

# Overcoming the Barriers to Sustainable Construction and Design Through a Cross-Reference of West Coast Practices

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There is no doubt that sustainable construction and design is the future of the construction industry. Unfortunately, the terms “sustainability” and “green building” invoke fears of increased paperwork and higher initial costs. Yet, the demand for more sustainable projects increases with more government regulation being passed and more owners asking for LEED certified buildings. A best practice guide for sustainable construction and design is a high necessity for today’s contractors. But, little research exists to provide a formal program for overcoming the barriers to sustainable projects. Through the use of an online research survey, construction industry professionals were asked what are the barriers to sustainable projects and what are the best ways to overcome them. Since the west coast states of California, Oregon, and Washington are perceived to be leading the sustainability race, the results from respondents on the west coast were cross-referenced and compared to the results from respondents from the rest of the country. The resulting analysis provides a preliminary platform for a best practice guide on overcoming the barriers to sustainable construction and design.

**Key Words:** Sustainable Construction and Design, Green Building, Barriers to Sustainability, California Sustainable Construction, LEED Projects.

## Introduction

Being a contractor in today’s market is not an easy task. Between a failed economy, increasing government regulations, increasing employee benefits, extremely desperate competitors, and increasing quality standards, builders are faced with more daunting hurdles than ever before. And, on top of all this, there is the big, green monster – sustainability.

There is no doubt that the words “sustainability” and “green building” stir up quite a commotion in the construction industry. So many factors are involved in the design and construction of sustainable projects that it can be very overwhelming. There are so many reasons to build sustainable projects, yet there can be even more reasons not to. The authors believe that several barriers exist to building and designing sustainable projects, such as money, time, resources, and an extreme amount of documentation. But, at the same time, there is an ever-increasing desire by owners and an increasing rate of government regulation requiring sustainable projects. This leads one to ask, so how can contractors across the country overcome the barriers to building sustainable projects?

The west coast states of California, Washington, and Oregon, are perceived by the authors to be leading the race when it comes to building and designing sustainable projects. Are there any lessons to be learned from how these states have overcome the barriers to sustainable construction and design?

## *Problem Statement*

A literature search showed that little research has been done to provide a best practice for overcoming the barriers to sustainable construction and design on a national scale. Also, there is a lack of evidence revealing *why* the west coast states of California, Oregon, and Washington are building more sustainable projects than the other 47 states in the country.

## *Research Objectives*

The objectives of this research are:

- First, determine what sustainability means to different companies in the construction industry across the country.
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- Second, discover what are the greatest barriers to sustainable projects.
- Third, determine what has been the most helpful in overcoming these barriers.
- Fourth, to discover why the west coast states are building more sustainable projects than the rest of the country.
- And thus, to determine what these west coast states and others have done to overcome the barriers to building green.

Research Hypothesis: There is a difference between the views and practices of the west coast states concerning sustainability compared to the rest of the country.

## **Literature Review**

A literature search was conducted to discover if this topic has already been researched and to what extent others have tried to answer the proposed research problem. Through the use of the online database *Proquest*, all research journals, newspaper articles, theses and dissertations were thoroughly searched. Four documents were found to be the most relevant to the proposed research problem. Hanby's (2004) *Assessing the Barriers to LEED Certification in Oregon*; Mogge's (2004) *Breaking Through the First Cost Barriers of Sustainable Planning, Design, and Construction*; Wood's (2007) *Barriers and Breakthroughs in Residential Green Building*; Panawek's (2007) *Changing Light' Green to 'Deep' Green: Mainstreaming green building in Hamilton County. An analysis and evaluation of the constraints facing the green building housing market in Hamilton County*; and Ouroussoff's (2007) *Why Are They Greener Than We Are?* Outlined below is a brief summary of each.

Hanby's (2004) research objective was to assess the barriers to the USGBC's LEED design and certification process in the state of Oregon by surveying architects. He outlined the barriers to LEED certified projects as applicability, acceptance, knowledge, time, and financial. The focus of Mogge's (2004) research question was the cost of sustainability and ways to overcome the first cost barriers. The purpose of his research was to find a solution as a whole to the barriers of sustainable design and construction, not just cost. He states that much research has been completed on overcoming the cost to building sustainable projects, and that a correctly designed project can be built with no extra costs except for the cost of increased inspections.

Wood (2007) outlines the barriers to building sustainable projects as: the confusion related to the costs and benefits of sustainable construction, who reaps the qualitative and quantitative benefits, risk and fears of using new materials and methods, lack of consistent data, lack of knowledge, education, and training, and lack of policy and incentives. Her research targets all phases of construction and is based upon one specific case study of a LEED certified residential development. Panawek's (2007) research, focused on residential projects, is limited to the confines of one county in Ohio. The purpose of the research was to discover if there is anything different being done on the west coast that leads to more sustainable projects being constructed.

Ouroussoff's (2007) article details that America is far behind Europe in building and designing sustainable projects. Much of this, he writes is because of America's limited view of what sustainability truly is, and also, the misleading focus of a points system which leads more to frustration than inspiration.

## **Methodology**

### *Sampling Design*

The target population for this research was developed by first determining what companies are the leaders in sustainable design and construction. This list was discovered by the magazine *Engineering News Record's* list of the nation's top 100 "green" contractors. The researcher for this project then cross-referenced this list with the USGBC's directory of LEED certified contractors and list of LEED AP's. The LEED AP is a certification offered by the USGBC endorsing individual professionals in the construction industry who complete the necessary requirements for certification. These individuals are chosen by leading contractors to be the heads of sustainable projects in the country. Also, in order to receive the input from designers and engineers in the industry, a list was discovered of alumni from Clemson University that are currently working as licensed engineers and architects.

As the target population for this research was chosen and nonrandom, the sample is clearly a non-probability convenience sample. Though this method of sampling is the least precise method of sampling, the researchers chose this method to gain perspective from leaders in the industry. The addition of engineers and architects also distorts the efficiency of a random sample, but again, the researchers chose to add this sample in to gain more perspective on the research problem.

### *Research Design*

The research design for this study was to create a survey and send it out to the leading construction industry professionals across the nation. If information received from the survey responses deemed to be inefficient to answer the research problem then personal interviews would be conducted. A survey was deemed the most efficient and convenient way to gain the views of a large target population across a large geographical area. Though personal interviews would have allowed for more specific detail, the use of survey provided for a set of numerical data that could be compared cross-nationally.

There was a strong intent in the creation of the survey to avoid defining sustainability and also to avoid leading a participant in any way. The survey was created in such a way that would lead to numerical quantities for the different questions. This was achieved through the use of numerical likert scales.

The survey included introductory questions to determine the experience and location of participants. Questions 7 – 12 were specific rating questions that were placed to form the main body of the survey. These questions were directed specifically to answer the research objectives. Also, the survey included a few final questions concerning the future of sustainable projects. These questions were added with the intent to forecast the future of sustainability, and perhaps, allow the researchers to again discover a difference in the perspective of individuals from different geographic locations.

The survey was then pilot tested among other industry and research professionals. The survey was constructed on the online website [www.surveymonkey.com](http://www.surveymonkey.com). This website provides a template and all necessary components to create, send, and analyze all results.

Participants were given 3 weeks to complete the survey. Out of 2,245 surveys sent out, there were 99 responses, 92 of which were complete responses. The sampling size was simply determined by the maximum amount of surveys that time allowed the researchers to send.

### *Data Collection*

Survey Monkey handled all the specific gathering of data for this project. Data was then collected and downloaded into Microsoft Excel format. The data was then organized and simplified for clarity. Careful attention was made to not accidentally edit any data, and no data was manipulated or purposely edited, as that would change possible results.

All data was overviewed for possible test taker error, and one question was found to contain a high probability of error. Confusion on the scaling of the question led to an odd array of data, which led to the extraction of the question.

### *Data Analysis*

After the data was collected and placed in Microsoft Excel format, the data was organized for statistical analysis. A separate spreadsheet was created and questions were arranged vertically for cross tabulation. The average mean for each sample was totaled for each individual question. For questions that had sub-questions, the sub-questions were averaged and arranged vertically according to the geographical location that the test taker inputted. Three geographical locations were determined for analysis: west coast states, non-west coast states, and nationwide. (Upon the analysis of the final survey results, it instantly became clear that 4<sup>th</sup> question should have been constructed differently. The open-ended format did not provide for a clear regional designation. Thus, the 3<sup>rd</sup> category of nationwide was developed for surveys that declared nationwide instead of an individual region of the country.)

The means from all sub-questions were then averaged into one total mean for each main question for each of the 3 geographical designations. A standard deviation was calculated for the west coast states selection, and then, the other 2 geographical designations were t-tested against the west coast states individually. The t-tests were completed through the use of Microsoft Excel's TTEST function. This statistical analysis provided a basis to determine whether the null hypothesis, that there is no difference between the west coast states and the rest of the country's results, would be rejected or accepted. If the calculated result was less than .05, the null hypothesis was rejected, meaning that there is a significant difference between the results of the west coast states compared to the rest of the country's results. The results from this statistical analysis were then recorded and studied to confer further conclusions. (Please see the Appendix for a Statistical Analysis Sample.)

### *Limitations*

Methodology Limitations: The first initial limitation present in this study is due to the nature of the non-probability sampling method. Though the sample population was specifically chosen for their knowledge of sustainability through their LEED AP certification, the sample is at high risk for bias and a poor representation of the population at large.

## **Findings and Results**

### *Introductory Questions*

The majority of respondents declared that they were either General Contractors and/or Construction Management firms. The largest market recorded by far was the commercial sector. This is followed closely by work performed in the medical and institutional fields. Of the work completed by survey respondents, 47% is completed in the public sector and 54.6% is completed in the private sector. Respondents came from all regions of the country, with 12 specifically from the west coast states as shown in Table 1. The average size project completed ranged drastically in different portions of the country. The amount of sustainable projects completed by respondents also varied drastically across the nation.

Table 1

<b>Regional Designation</b>	<b>West Coast States</b>	<b>Non – West Coast States</b>	<b>Nationwide</b>
Quantity Responded	12	49	26

### *Sustainability Questions*

Energy savings, lower lifecycle costs, and water savings were ranked the most important qualities to a sustainable project. The least important quality was visual aesthetics, as show in Figure 1. The two greatest benefits of sustainable design and construction to the contractor were increased marketability to attract clients and contractor's

desire to build with current market trends. The least beneficial was labor cost savings. The greatest barriers to sustainable construction and design were increased documentation, learning curve of new materials and methods, and higher initial costs spent in pre-project planning. The least difficult barrier to overcome was difficulty in obtaining insurance and bonding. The two most helpful barrier breakers were experience in sustainable projects and extensive pre-project planning. The least helpful barrier breaker was partnering with other companies, as shown in Table 2. The three factors that most greatly contribute to the west coast states building more sustainable projects were culture and community influence, higher cost of energy, and more government regulation. The factor that contributed the least was less resources, see Table 3.

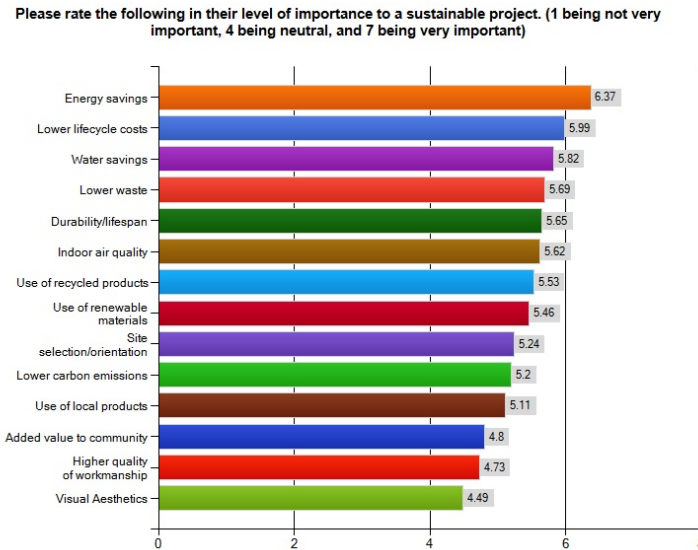


Figure 1

Table 2

Answer Options	1	2	3	4	5	6	7	Rating Average	Response Count
Education in sustainable materials and methods	0	4	4	14	23	33	11	5.24	89
Experience in sustainable projects	0	3	2	9	14	27	34	<b>5.82</b>	89
Desire to protect environment	5	7	3	25	27	17	5	4.49	89
Strong desire to add value to community	2	9	10	22	21	17	8	4.51	89
Partnering with other companies	6	10	5	30	16	15	7	4.27	89
Extensive pre-project planning	0	2	2	9	16	32	27	<b>5.76</b>	88
Use of best practice guides and case studies	2	6	4	16	28	26	7	4.89	89

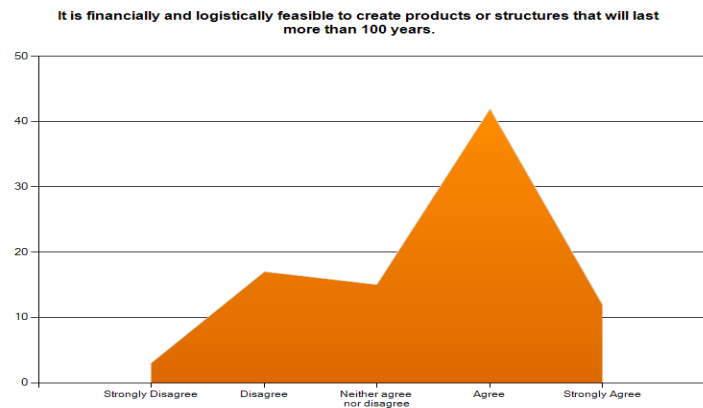
Table 3

Answer Options	1	2	3	4	5	6	7	Rating Average	Response Count
Culture and community influence	2	0	1	3	5	19	59	<b>6.39</b>	89
Less resources	18	14	10	23	12	7	4	3.39	88
Higher cost of energy	3	2	3	7	22	28	24	<b>5.51</b>	89
Higher taxes	3	4	2	23	15	22	20	5.12	89
More financial support	6	3	5	20	27	15	13	4.75	89
More opportunity	5	8	9	17	20	20	8	4.51	87
More government regulation	2	0	3	6	18	19	41	<b>5.91</b>	89
Weather	13	6	8	27	22	6	6	3.92	88
Access to more sustainable resources	12	8	10	22	18	15	4	3.98	89
More owner education	3	2	7	15	20	24	18	5.15	89

### Final Questions

The overwhelming majority of the respondents agree that true sustainability is measured in a building's durability and life span. The majority of respondents agree that it is financially and logistically feasible to create products or structures that will last more than 100 years, see Figure 2. The majority of respondents believe that it financially make sense to build sustainable projects, in the current market today. Respondents agree that in 10-15 years from now, sustainable methods and materials will be the standard for building and designing structures in the United States.

Figure 2



### Conclusions and Recommendations

An underlying intent of this research project was to plant the seeds for a formal best practice guide for overcoming the barriers to sustainable construction and design. Through a research of construction industry best practice organizations, there does not currently exist a best practice guide for sustainability. The best two ways to overcome the barriers of sustainable construction and design are experience in previous projects and pre-project planning. Unfortunately, experience in previous projects cannot be taught in a formal training session, only appreciated that overcoming the barriers to sustainable construction will only get easier as a company completes several projects. But, as with many barriers that exist to all phases of a project, spending an extensive amount of time in the pre-project phase usually brings a high level of success. A best practice should definitely be developed on the implementation of the extensive pre-project planning of sustainable projects.

The three main factors that contribute to the west coast states building more sustainable projects were culture and community influence, higher cost of energy, and more government regulation. An interesting topic for further study to develop a best practice guide for sustainability would be how can the rest of the country create a similar culture and community attitude to promote the success of building green? Or, what is the inspiration or source that causes the west coast states to have such a strong community push for sustainable design and construction? Almost all of the responses from the west coast states were the highest ranking for community and culture influence.

If sustainability is measured in a building's durability and life span, another interesting topic for further research and study would be to perform a correlational study between building life span and sustainability . If a building lasts twice as long as another building, then technically, is the building twice as sustainable as another since it does not have to be rebuilt? How can companies promote the use of materials that last up to 100 years or more? Most bridges in the United States were built to only last 50 years, but there are many structures around the world that have been standing for a 1000 years. Surely, a bridge that has to be built 20 times to last 1000 years is not very sustainable, no matter how many sustainable products are used in its construction. How may the priorities of sustainable construction change in the future?

Though an immense amount of material was organized, cross-referenced, and analyzed for this research project, there still exists an incredible amount of data that has not been addressed. Further more focused and intensive research could be acquired through the use of personal interviews with the west coast contractors that took part in this research. Also, outside of this text, further research could be studied concerning more specific details of overcoming the barriers to sustainable construction and design.

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