framing products like precast insulated walls, use of recycle/local/ natural content materials
Durability and Moisture Management	Moisture control Products (like rain screen, vapor barrier, dehumidifiers, etc.)
Indoor Air Quality	Low VOC materials, MERV filters 6+ for air cleaning systems
High Performance Building Envelope	Insulation exceeding code minimum, window and doors exceeding code mandated energy performance, Energy Star home V3 certification program, blower door test improving envelope leakage ratio
Energy Efficient Systems	Energy Star Advanced lighting package, Energy star bath fans, heat pump, water heater, Highly efficient HVAC systems (like ERV), Sealing duct system with mastic tape/ Improved duct design, Energy Star Appliances
Water Efficiency	WaterSense faucets and fixtures, Effective irrigation techniques (like drip irrigation, drought tolerant/native plants), Install rain barrel
Education and Operations	Educating more people through the project like providing subcontractors ECH worksheets, marketing project, hiring EC specialized persons on site)
Innovation	Any innovation involving the use of sustainable techniques or practices, Home based energy generation like solar arrays, wind turbines, etc.

Research Methodology

Given that EarthCraft house originated in the Atlanta metropolitan area, it is natural to select this area as the focus for this study. For this particular study, only construction costs have been accounted and all other costs (like life cycle costs, maintenance & operational costs, etc.) related to building have been considered constant. EarthCraft house certification covers a variety of buildings such as single family, multifamily, community development, and light commercial. However, for this study EarthCraft House program certifying single-family detached homes, townhomes and duplexes have only been taken into consideration.

An average standard house measuring 2350 sq. ft. has been chosen as base for both EarthCraft Home and Conventional Home for the purpose of research. Conventional home as referenced in this paper is a new construction built as per State of Georgia's minimum Standard Construction Codes. Ideally Conventional built homes are the ones that are built to minimum building and energy code requirements, but code enforcement is often inconsistent and varies in different counties.

The relevant data for research has been obtained through a three-step process. First, a list of key green products/strategies used in EarthCraft house from within all the categories was prepared. Next, a specially designed structured survey questionnaire was prepared. The survey was distributed to 40+ randomly selected EarthCraft

builders operating in Atlanta region to collect their inputs on the survey questions. Two in person interview and two telephonic interviews were also conducted with some of these builders to get detailed specifics around questionnaire. Lastly, based on their input a cost comparison analyses was drawn between Earthcraft and Conventional homes. For this study, all the relevant data collected from survey results was refined and presented in the form of charts and graphs in the paper.

Results and Inferences

Below, Figure 1 depicts the most common strategies used by majority of the EarthCraft builders from the list of 15 green strategies or features. Based on the survey questionnaire results, the strategies such as Highly Efficient HVAC System, Insulation Exceeding Code Minimum, Windows and Doors Exceeding Code Minimum, Low VOC materials and Energy Star Appliances can be referred as the most commonly implemented green features by the EarthCraft builders. The reason for the same is to have a better building envelope, to reduce energy loss from the building and energy efficiency.

Figure 2 represents the cost differential component (in terms of percentage) associated to implementation of every green strategy. This means that how much impact implementing a particular green strategy will have on the construction cost of an EarthCraft home. Looking at the survey questionnaire results it can be inferred that adoption of most of the green strategies is either cost neutral or influences the overall construction cost of an EarthCraft home by only 1-5% in comparison to a Conventional home. The most widely used technique which is insulation exceeding code minimum have a differential cost in a range of 1-5%. However, two of the most commonly implemented green strategies i.e. Highly Efficient HVAC System and Windows and Doors Exceeding Code Minimum does have a cost differential factor of 6-10%.

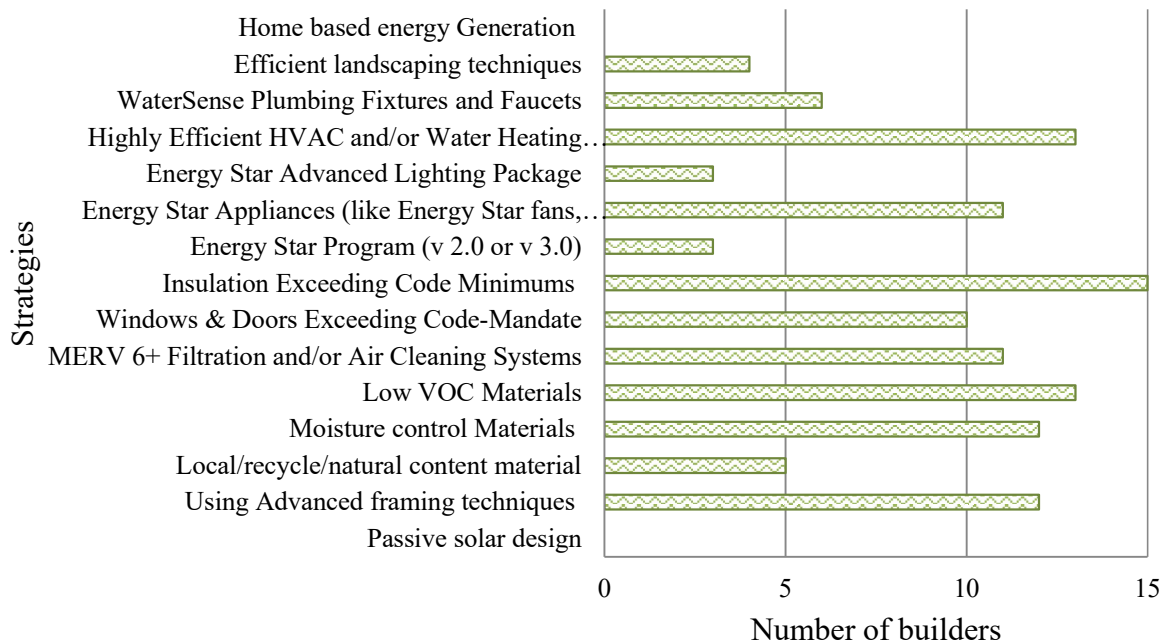


Figure 1: EarthCraft strategies V/s Number of builders implementing a strategy

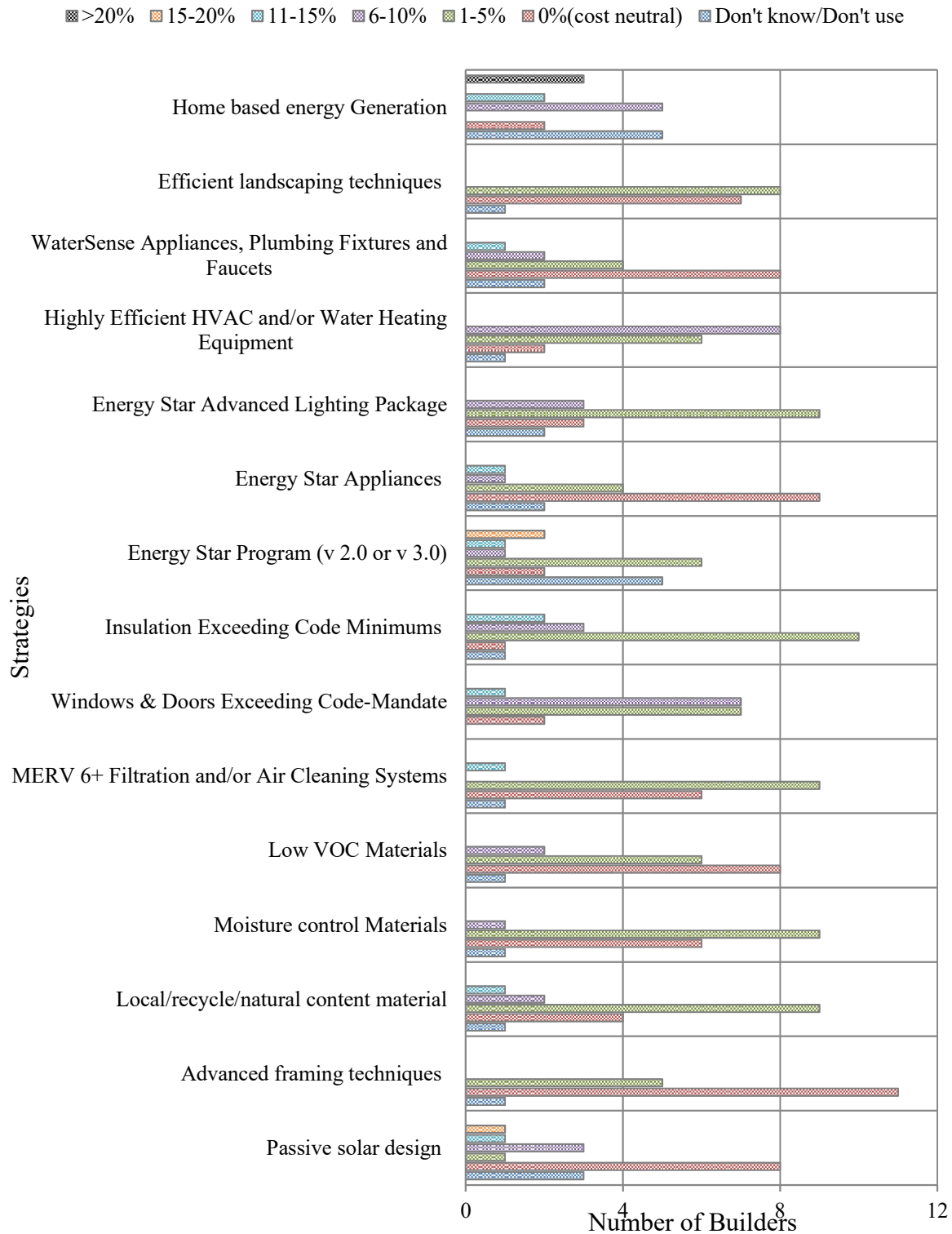


Figure 2: EarthCraft Strategies V/s Number of builders agreeing to a particular Percentage cost differential range

Conclusions

This paper focuses on the added cost involved in the construction of a single family EarthCraft house as compared to a traditionally built home of ordinary specifications. The results conclude that the construction cost of EarthCraft house is NOT 20% more than the Conventional home. Most of the strategies used in ECH other than conventional home, are either cost neutral or increase the construction cost of green home with in a range of 1-5%. Very few of them drive up the cost in the range of 6-10% and hardly any for more than 15%. There are some other costs other than the specific features of ECH such as labor costs, certification fees, recordkeeping, verification and testing fees, 3rd party certification, etc. which also increases the cost of green building. The results do confirm that the construction cost of an EarthCraft house is more than the conventional home. However, if builders carefully choose green strategies and homebuyers are well informed and aware about the market, than they together can make the difference by making wise decisions and help in bringing down the cost of green buildings. The higher upfront cost of EC homes could also be compensated through the operational and maintenance savings over the life cycle. A net value estimate for a 30-year life tells us that EarthCraft homes are more cost effective than their conventional alternatives in longer term.

83% of the homebuilders and remodelers believe that consumers are willing to pay more for a healthier home (NAHB, 2015) but the question still remains is how much extra i.e. up to what extent, and that is where the gap lies. The building recovers extra cost over the life cycle of project but the higher upfront costs still remains a concern. Therefore, it is recommended that the US Govt. Agencies and lawmakers should frame some policies those are financially appealing to the builders and buyers of Green Home, and encourage more and more investment in Green building sector.

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References

- Alexia Nalewaik, and Valerie Venters. (2009). "Cost Benefits of Building Green." *Cost Engineering*, 51(2), 28.
- Bartlett, E., and Howard, N. (2000). "Informing the decision makers on the cost and value of green building." *Building Research & Information*, 28(5-6), 315-324.
- Chan, E. H. W., Qian, Q. K., and Lam, P. T. I. (2009). "The market for green building in developed Asian cities—the perspectives of building designers." *Energy Policy*, 37(8), 3061-3070.
- EarthCraft. (2017). "EarthCraft House." <http://www.earthcraft.org/> .
- Ken Yeang. (2009). "Strategies for green design."
- Keoleian, G. A., Blanchard, S., and Reppe, P. (2000). "Life-Cycle Energy, Costs, and Strategies for Improving a Single-Family House." *Journal of Industrial Ecology*, 4(2), 135-156.
- Langdon Davis. (2009). "Cost of Green Analysis for Affordable Housing in Seattle and Portland." .
- Luciuk, M. e. (2005). "A Business Case for Green Buildings." Ottawa: Morrison Hershfield, .
- Matthiessen, L. F., and Morris, P. (2004). "A Comprehensive Cost Database and Budgeting Methodology." *Costing Green: Davis Langdon Research Group*, London, .
- NAHB: Dodge Data & Analytics. (2015). "Green and Healthier home." .

Shi, Q., Zuo, J., Huang, R., Huang, J., and Pullen, S. (2013). "Identifying the critical factors for green construction – An empirical study in China." *Habitat International*, 40 1-8.

Southface. (2017). "Southface Energy Institute." <http://www.southface.org/> .

Stephen J Glossner, Sanjeev Adhikari, and Hans Chapman. (2015). "Assessing the Cost Effectiveness of LEED Certified Homes in Kentucky." *Journal of Technology Studies*, 41(1), 10.

Stephenson, R. M. (2012). "Quantifying the effect of green building certification on housing prices in metropolitan Atlanta". Georgia Institute of Technology, .

Taylor, H. (2015). "Cost of Constructing a Home."

U.S. Department of Energy. (2011). "Chapter 1: Buildings Sector".

United Nations Environmental Program. (2011). "Buildings Investing in Energy and Resource Efficiency".

United Nations Environmental Program. (2003). "Sustainable building and construction:facts and figures." UNEP Industry and Environment, 6-7.

Yean Yng Ling, F., and Gunawansa, A. (2011). "Strategies for potential owners in Singapore to own environmentally sustainable homes." *Engineering, Construction and Architectural Management*, 18(6), 579-594.

Zalejska-Jonsson, A., Lind, H., and Hintze, S. (2012). "Low-energy versus conventional residential buildings: cost and profit." *Journal of European Real Estate Research*, 5(3), 211-228.

Appendix

Appendix A. Survey Questionnaire

The objective of my research is to find cost differential between an EarthCraft house and a Conventional home. While answering, please note that the survey questionnaire is specific to EarthCraft single family detached residential homes and considers only construction costs and not the whole life cycle cost.

Part I

1. How many floors do you think a typical single-family detached residential house with average size of 2350 sq. ft. has?

- a) Only walk-in level
- b) Walk-in-level and upper floor
- c) Walk-in-level and 2 floors
- d) Others

2. How many bedrooms and bath do you think a typical single-family detached house with average size of 2350 sq. ft. has?

- a) 1 bedroom and 1 bath
- b) 2 bedroom and 2 bath
- c) 3 bedroom and 2 bath
- d) 3 bedroom and 3 bath
- e) 4 bedroom and 3 bath
- f) Others

3. Which of the following do you think a typical single-family detached house with average size of 2350 sq. ft. has?

- a) Covered Garage with 1 Car park connected to unit

- b) Covered Garage with 2 Car park connected to unit
- c) Open Parking
- d) Others

4. What do you think is the average construction cost of a 2350 sq. ft. EarthCraft house?

5. What do you think is the average construction cost of a 2350 sq. ft. Traditional home (Non- EarthCraft house)?
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Part II

1. Which of the following green strategies/features do you use in constructing an EarthCraft house as compared to a Non EarthCraft house (Traditionally Built home)?

(Select at least 5 or more strategies. Please note that answers should be specific to EarthCraft single family detached residential house only)

- a) Passive solar design & orientation for Natural heating/ or Cooling
- b) Using Advanced-framing techniques (Like Insulated Headers, California corners, etc.)
- c) Using local/recycle/natural content material
- d) Moisture control Materials (Vapor barrier, Rain screen, Dehumidifiers)
- e) Low VOC Materials
- f) MERV 6+ Filtration and/or Air Cleaning Systems
- g) Windows & Doors Exceeding Code-Mandated Energy Performance
- h) Insulation Exceeding Code Minimums (example: Spray foam insulation)
- i) Energy Star Program (v 2.0 or v 3.0)
- j) Energy Star Appliances (like Energy Star fans, dishwasher, etc.)
- k) Energy Star Advanced Lighting Package
- l) Highly Efficient HVAC and/or Water Heating Equipment
- m) WaterSense Appliances, Plumbing Fixtures and Faucets
- n) Efficient landscaping techniques like drip irrigation, drought tolerant plants, install rain barrel
- o) Home based energy Generation (like solar arrays, wind turbines, etc.)

2. Which of the strategy/s not listed above do you think also adds to the construction cost of an EarthCraft House?
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3. Mark the following green strategies/features of an EarthCraft house to an appropriate percentage range of cost escalation. Percentage indicates an average increase in the construction cost of EarthCraft House compared to a Non EarthCraft house (Traditionally Built house) for implementing that particular feature
(Please note that answers should be specific to EarthCraft single family detached residential house and should consider construction costs only)

	Don't know/ Don't use	0% (Cost Neutral)	1-5%	5-10%	10-15%	15-20%	> 20%
Passive solar design & orientation for Natural heating/ or Cooling							
Using Advanced-framing techniques (Like Insulated Headers, California corners, etc.)							
Using local/recycle/natural content material							
Moisture control Materials (Vapor							

