



ISSN 1647-0621 (print) ISSN 2182-2743 (on line)

www.ijsc.greenlines-institute.org



International Journal of Sustainable Construction

Vol. 1, No. 1, December 2012, pp. 33-42

Patterns in green building practice: analysis of LEED project data

Joel Anne Todd

Environmental Consultant, Cabin John, Maryland, USA

joeltodd@cpug.org

Robert Tufts

U.S. Green Building Council, Washington, DC, USA

Over the past decade, the field of building sustainability assessment has matured, with an increasing number of assessment systems and countries implementing such systems. There have been many studies comparing the methodologies used by these certification systems, but there has been little quantitative analysis of the projects that have achieved certification. This paper analyzes data on LEED-certified projects in the United States. This research will contribute to a better understanding of the certification systems in practice, their effects on practitioners and markets, and trends in markets and practice over time.

© 2012 Green Lines Instituto para o Desenvolvimento Sustentável. All rights reserved.

Introduction and methodology

The U.S. Green Building Council launched its LEED Rating System in 1998; since then, LEED has undergone several significant updates, most recently in 2009 with another update projected in 2012, and has expanded to include new markets and building types. Since 2000, LEED has certified 12,320 projects worldwide under the commercial rating systems with 11,329 in the United States; LEED for Homes and LEED for Neighborhood Development are excluded (USGBC LEED Project Database, 2012). The numbers of projects certified under the various versions of the LEED Rating System are summarized below (USGBC LEED Project Database, 2012)

New Construction	6410
Commercial Interiors	2535
Existing Buildings	1679
Core and Shell	964
Schools	286
Retail (Interiors)	260
Retail (New Construction)	195
Total	12,329

LEED certifies projects at four levels: Certified (the lowest), Silver, Gold, and Platinum (the highest). The versions of LEED addressed in this paper – LEED for New Construction, Existing Buildings, Core and Shell, and Commercial Interiors – contain prerequisites and credits in the following categories:

- The Sustainable Sites, which addresses project location, access to alternative transportation, site development, stormwater control, heat islands, and light pollution.
- Water Efficiency, which addresses overall water use reduction from landscaping and domestic water consumption.

- Energy and Atmosphere, which addresses energy performance, commissioning, refrigerants, renewable energy, green power, and measurement and verification.
- Materials and Resources, which addresses building and materials reuse; use of recycled content materials, local materials, rapidly renewable materials, and certified wood; and construction waste management.
- Indoor Environmental Quality, which addresses indoor air quality, ventilation, low-emitting materials, control of environmental tobacco smoke and indoor chemicals/ pollutants, controllability of systems, thermal comfort, and daylight/ views.
- Innovation in Design, which includes the LEED Accredited Professional and credits which can be earned for exemplary performance or innovative strategies. This category of credits is not included in this analysis since the content varies widely.

More information on the LEED Rating System can be found on the USGBC web site.

The analysis is based on a USGBC database that contains information from certified projects that has been gleaned from the LEED Online system. In order to have a concise analysis, we queried projects from the database that were only located in the United States and we did not include any projects that were residential or owned by foreign governments. The analysis updates and compares findings reported in a paper presented at the SB11 conference in Helsinki with data currently available in the database (Todd et al, 2011). This updated analysis includes more recent certified projects from LEED NC 2.1 and 2.2 (the versions of the LEED Rating System addressed in the SB11 paper) as well as projects certified under LEED 2009, the more recent version. The paper also expands the analysis beyond LEED for New Construction to include LEED for Existing Buildings, Core and Shell, and Commercial Interiors.

Findings: characteristics of LEED projects

Projects by certification level

LEED contains four certification levels that are defined by the number of credits earned: Certified (the lowest), Silver, Gold, and Platinum (the highest). As an example, in LEED 2009, the levels for Building Design and Construction (new construction and major renovations) are defined as follows:

Certified	40-49 points
Silver	50-59 points
Gold	60-79 points
Platinum	80 points and above

Total points and levels were defined differently in previous versions.

As shown in Figure 1, the first projects that certified under LEED in 2000 were at the lowest, Certified and Silver, levels. There was only one Platinum project and no Gold projects in the first year. Over time, however, the percentage of projects certifying at higher levels has increased, with Gold certification becoming the highest percentage of total projects certified in 2009. The percentage of projects at the Certified level has decreased significantly. Platinum projects have remained a small and relatively stable percentage of the total although the total number of Platinum projects has increased.

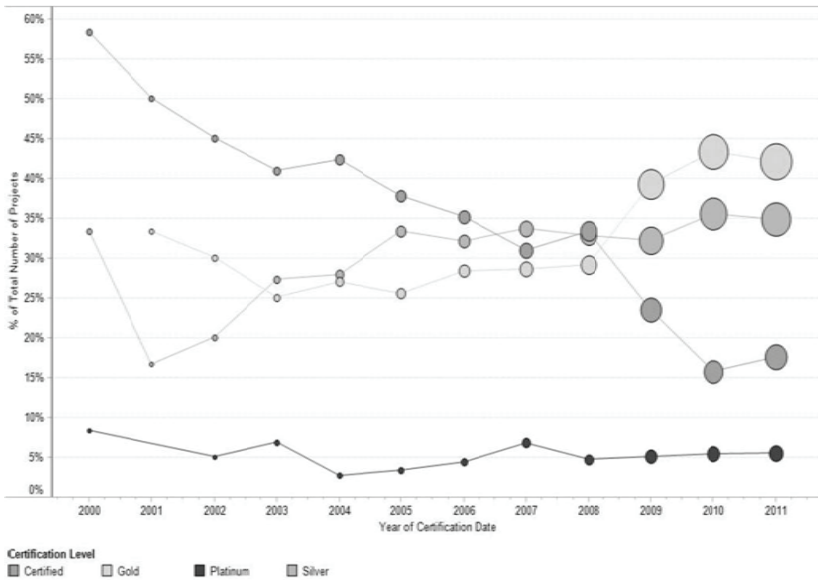


Figure 1. Yearly trend of % of projects certified by achievement level and sized by number of projects certified each year.

When certification levels are examined by rating system (New Construction, Existing Buildings, Core and Shell, and Commercial Interiors) as shown in Figure 2, trends emerge. In New Construction, Certified projects have decreased consistently as a percentage of total projects certified yearly while Gold projects have increased. The percentage of Platinum projects has not changed significantly. In 2008, there was a noticeable increase in Certified projects under the Existing Buildings and Commercial Interiors systems, but the levels returned to pre-2008 percentages. This figure starts at 2005 since not all rating systems had certified projects until that year.

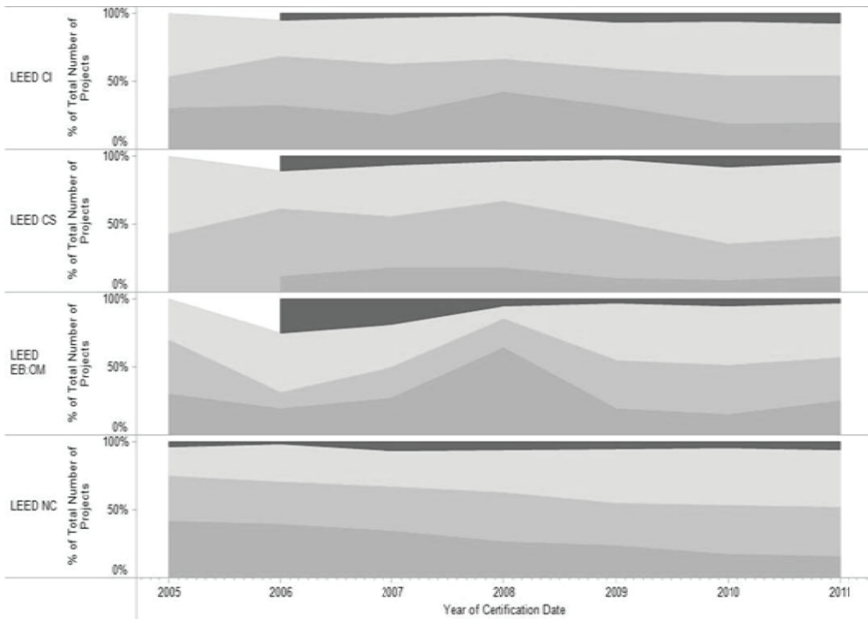


Figure 2. Yearly trend of % of level of achievement for certified projects listed by rating system.

Projects by size

LEED projects include a wide range of sizes, from small offices to huge skyscrapers. This analysis explored whether the size of the project related to other characteristics.

There is variation among rating systems in the total floor area represented at different certification levels in the rating systems. As Figure 3 shows, projects certified under LEED for Existing Buildings are, on average, larger than projects in other certification systems. For example, the average project size for Gold level projects is 516,006 sq ft, while the average project sizes are 104,928 sq ft for New Construction projects, 237,127 for Core and Shell, and 50,788 sq ft for Commercial Interiors projects.

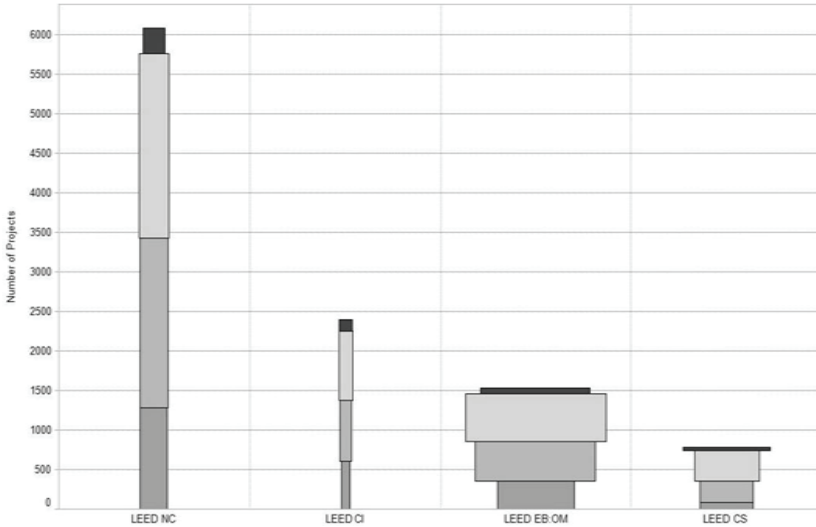


Figure 3. Number of certified project for each rating system shaded by the level of achievement and sized by the average gross square footage for each level of achievement.

Figure 4 shows the number of projects and their average size by rating system. Platinum continues to be the smallest number of projects in each rating system. CI and NC do not show as much variation among certification levels as do CS and EB.

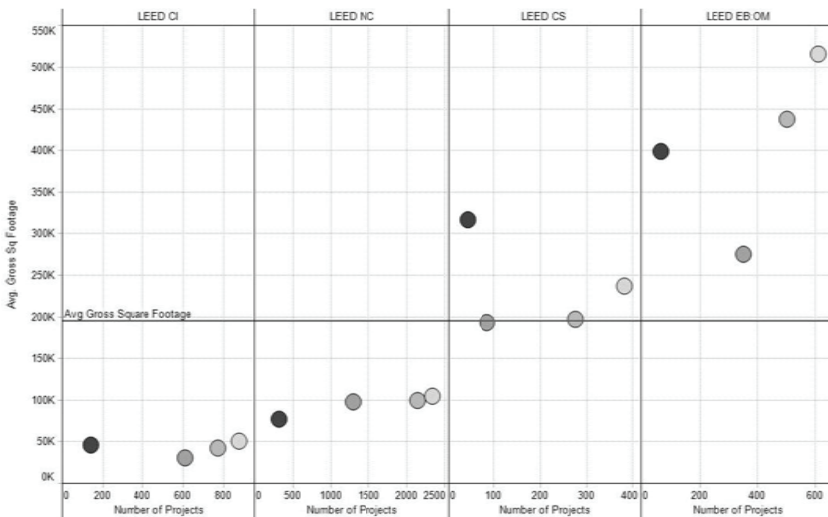


Figure 4. Number of certified projects and average gross square footage for each level of achievement within each rating system.

When LEED projects are classified by size, in increments of 50,000 sq ft, the largest category of projects is those under 50,000 sq ft, as shown in Figure 5. The width of the bars illustrates the total number of projects. The next largest category is 50,000 to 99,000 sq ft, then 100,000 to 149,999 and larger than 500,000 sq ft, which have a similar number of projects. While there is some variation in percentages of projects at each certification level within each size category, the percentages are quite similar across size categories for each level.

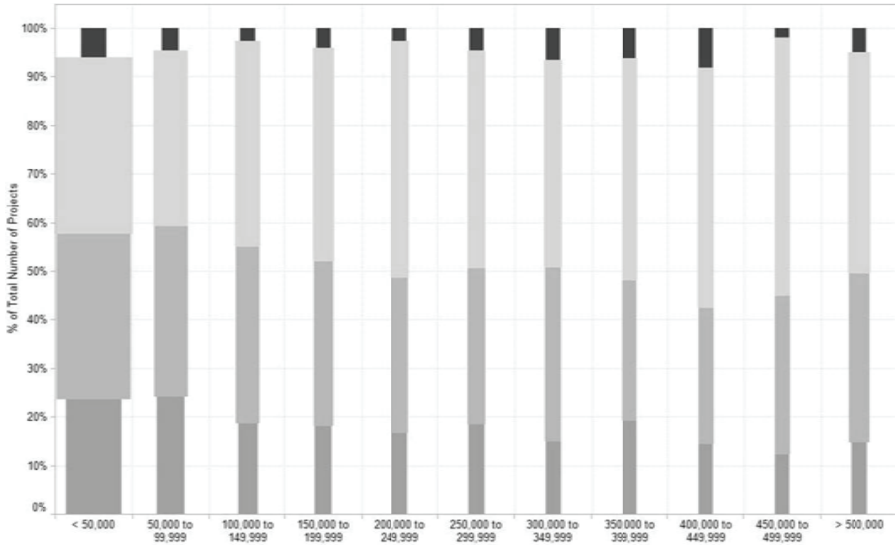


Figure 5. Certified projects grouped in bins 50,000 gsf . Colored by percent of level of achievement for projects within each grouping. Sized (width) by number of projects.

Figure 6 clearly indicates that total number of projects and total floor area certified at each level over time vary independently. The trends in total numbers of projects certifying at each level show increasing percentages of Gold projects and decreasing percentages of Certified projects, with more stable percentages of Platinum and Silver projects. Total floor area, shown in gross square footage, shows a similar trend in starting and ending points, but with several interruptions in the overall trend lines.

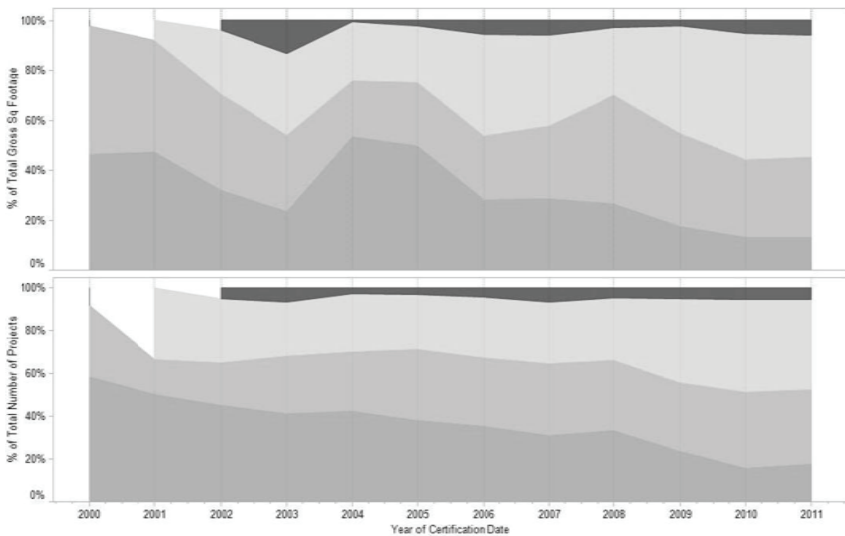


Figure 6. Yearly trend of total percentage of projects and the total percent of gross square footage colored by achievement level.

Projects by ownership

Projects show variation by type of owner. Figure 7 shows that new construction projects with corporate or investor owners tend toward lower levels of certification for all years and sizes, while projects owned by non-profits tend toward higher levels of certification. Non-profit projects have almost double the percentage of Platinum projects as compared to Gold, Silver, or Certified levels of achievement. Platinum level projects show the least difference between owner type while certified projects show the greatest difference.

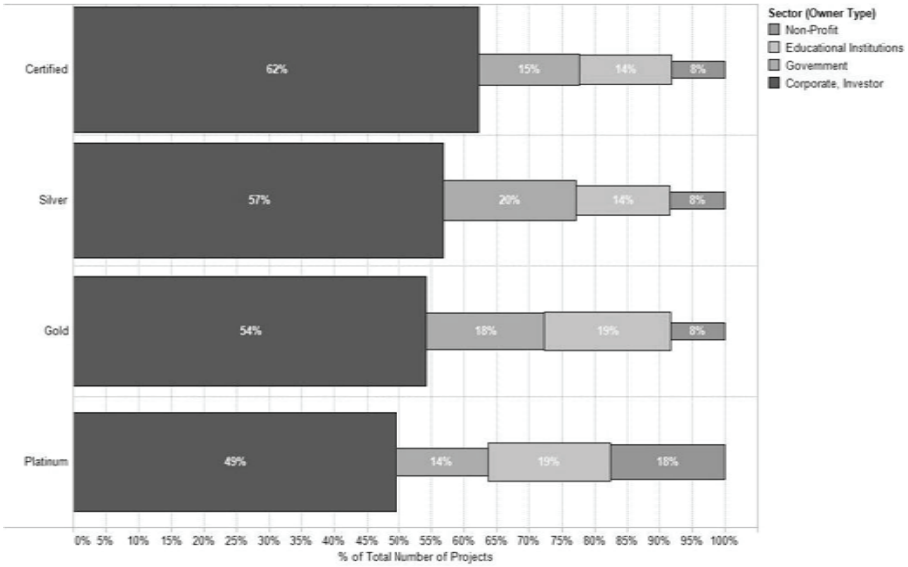


Figure 7. Percentage of ownership by achievement level (bars are sized to reinforce % of ownership).

Figure 8 shows that although non-profits account for 18% of all Platinum projects, Platinum projects only account for just over 10% of all certified projects owned by non-profits. Further, Gold accounts for the highest percentage of certified projects owned by non-profits. In fact, the trend for level of achievement of projects owned by non-profits, is similar to the trend for all certified projects.

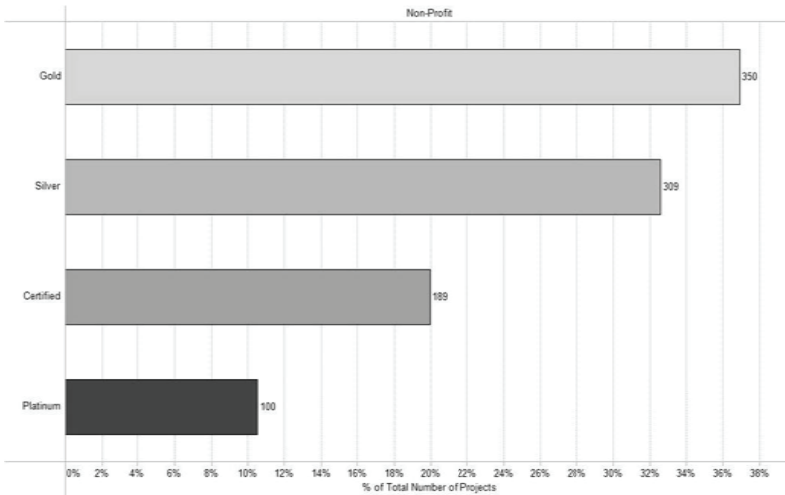


Figure 8. Percentage of projects owned by non-profits by level of achievement. Label indicates the actual number of projects.

LEED Platinum projects

The preliminary analysis conducted in 2011 focused on Platinum projects, exploring whether they were, in fact, different from other LEED certified projects in aspects other than number of points achieved. The authors updated this analysis and expanded it to include additional versions of the rating system.

To further explore Platinum projects, we looked at geographic distribution of platinum projects in relation to other certified projects in the continental United States. Figure 9 shows that while California and New York account for the largest numbers of Platinum projects, their Platinum projects are a smaller percentage of all their certified projects. States that have a high percentage of Platinum in relation to their overall number of certified projects are Montana and Oregon. The map on the right side controls for just platinum projects owned by non-profits. The trend is similar to what we see on the left. However, looking at the total number of Platinum projects in some of the states, we can start to see that non-profits do have a significant impact on the percentage of Platinum projects in certain states.

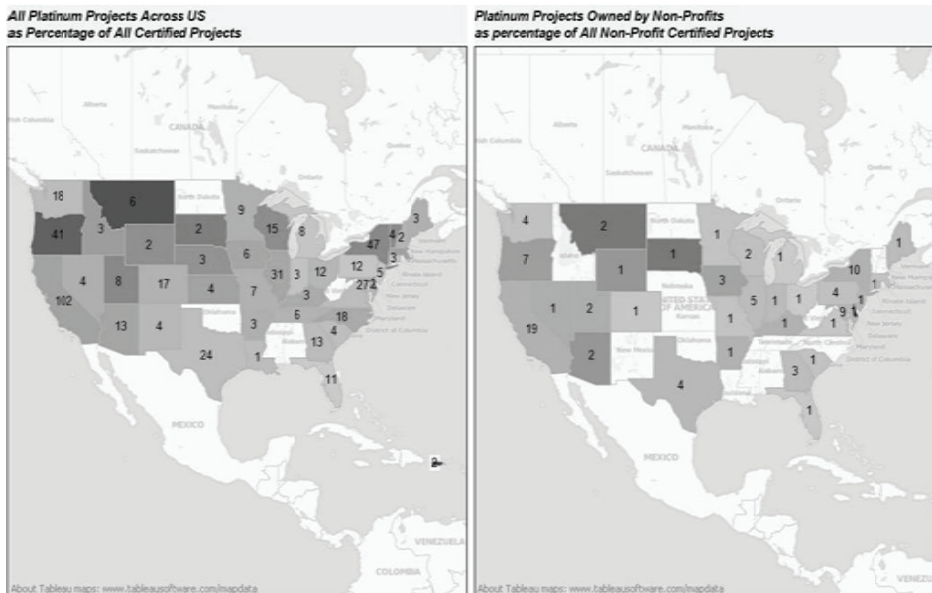


Figure 9. Map of distribution of LEED Platinum projects by U.S. states (excludes HI and AK).

Figure 10 shows trends in Platinum projects over time, by rating system and average size based on a 12-month rolling average. Platinum projects under LEED for new construction show a steady increase in size. Commercial interiors projects have seen an increase, although the overall size of these projects is much smaller on average. Core and Shell also has seen an upward trend in the average size of projects. However, the outlier is Existing Buildings. The overall trend for the average size of EB:OM Platinum projects has declined over time.

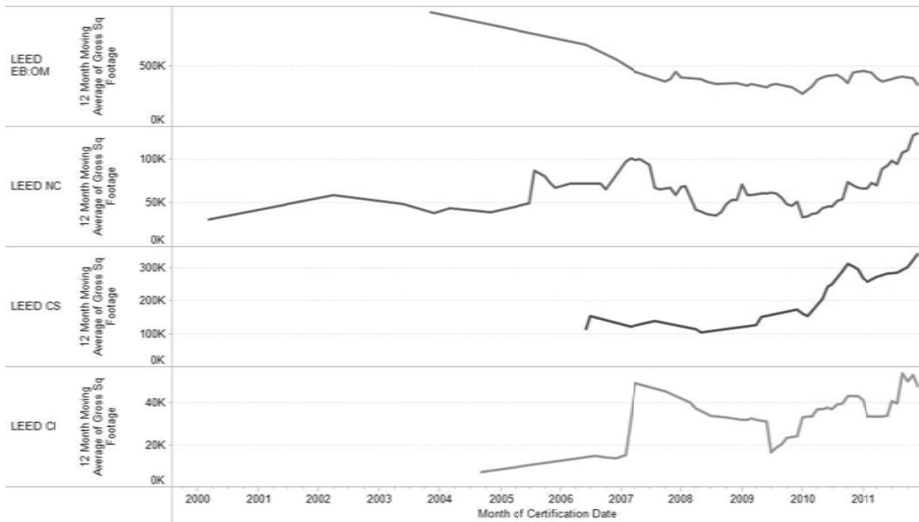


Figure 10. 12 month rolling average of certified square footage for Platinum projects.

Discussion and conclusions

The analysis presented in this paper is primarily descriptive, exploring characteristics of LEED projects, their trends, and the relationships among some of these characteristics. In most cases, the analysis is not able to explain the patterns that emerge, although the authors suggest possible connections that could be explored in future research.

The trend over time is for projects to certify at higher levels, with Gold certification becoming the largest percentage overall and having the largest number of projects in 2009 and continuing through 2011. This trend is most evident in projects certified under LEED for New Construction and Core and Shell. LEED for Existing Buildings shows a different pattern, with increases in percentage of Gold projects but a dramatic spike in Certified projects in 2007-2008. It should be noted that changes in 2009 are not likely to be associated with the new version of LEED that was released that year, since it usually takes several years for a project to progress from initial registration to final certification. The overall increase in higher levels of certification could be a reflection of several factors, although additional research would be needed to explore these ideas: the level of expertise and interest among owners and project teams has increased; green materials, services, and technologies have become more widely available; expectations of the overall market have increased; green requirements have been written in policies and government incentives; and other indicators of wider acceptance of green buildings. Further, some of the thresholds in LEED credits have not been raised significantly, so actual practice might be catching up; LEED 2012 proposes to “raise the bar” in many credits to address this issue. Finally, the impact of the economic downturn and its effect on the construction industry is not clear.

While LEED projects vary widely in size, they cluster in the smaller and very large categories. The largest number of projects is in the category less than 50,000 square feet (square meters), followed by the next largest categories, 50,000-99,999 (meters) and 100,000-149,999 (meters) square feet, and the largest category, more than 500,000 square feet (meters). The categories in between contain very similar numbers of projects. Average sizes of projects vary significantly by rating system; projects certified under LEED for Existing Buildings are much larger on average than other rating systems at all certification levels. As expected, projects certified under LEED for Commercial Interiors are smallest at all certification levels. Projects certified under LEED for Existing Buildings show the widest range of average project size by certification level, while those certified under LEED for New Construction and Commercial Interiors show much less variation. Finally, the size of project by certification level has varied over time. Certified level projects have had the most variation, while Silver projects had one spike in 2008.

Different types of owners are more likely to achieve different certification levels. Corporate/investor owners are most likely to certify at the lower levels and non-profits have almost double the percentage of total projects certified as Platinum, as compared to all other owner types. Some factors that affect certification levels are government agency and corporate policies that mandate specific achievement levels.

The initial analysis of projects certified under LEED NC 2.1 and 2.2 indicates that Platinum projects are different from projects certifying at other levels in ways other than total point achievement (Todd et al, 2011). Some of these differences were corroborated by the current paper:

- Both papers found that Platinum projects are increasing in number but are not increasing as a percentage of total projects certified because other levels of certification are seeing larger increases in number of projects.
- Both papers found that Platinum projects tend to be smaller than projects at other certification levels.
- Both papers found that non-profit organizations most often own Platinum projects while projects at other certification levels are most often owned by for-profit organizations. Platinum projects are less likely to be owned by Federal or local governments than projects at other certification levels.

Other results of the 2011 study on credit achievement are beyond the scope of the current paper. Although the current study has added data from other rating systems and more current data, the number of Platinum projects is still small and hampers detailed analysis. For example, the analysis of location found that many states only had one Platinum project and the authors chose not to base analyses on such small numbers.

Future research would be useful in understanding the causes for some of these patterns. It would be useful to explore the extent to which patterns track with trends in the market, how differences in ownership affect certification levels, and how certification varies by space type.

References

- Todd, J. A., Pyke, C. & Rohloff, A. (2011). Understanding trends in characteristics and achievement of LEED Platinum buildings. In *SB11 - World Sustainable Building Conference. Helsinki, October 2011*. Helsinki: Finnish Association of Civil Engineers RIL.
- USGBC LEED Project Database, U.S. Green Building Council.