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Is LEED a True Leader? Studying the Effectiveness of LEED Certification in Encouraging Green Building

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Introduction

Leadership in Energy and Environmental Design – the name itself speaks to what the LEED certification system hopes to be. As the most popular sustainable building certification system in the United States (and gaining favor abroad as well), LEED is a metric by which to judge how "green" a building is. Its best-known form, LEED for New Construction and Major Renovations (LEED-NC), sets a standard for the design and construction of new or significantly renovated[1] commercial and institutional buildings, ranking them as Certified, Silver, Gold, or Platinum depending on how many points they accrue during the design process. These points are divided into several major categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Design Process, and Regional Priority.[2] Each category attempts to address a subset of ecological concerns that the U.S. Green Building Council (USGBC), the organization which created LEED, has deemed important in creating sustainable buildings; careful site selection is promoted to preserve wildlife habitats and virgin land, and points for high albedo (reflectivity) surfaces and low light pollution help ensure that buildings do not adversely affect their surroundings or create heat islands. Water-use reduction is emphasized to prevent the depletion of fresh water sources, while reduction in energy use is encouraged to help slow the progression of global warming. Similarly, the use of sustainably harvested building materials and the reduction of

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[1] According to *LEED 2009 for New Construction and Major Renovations* (page xiv), a "major renovation involves major HVAC renovation, significant envelope modifications, and major interior rehabilitation."

[2] See Appendix 4 for a sample LEED-NC 2009 Project Checklist.

materials in general are rewarded to help preserve natural resources and manage waste output. Human health is also supported by credits specifying low-VOC (volatile organic compound) building materials and regulating minimum standards of ventilation. The final two categories serve as a means of bonus points, either for going above and beyond the requirements of LEED or for tackling design issues particularly relevant in the site's geographic region.

For all the good intention these categories embody, just how sustainable can LEED-NC buildings be when their ratings are entirely based on pre-construction predictions and design specifications? At the moment post-construction data has no bearing on buildings' certification status, which means that structures using more energy or water than expected still retain the credits they earned during the design and construction phases; thus, a building's LEED rating is based entirely on its compliance to design standards, not its actual performance. Furthermore, LEED's current design standards require a minimum energy use reduction of only 10% as compared to the 2007 version of the American Society of Heating, Refrigerating and Air Conditioning Engineers' (ASHRAE) Standard 90.1, an energy efficiency standard used as the basis of many local building codes; previous versions of LEED were even less demanding. The USGBC defends this lax system by claiming LEED is a design-based brand of ratings intended to create a market shift toward sustainability, and that low prerequisites help encourage more developers to try building green for the first time. Former USGBC director Rob Watson has noted that as a voluntary system, LEED cannot require "minimum performance that is too far beyond the ability of the market to deliver."[3] Unfortunately this free-market approach assumes an unrealistically optimistic timeline with regards to climate change: as LEED critic Auden Schendler has said, even obtaining all available points for energy efficiency "frankly isn't even enough to solve the climate problem."[4] For a system that touts itself as the leader in energy and environmental design, LEED's effect on buildings' sustainability can be much smaller than many designers and environmentalists feel is necessary to slow global warming.

However, to meaningfully discuss the sustainability of LEED buildings, a clear definition of the term "sustainable" must be established for use within the scope of this thesis. A concise meaning is difficult to pin down, and even when solely discussing matters of climate change and ecological threats a solid definition of sustainability has remained elusive. The Brundtland Commission's report *Our Common Future* defines it thusly: "[s]ustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[5] Even this definition encompasses many issues, all of which the LEED system attempts to address to some degree: global warming, fresh water depletion, deforestation, depletion of mineral resources, excess waste and pollution, and human health concerns, among others.

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[3] Rob Watson, "LEED Is Not Perfect, But It's Not Broken," *environmental design + construction*, BNP Media, December 23, 2005, http://www.edcmag.com/CDA/Archives/44b973b231d98010VgnVCM100000f932a8c0____

[4] Anya Kamenetz, "The Green Standard?" *Fast Company* 119 (October 2007), http://www.fastcompany.com/magazine/119/the-green-standard.html

[5] Brundtland Commission, "Towards Sustainable Development," *Our Common Future*, (Oslo: United Nations World Commission on Environment and Development, 1987), http://worldinbalance.net/intagreements/1987-brundtland.php

In this thesis I intend to focus on LEED's relationship to global climate change and its contribution to the effort to reduce greenhouse gas emissions. Countless scientific reports have indicated that a 2°C increase above preindustrial temperatures is the maximum level of climate change permissible without causing catastrophic damage to global ecological systems – i.e., the upper bound of sustainability with regard to global warming.[6] To stay within this limit, atmospheric greenhouse gases would need to be stabilized almost immediately, requiring a cutback to between 50 and 85% of carbon dioxide (CO_2) emissions circa 2000 by the year 2050.[7] Buildings in the United States represent 39% of the country's total energy use as well as 39% of its CO_2 emissions – more than either transportation or industry – making architecture an especially important target for reductions in emissions and energy use.[8] LEED was created in part to help encourage such reductions, as indicated by the USGBC's summary of "What LEED Is," which describes the system as "aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts."[9] By using these metrics, LEED intends to decrease both the embodied and operational CO_2 emissions of

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[6] Bill Hare and Malte Meinshausen, "The EU, the IPCC and 2oC," The Institute for European Studies, October 8, 2008, http://www.ies.be/files/repo/Bill%20Hare%20081008.pdf

[7] Intergovernmental Panel on Climate Change, "The long-term perspective," *Climate Change 2007: Synthesis Report*, (Valencia: Intergovernmental Panel on Climate Change, 2007), 67, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

[8] U.S. Department of Energy, "Why Building Energy Codes?" *U.S. Department of Energy Building Energy Codes Program*, 15 July 2010, http://www.energycodes.gov/why_codes/

[9] U.S. Green Building Council, "Intro - What LEED Is," *U.S. Green Building Council*, 2010, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988

buildings: the emissions caused by constructing the building and those created in operating it post-construction. Energy usage is the primary source of existing buildings' operational CO_2 emissions; currently, the embodied energy (the energy associated with obtaining, purifying, and transporting) of tap water usage seems to contribute a negligible amount, though this will no doubt increase as fresh water becomes a scarcer resource.[10]

Most existing buildings are relatively energy inefficient, and unfortunately LEED has not yet effectively incentivized serious efficiency improvements. Even for those LEED buildings which have earned the maximum number of energy efficiency credits (reducing energy usage by 48%), operational emissions constitute over 80% of the buildings' carbon footprints over their lifetimes.[11] For buildings that attained only the bare minimum of energy efficiency under any LEED-NC versions before 2007 (see Table 1), the sum of operational emissions since the date of occupancy have likely already surpassed the total emissions caused by the construction process.[12] Although these figures assume that energy production remains largely fossil fuel-based, this is unfortunately a fairly safe assumption for the coming decades; one scientific report encouraging a shift to renewable energy estimated that "[w]ith sensible broad-based policies and social changes, it may be possible to convert 25% of the current energy system to [wind, hydroelectric, and solar] in 10-15 years and 85% in 20-30 years. Absent that clear

[10] Matthew Sparkes, "Carbon Footprint of Tap Water," *Treehugger*, February 8, 2007, http://www.treehugger.com/files/2007/08/carbon_footprin_1.php

[11] Engin Ayaz and Frances Yang, "Zero Carbon Isn't Really Zero: Why Embodied Carbon in Materials Can't Be Ignored," *DesignIntelligence*, September 1, 2009, http://www.di.net/articles/archive/zero_carbon/

[12] *Ibid*.

direction, the conversion will take longer, potentially 40-50 years."[13] As the world's energy production shifts to more renewable sources, buildings' embodied emissions will become a more significant factor, but for the time being operational emissions represent a greater threat. It is for this reason that I have chosen to focus on LEED buildings' operational emissions when judging their sustainability.

Table 1. LEED-NC energy requirements over time[14]

LEED-NC Version	Minimum Energy Performance Prerequisites	Increase in Efficiency from Previous Version
2.0 & 2.1 (2000, 2002)	Comply with ASHRAE 90.1-1999 or the local energy code, whichever is more stringent; non-regulated loads excluded	Data not available[15]
2.2 (2005)	Comply with ASHRAE 90.1-2004 or the local energy code, whichever is more stringent; after June 26th, 2007, 2 points from EA credit 1 (a 14% energy use reduction) were required[16]	15% before June 2007; 26.9% after June 2007
3.0 (2009)	Show 10% improvement over ASHRAE 90.1-2007, or comply with ASHRAE Advanced Energy Design Guide or NBI Advanced Buildings Core Performance Guide[17]	12.7% - 14.5%

By the middle of November 2010, roughly 6,000 projects have been LEED certified, over half of them LEED-NC (new construction or major renovation projects).[18] These 3,250 buildings

[13] Mark Z. Jacobson and Mark A. Delucchi, *Evaluating the Feasibility of a Large-Scale Wind, Water, and Sun Energy Infrastructure*, (Stanford: Stanford University, 2009), 25, http://www.stanford.edu/group/efmh/jacobson/WindWaterSun1009.pdf

[14] Rob Watson, *Green Building Market and Impact Report 2009*, *GreenerBuildings.com*, Greener World Media, 2009, 21, http://www.greenbiz.com/sites/default/files/GreenBuildlingImpactReport2009.pdf

[15] Energy performance prerequisite data for version 1.0 / pilot not available.

[16] See Appendix 3, Energy & Atmosphere credit 1.

[17] U.S. Green Building Council, *LEED 2009 for New Construction and Major Renovations*, (Washington, DC: U.S. Green Building Council, 2008), 31-32, http://www.usgbc.org/ShowFile.aspx?DocumentID=5546

have been constructed to LEED standards, which have been generally accepted as the most popular way to ensure structures are sustainable, and as commercial buildings they will continue to exist and use energy and water for approximately 70-75 years.[19] Construction factors and material choices can be considered a sunk cost of sorts, since they count as embodied emissions and therefore not recurring sources of CO_2 emission. Because most energy in the United States is produced using fossil fuels, known for their significant carbon footprint, reducing a building's energy usage by 50 to 85% can be seen as a proxy for reducing its CO_2 emissions by the same amount. LEED's method of judging energy use reduction complements this line of thought, since incorporating renewable energy into a project counts toward energy savings; this makes the corresponding LEED credits an accurate reflection of the amount of carbon-intensive energy saved, and thus CO_2 emissions prevented. Unfortunately points are only allotted for savings up to 48% – anything more is considered "exceptional performance above the requirements set," even though this falls beneath the bare minimum needed to remain under the 2°C threshold.[20] To better understand why LEED's requirements have set the bar relatively low, we must first examine the history of the LEED system and the intentions behind its creation.

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[18] U.S. Green Building Council, "LEED Projects & Case Studies Directory," *U.S. Green Building Council*, 2010, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx

[19] D&R International, Ltd., *2009 Buildings Energy Data Book*, (Buildings Technologies Program, Energy Efficiency and Renewable Energy, U.S. Department of Energy: 2009), 3-12, http://buildingsdatabook.eren.doe.gov/docs/DataBooks/2009_BEDB_Updated.pdf

[20] USGBC, *LEED 2009*, 35.

The History of LEED

The U.S. Green Building Council, parent organization of the LEED rating systems, was co-founded in 1993 by an unlikely pair: David Gottfried, a real-estate developer, and Mike Italiano, an environmental lawyer and analyst. By 1994 the USGBC had organized a committee consisting of environmentalists and real estate agents, architects, industry representatives, a building owner, and a lawyer. Richard Fedrizzi, the USGBC's current president, CEO, and a founding chairman, explained these staffing choices by noting that "[t]he great majority of environmental organizations had invested in keeping companies on the other side of the fence. David [Gottfried] thought that we could do things differently. If we could invite business to the table, we could develop standards relative to building performance, buy in at the very top, and be able to transform the marketplace toward sustainable buildings."[21] The committee, headed by Natural Resources Defense Council senior scientist Rob Watson, worked for three years on the principles of what would eventually become LEED before receiving funding from the U.S. Department of Energy's Federal Energy Management Program; by late 1998, the LEED Pilot Project Program (LEED Version 1.0) was introduced. After the certification of a handful of building projects, the ratings system was heavily restructured, and LEED Version 2.0 was born in March of 2000. Versions 2.1 and 2.2 then followed in 2002 and 2005 respectively, with each iteration revising and updating credits until they closely resembled those in place today.[22]

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[21] Kamenetz, "The Green Standard?"

[22] Building Design & Construction, *White Paper on Sustainability*, Building Design & Construction, November 2003, 7, http://www.usgbc.org/Docs/Resources/BDCWhitePaperR2.pdf.

Just as the LEED system was evolving, the corporate strategy of the USGBC continued to develop over time as well, a process which accelerated when Rick Fedrizzi became CEO in 2004. Previously a marketing executive at an air conditioning company, Fedrizzi saw flaws in the way the organization was presenting itself; he felt it was "getting the messaging wrong, leading with the environmental story. We had to lead with the business case."[23] As journalist Anya Kamenetz succinctly described it:

> The business case isn't just that green building saves money on energy. It's that LEED certification sells buildings to high-end clients and governments, gets architects and builders sparkling free publicity, and creates a hook for selling new products, materials, and systems to builders. It's a whole new commercial ecosystem.[24]

This strategy's success is evident in the rapid expansion of both LEED project registration and USGBC membership around the time Fedrizzi assumed control. As his profile on the USGBC website proudly touts, membership has tripled during his time as CEO,[25] and an analysis of LEED registration and certification annual totals shows that on average, both numbers have roughly doubled each year, showing no signs of slowing even during the current economic recession (see Figure 1).

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[23] Kamenetz, "The Green Standard?"

[24] *Ibid.*

[25] U.S. Green Building Council, "Executive Staff," *U.S. Green Building Council*, 2010, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=61#sfedrizzi

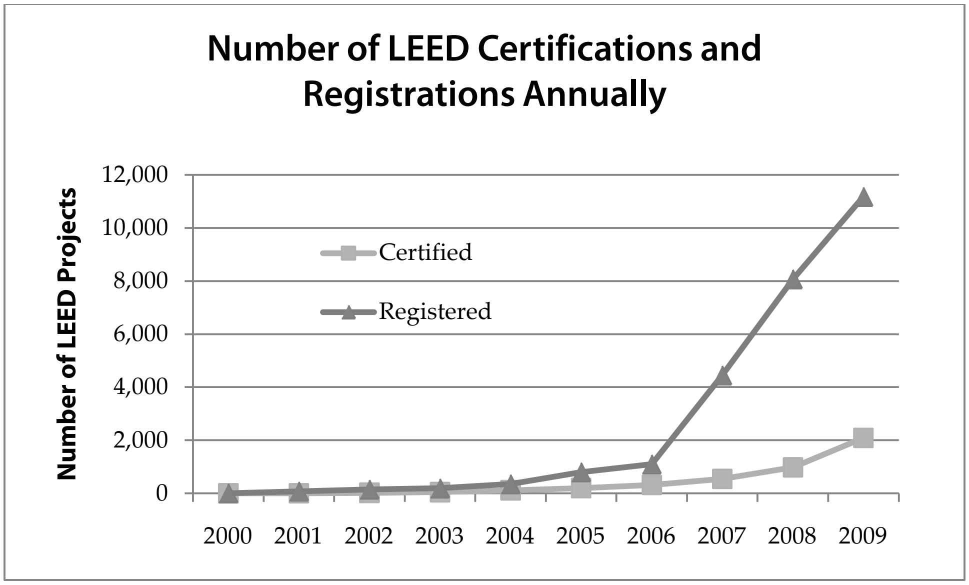

Figure 1. Number of projects LEED certified and registered each year[26]

Such growth seems counterintuitive during a time when construction activities are at a lull, but Fedrizzi's twofold marketing strategy has obviously paid off; as environmentalists (and famed LEED critics) Randy Udall and Auden Schendler have jokingly described it, the USGBC has managed to "Oprah-ize" the field of green building, making it "understandable – even sexy – to the masses."[27] However, it is this same popularity that has made it an ample target for many detractors.

Engineers Jay Stein and Rachel Reiss summed up the quandary of LEED's celebrity status quite eloquently: "[i]n making the LEED System simple enough to allow mainstream industry players to participate in green building projects, much of the critical information that

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[26] "Number of LEED Certifications Skyrockets," *Green Building Insider*, WPL Publishing Co., Inc. January 7, 2010, http://www.greenbuildinginsider.com/articles/20100105

[27] Randy Udall and Auden Schendler, "Leed is Broken – Let's Fix It," *iGreenBuild.com*, August 9, 2005, http://www.igreenbuild.com/cd_1706.aspx

designers and clients need to make informed choices has been lost in the shuffle."[28] Fearing this business-friendly approach would dilute LEED's credibility, they published a report in September 2004 entitled *Ensuring the Sustainability of Sustainable Design: What Designers Need to Know About LEED*. In this work Stein and Reiss criticized the rating system for various characteristics which undermine its ability to produce truly green buildings. They began with version 2.1's lack of credit weighting, meaning that installing bike racks on a project site carried the same reward as reducing overall water consumption by 20%. Combined with a lack of regionalization – weighting credits differently based on needs and issues specific to a project's geographic location – this resulted in many project teams aiming for the low-hanging fruit, or "shopping for points," racking up credits that were easy to fulfill yet not always relevant to a building's geographic or socioeconomic environment (i.e. "cool roofs" in the already-chilly Rockies, or electric vehicle charging stations in a town with only six electric cars). This could result in highly-ranked LEED buildings which had not earned a single energy credit beyond the prerequisites, something that can hardly be considered sustainable with regards to climate change. It is precisely this situation that worried Stein and Reiss, who felt that the existence of such buildings diminished the value of LEED overall and weakened its power as a branding tool, green building standard, and comparative mechanism.

Because new versions of LEED are not retroactive and no follow-up data is required, these buildings can retain their rankings and all the benefits that come with them, even if they

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[28] Jay Stein and Rachel Reiss, *Ensuring the Sustainability of Sustainable Design: What Designers Need to Know About LEED*, (Boulder, CO: Platts, 2004), i, http://dada.cca.edu/~mbaum/Readings/07/Ensuring_Sustainability.pdf

function no more sustainably than the non-certified structure next door. The authors noted that "[t]he USGBC sidesteps the issue by insisting that LEED-NC is focused on design, not implementation. That makes sense, but it's a distinction that could be lost on the general public, which will ultimately judge LEED's efforts."[29] In writing this thesis I have personally encountered many misconceptions about what LEED means; one classmate was under the optimistic impression that LEED buildings were carbon-neutral. Since the publishing of Stein and Reiss' article LEED has become an international symbol of green building, and as such the public expects LEED-certified buildings to be green buildings throughout their lifetimes, not just until the date of occupancy; even if the USGBC tries to shy away from this duty, its rating system has become the *de facto* indicator of sustainability both because of its meteoric rise to prominence and because of the rhetoric used to promote it. Several months after Stein and Reiss published their paper, Rick Fedrizzi proclaimed that "if it's not LEED, it's not green," a statement that certainly suggests the creators of LEED consider it the preeminent marker of green design.[30] As the authors argued, the USGBC must ensure that the LEED rating system is a good indicator of sustainability if they wish it to function as such, since "[t]he value of LEED certification rests in the credibility it confers on a project. The LEED imprimatur proclaims to the world that a building's designers and developers have done a good thing."[31] Stein and Reiss' paper was an important means of voicing early concerns among the architectural and

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[29] *Ibid*, 10.

[30] Nadav Malin, "If It's Not LEED, Can It Still Be Green?" *Environmental Building News* 13, no. 12 (December 2004), http://www.buildinggreen.com/auth/article.cfm/2004/12/1/If-It-s-Not-LEED-Can-It-Still-Be-Green/

[31] Stein and Reiss, *Ensuring Sustainability*, 12.

engineering community, and it paved the way for further constructive criticisms that would help shape the trajectory of the LEED system.

In August of 2005, a few months before LEED-NC version 2.2 was released, Randy Udall and Auden Schendler published a critique that rocked the world of green building; their title boldly stated that "LEED is Broken – Let's Fix It." Although they acknowledged the USGBC's success in publicizing sustainable design, they were not afraid to castigate it for its flaws, writing the following scathing summary:

> We're concerned that LEED has become costly, slow, brutal, confusing, and unwieldy, a death march for applicants administered by a soviet-style bureaucracy that makes green building more difficult than it needs to be, yet has everyone genuflecting at the door to prove their credentials. The result: mediocre "green" buildings where certification, not environmental responsibility, is the primary goal … and a discouraged cadre of professionals who want to build green, but can't afford to certify their buildings.[32]

In their paper, Udall and Schendler argued that striving for LEED certification is too expensive, counterproductive, complicated, bureaucratic, and overhyped. While some of the additional costs of LEED are merited – such as the greater investment in good design, high-quality materials and appliances, and commissioning to ensure the building is working as intended – others are unnecessary fees tacked on by the system itself: project registration and certification, USGBC membership, and the cost of compiling mountains of documentation. The deluge of

[32] Udall and Schendler, "LEED is Broken."

paperwork required for certification is a reflection of the bureaucracy inherent in the system: reviewers can be unnecessarily impersonal and inflexible in their handling of project teams' submissions, and as the authors discovered in their own green building endeavors, attempts at meeting the spirit of a credit can shut one out from earning the credit at all. When designing an office space, Udall and Schendler chose to make all workspaces adjacent to perimeter walls and windows in order to improve natural lighting and air flow; rather than earning them a credit for improving the quality of non-perimeter workspaces[33] (which they had managed to eliminate), this indisputable design improvement cost them the credit altogether. In the authors' words, "[t]he review process needs to be dramatically streamlined, and injected with a serious dose of humility and humanity."[34]

Similar issues are evident with regards to energy modeling and energy use reduction. Modeling energy usage, a notoriously complicated, difficult, and sometimes expensive endeavor, is one of several options used within LEED 2009 to ascertain how many points a building can earn for optimizing energy performance.[35] Udall and Schendler instead maintained that "modeling is most valuable as a design tool … Intelligent modeling, early in the design process, can save lots of energy, money, and pollution."[36] Unfortunately at that time, energy modeling was required at the end of the design process as a predictive tool for obtaining energy

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[33] See Appendix 3, Indoor Environmental Quality credit 6.2.

[34] Udall and Schendler, "LEED is Broken."

[35] See Appendix 3, Energy & Atmosphere credit 1.

[36] Udall and Schendler, "LEED is Broken."

performance credits: by estimating the energy usage of a future building and comparing that to an estimated "baseline" budget building, project teams could arrive at their supposed energy savings and be rewarded accordingly – all without metering a single kilowatt in the real world. Furthermore, at the time the authors were writing, this energy use prediction only took into account "regulated loads," excluding "plug loads" – any energy usage other than HVAC, lighting, and water heating. As a result, any appliances outside the realm of "regulated load" had no bearing on a building's energy usage rating, even if they created tremendous energy savings (or energy hogs); fortunately this oversight has since been addressed to some extent.

Counterintuitive prioritizing within LEED version 2.1 was mirrored by the fact that credits remained unweighted even after the introduction of version 2.2. This contributed in part to what Udall and Schendler described as "point mongering" and "LEED brain" – two design maladies encouraged by the LEED system (though to a lesser extent with LEED 2009's weighted credits). The former is "what happens when the design team becomes obsessively focused on getting credits, regardless of whether they add environmental value … because there is prestige in getting a high LEED rating," while the latter is "what happens when the potential PR benefits of certification begin driving the design process."[37] As Stein and Reiss described earlier, designers were rewarded by playing to the system, and because LEED certification has acquired such prestige, "gaming a final few credits can be worth its weight in LEED Gold."[38]

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[37] *Ibid.*

[38] *Ibid.*

Udall and Schendler's final, somewhat pessimistic point was that the financial benefits of green buildings may be overstated. Although studies have shown that sustainable buildings can result in increased worker productivity and reduced absenteeism, these qualities are "difficult to quantify … [and] don't impact first costs," and their relative value depends on the perspective of the developer.[39] Similarly, the financial benefits of more efficient buildings are often general, societal benefits that will only begin to pay back the owner's investment in the long term. In today's world of rapid construction and short-term occupancy, such returns on investments may not accrue fast enough to sway developers. Nonetheless, the environmental benefits of green design are very real, and LEED can be a helpful tool to encourage a shift toward sustainability. The authors closed with the suggestion that true sustainability may require a prescriptive system of requirements and specifications, rather than the performance-based certification approach LEED takes. However, they concluded that because "we need green building to triumph, to take over our culture … we need LEED – or something like it – to accelerate that transition," and they hoped that their tough-love criticism could help reform and reinvent the system.[40]

Udall and Schendler's critical analysis of LEED drew a lot of attention in the world of green building, prompting a response from the "father of LEED" himself, Rob Watson (one of the founding members of the USGBC). Watson wrote that he had "smiled a sad smile and nodded [his] head in agreement with about 80 percent of what the authors were saying," but

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[39] *Ibid.*

[40] *Ibid.*

that because of the continual evolution of LEED and the introduction of version 2.2, the article "essentially was obsolete the day it was published."[41] In his response he cited the "streamlining [of] LEED's documentation and certification requirements" as well as a newly introduced online workspace for project teams as two ways in which the certification process was becoming easier to navigate. He also defended LEED's energy-efficiency standards, saying that version 2.2 and newer energy standards released by ASHRAE fixed many of the complaints targeted at its Energy and Atmosphere section, and that ASHRAE should not be viewed as "national standard practice," but rather an above-average metric of energy performance (see Table 2). He asserted that "we need to abandon the 1980s view that operational energy is the only relevant parameter; it's about 60 percent of the equation," with all of the other elements prescribed by LEED contributing to a building's carbon footprint.[42] (While this statement is quite true during the construction phase and significantly affects a building's embodied energy, many of these factors become sunk emissions costs that are proportionately less significant during a building's meaningful life, as described earlier.) With this in mind, Watson closed his rebuttal with a quote from Gandhi to sum up the USGBC's philosophy of encouraging market shifts rather than mandating sweeping changes: "A leader who is 100 paces ahead of his followers is revered and called a visionary; one who is a thousand paces ahead is stoned and called a heretic."[43]

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[41] Watson, "LEED Is Not Perfect."

[42] *Ibid.*

[43] *Ibid.*

Table 2. Percentage of United States using 1999, 2004, and 2007 versions of ASHRAE standard 90.1 as basis for commercial building code

	1999	2004	2007
% of U.S. using ASHRAE Standard at time of LEED adoption[44]	66%	45%	8%
% of U.S. using ASHRAE Standard or stricter by Nov. 2010[45]	76%	66%	32%

Despite Watson's defense of the LEED system, Udall and Schendler's critique struck a chord, and many of the suggestions put forward by Udall, Schendler, Stein, Reiss, and others made their way into the third complete version of LEED standards, released in April 2009. LEED 3.0 introduced a system of credit weighting intended to make each credit's value reflect its environmental impact: improving a building's energy efficiency now gains LEED project teams up to 19 points, whereas including on-site bicycle racks earns only one. To do this, LEED has been adjusted to a 100-point scale (with the potential for 10 bonus points), making it easier for teams to determine which tier of certification they can obtain. Also included in LEED 3.0 are "regional priority credits," extra points that can be earned if buildings fulfill normal credits particularly important in their area of the country; this addition was intended to encourage designers to be mindful of their site locations when choosing which green technologies to emphasize and what climactic and ecological factors to take into account. In Claremont, CA, for example, regional priority credits emphasize the region's ample sunshine, moderate but dry climate, and tendency toward sprawl by rewarding proximity to public transit, avoidance of

[44] Watson, *Green Building Report*, 21.

[45] U.S. Department of Energy, "Status of Commercial Energy Codes," *U.S. Department of Energy Building Energy Codes Program*, September 14, 2010, http://www.energycodes.gov/states/maps/commercialStatus.stm

creating heat islands, water conservation, use of renewable energy (such as solar power), and daylighting. Although all of these modifications to LEED were welcomed by its supporters and critics alike, the certification system's ability to produce truly sustainable buildings is still subject to question.

Performance of LEED Buildings

The most straightforward way to ascertain LEED buildings' level of sustainability is by analyzing their performance. In March of 2008 the New Buildings Institute (NBI) did just that; in a comprehensive survey of data supplied from 121 buildings certified under LEED-NC version 2, NBI (funded by the USGBC and the Environmental Protection Agency) conducted the first-ever large-scale analysis of the energy efficiency of LEED-NC buildings.[46] 552 buildings were certified LEED-NCv.2 as of December 2006, constituting 75 percent of total certifications at the time and therefore providing "the largest coherent subset on which to base energy analysis."[47] Because of this, the NBI invited all NCv.2 buildings at the time to participate in the study, receiving positive responses from about half. However, half of this group was unable to participate for technical reasons – such as lacking a full year's worth of energy usage data – and so the final sample size was 22% of total LEED-NCv.2 certified buildings.[48] Despite the nature of their selection, these buildings were reasonably representative of NCv.2 buildings in terms of

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[46] Cathy Turner and Mark Frankel, *Energy Performance of LEED for New Construction Buildings*, *U.S. Green Building Council*, New Buildings Institute, 2008, http://www.usgbc.org/ShowFile.aspx?DocumentID=3930

[47] *Ibid*, 7-8.

[48] *Ibid*, 33.

size distribution, climate zone, and certification level, though skewed in favor of office buildings when divided by building type. These 121 buildings reported one year of energy use data, excluding credit from on-site energy production and including "plug loads;" this data was then compared to the energy usage averages from the 2003 Commercial Building Energy Consumption Survey (CBECS), a "national survey of building energy characteristics completed every four years by the federal Energy Information Administration."[49] This comparison revealed that the LEED buildings studied had a median Energy Use Intensity (EUI, a calculation of $kBtu/ft^2$) that was 24% below the average EUI from CBECS.[50] This finding is rather underwhelming in light of the 50-85% reduction required to prevent significant climate change, and unfortunately its statistical usefulness is limited as well. Upon examining individual LEED buildings' EUIs, the authors discovered:

> The results show a level of spread within building types and certification levels that can't be explained solely by the building characteristics data available. While differences in averages suggest possible relationships, the variance in the data is too large for statistically significant confidence in the size of those differences.[51]

This degree of variance necessitated the use of median values rather than means when describing the averages for the LEED dataset, in part because of a subset of outliers which Turner and Frankel dubbed "High Energy Type" buildings. These buildings, which accounted

[49] *Ibid*, 2.

[50] *Ibid*, 13-14.

[51] *Ibid*, 10.

for 17% of the LEED dataset, were primarily used as labs and datacenters, which require more operating energy than typical commercial buildings (and actually used nearly two and one-half times more energy than predicted in their designs, on average).[52] In comparison, the CBECS dataset consisted of only 11% High Energy Type buildings, in addition to 8% low-energy structures such as warehouses and vacant buildings, none of which were present in the LEED dataset.[53] Because of this disparity, Turner and Frankel chose to exclude the High Energy Type buildings from the remainder of their in-depth analysis, studying only what they termed "Medium Energy Type" buildings, or those with more typical energy usage. The authors then compared these buildings using various categorizations, starting with average EUIs for different levels of LEED certification (see Figure 2). As expected, more highly ranked buildings performed better, with certified projects having a 26% lower average EUI than CBECS' average, while silver projects' average EUI was 32% lower. Gold and platinum buildings (combined into one category because of the scarcity of platinum-ranked respondents) had an average EUI 44% lower than CBECS', a reduction that is nearing Architecture 2030's interim goal of 50% – also the low end of what could be considered truly sustainable. As before, however, the authors cautioned that although "[t]his suggested trend in medians is encouraging … the wide scatter within each level shows significant further room for improvement."[54] This same tendency was evident in an analysis of the buildings by the number of Energy & Atmosphere credit 1 (EAc1)

[52] *Ibid*, 28.

[53] Watson, *Green Building Report*, 22.

[54] Turner and Frankel, *Energy Performance of LEED*, 16.

points they obtained (see Figure 3): those which earned 8 to 10 points had a noticeably lower median EUI than those which earned only 2 or less, but each category's range was wide enough to overlap significantly. Categorizing buildings by climate zone revealed that those in mixed, cool, or cold climates had median EUIs 38% to 49% lower than their CBECS counterparts, but buildings in warm and hot climates showed no improvements over CBECS structures in their regions; this could suggest that energy efficiency is harder to achieve in hotter locales, a topic on which Turner and Frankel recommended further study.[55]

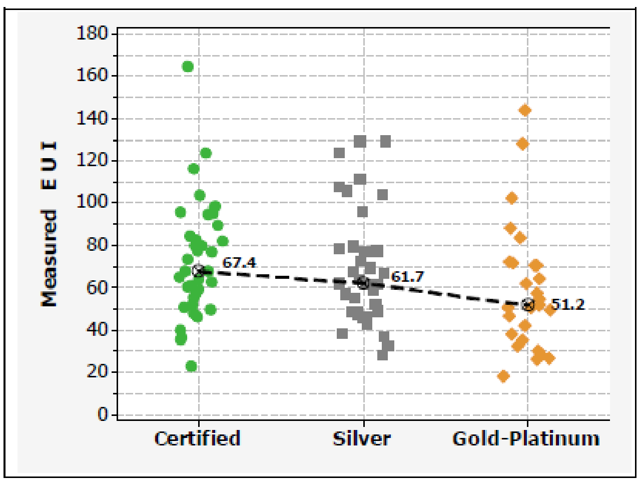

Figure 2. Measured EUIs (kBtu/sf) by LEED-NC Rating Level[56]

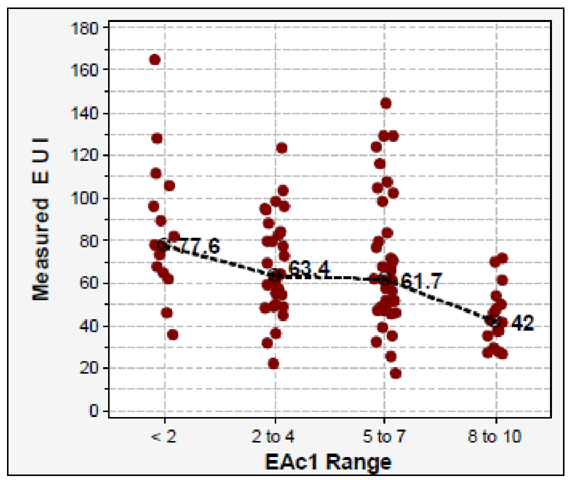

Figure 3. Measured EUIs (kBtu/sf) by EAc1 Point Range[57]

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[55] *Ibid*, 17.

[56] *Ibid*, 16. Unless otherwise noted, all graphs in this section are reproduced from the original report with permission from the authors.

[57] *Ibid*, 17.

The next section of the report calculated hypothetical Energy Star ratings for buildings within the LEED dataset eligible for the Energy Star program (see Figure 4). Since the ratings "represent performance percentiles," an assumed national average of 50 (i.e. the 50th percentile) was used as a point of comparison.[58] The median Energy Star rating of eligible LEED buildings was found to be 68, with three-quarters of buildings above the national average and half above a rating of 75 – "top performance," according to the Energy Star website.[59] Another 17% had ratings surpassing 90, but on the other end of the spectrum, 15% of buildings studied were rated below 30, meaning they actually performed worse than 70% of similar buildings.

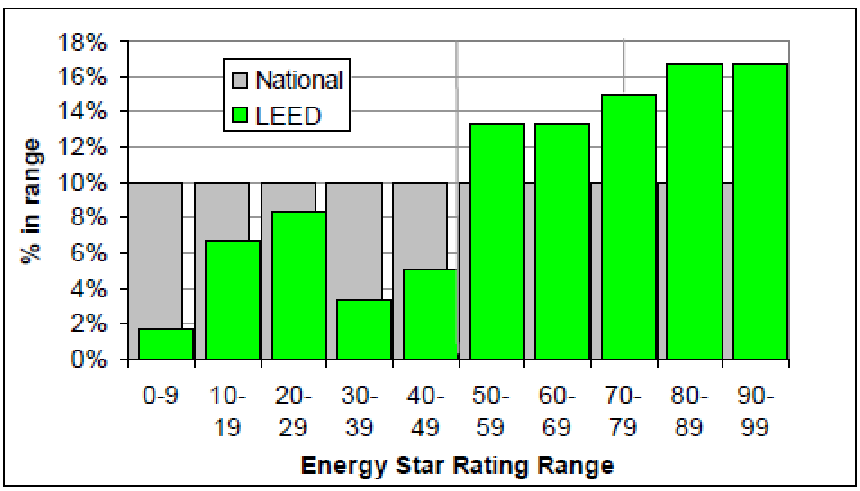

Figure 4. Distribution of LEED Building Energy Star Ratings[60]

[58] *Ibid*, 18.

[59] Environmental Protection Agency, "How the Rating System Works," *Energy Star*, http://www.energystar.gov/index.cfm?c=evaluate_performance.pt_neprs_learn

[60] Turner and Frankel, *Energy Performance of LEED*, 19.

Some of these buildings were even revealed to be using more energy than their project baseline figures (maximum energy usage allowed by building standards), a fact which Turner and Frankel uncovered in their analysis of measured versus proposed energy use. The authors prefaced their comparisons to design proposals by noting:

> [M]ost professionals in the energy modeling industry are careful to adopt caveats in their predictions or emphasize that modeling is a tool to identify relative energy performance, not to predict actual energy use. Despite these caveats, modeling is widely used to estimate actual future energy use … Therefore, the predictive accuracy of energy modeling in terms of both relative and actual energy performance becomes critical to the building industry.[61]

On average, the authors found that the ratio of measured EUI to predicted EUI was 92%, suggesting that average EUI numbers from energy modeling are fairly reliable. Furthermore, average measured energy savings below project baseline figures were 28%, which is close to the average of 25% projected during the design phase, as well as the 24% savings found when comparing the LEED and CBECS averages. However, the variation in performance across the dataset suggests that on a smaller scale, energy modeling is not nearly as reliable (see Figure 5); as the authors summarized:

> [T]he accuracy of individual energy use predictions is very inconsistent … [T]his suggests energy modeling is a poor predictor of project-specific energy performance.

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[61] *Ibid*, 20-21.

Measured EUIs for over half the projects deviate by more than 25% from the design projections, with 30% significantly better and 25% significantly worse … The conclusions are similar for relative *savings* predictions on an individual project basis … Fully 25% of the buildings show savings in excess of 50%, well above any predicted outcomes, while 21% show unanticipated measured losses, i.e., measured energy use exceeding the modeled code baseline.[62]

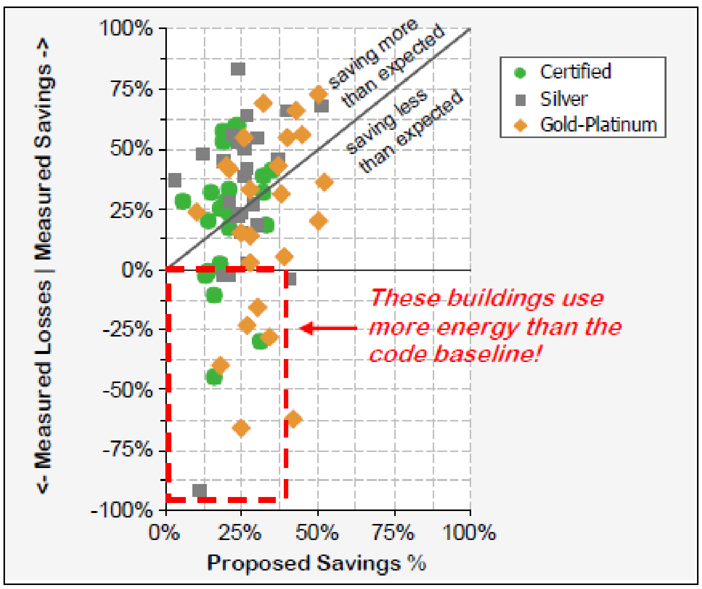

Figure 5. Measured versus Proposed Savings Percentages[63]

To further investigate this disparity, Turner and Frankel turned to projects' calculated baseline figures. Since these estimates are used as a standard of comparison to determine LEED

[62] *Ibid*, 22-23.

[63] *Ibid*, 24.

buildings' energy savings over similar non-LEED buildings, their accuracy can have a large effect on how many points a project is awarded for EAc1. The authors found that even when considering only office buildings, baseline EUIs had a "factor of four variability within a single project type," suggesting that their methods of calculation are in dire need of improvement and standardization.[64] Further complicating this uncertainty is the fact that average baseline EUIs for building types did not always correspond to the average EUIs for building type categories within CBECS, indicating that they may not be good representatives of the buildings they intend to approximate. Another result of this inaccurate prediction is that "[p]rojects that set higher energy performance targets seem to be held to a higher baseline standard from which to measure improvement," likely because of the way in which the ASHRAE 90.1 standard – the basis for baseline calculation – determines what could be considered a similar building.[65] For example, a building using a geothermal heat pump for its HVAC needs would have to be compared to a baseline using this same technology, rather than the more commonly used but less efficient air-source heat pumps. As the authors warned, "this protocol may represent a disincentive for the adoption of more efficient mechanical systems," since a higher baseline could result in less points from EAc1.[66] Turner and Frankel closed the report with a short discussion of other energy-related credits (which had "little conclusive impact on energy performance") and a survey of building occupants (which showed either positive or neutral

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[64] *Ibid*, 25-26.

[65] *Ibid*, 26-27.

[66] *Ibid*, 27.

opinions on comfort, productivity, and overall satisfaction), summarizing their earlier findings and suggestions in their conclusion.[67]

Likely because of its objective and even-handed nature – and its position as the only comprehensive study of LEED-NC energy efficiency to date – the *Energy Performance of LEED* report has been used to support the arguments of boosters and detractors alike. One of the most outspoken critics of the study, the LEED system, and the USGBC as a whole has been Henry Gifford, an energy-efficiency specialist working in New York City. Gifford wrote an especially negative response to the *Energy Performance* report, taking issue with much of its methodology. His first criticism was that the building dataset is not a random sampling of available LEED buildings, explaining his qualms in the following way:

> This sample appears to constitute only those owners or operators of LEED certified buildings who were willing to divulge their energy use data, which is a little like making generalizations about drivers' blood alcohol levels from the results of people who volunteer for a roadside breathalyzer test.[68]

Admittedly self-selection bias is a possibility, but the report's co-author Mark Frankel has defended the dataset by noting that statistical methods were used to test for bias, and some participants were not even aware of how their buildings were performing before submitting

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[67] *Ibid*, 29-31.

[68] Henry Gifford, "A Better Way to Rate Green Buildings," EnergySavingScience.com, 3, http://www.energysavingscience.com/

data.[69] Gifford's second criticism was that the study unfairly compared new LEED-certified buildings to older buildings within the CBECS database, which he claimed use more energy because of their age. He suggested that the post-2000 LEED buildings should have been compared to post-2000 CBECS buildings, even though data was only available up to 2003.[70] The authors of the study addressed this very point in an appendix to their report, noting that they had analyzed energy use by building age and had not found a significant downward trend in recent years, and that the CBECS buildings built between 2000 and 2003 are not a large enough sample size to present a reliable trend.[71] Frankel has since noted that since some of the LEED buildings were renovations of older buildings, a comparison to all-new CBECS buildings may have been unfairly strict. He also reiterated that a 3-year sample size is not representative, noting that historically, "when CBECS published data for just a few years it looked better, only to worsen when the full decade's data were compiled."[72] These two points, however, were only a prelude to Gifford's primary issue with the *Energy Performance* report. His main criticism lay with the fact that study utilized median values for its average of LEED data, while CBECS' average data was based on an arithmetic mean. He even went so far as to say that this comparison is "worthless," and that only a comparison of the full LEED dataset's mean to CBECS' mean could produce reliable results; after performing such a comparison Gifford

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[69] Nadav Malin, "Lies, Damn Lies, and… (Another Look at LEED Energy Efficiency)," *BuildingGreen.com*, September 2, 2008, http://www.buildinggreen.com/live/index.cfm/2008/9/2/Lies-Damn-Lies-and-Are-LEED-Buildings-iLessi-Efficient-Than-Regular-Buildings

[70] Gifford, "A Better Way," 3-4.

[71] Turner and Frankel, *Energy Performance of LEED Buildings*, 36-37.

[72] Malin, "Lies, Damn Lies, and…"

declared that LEED buildings actually use 29% *more* energy than their CBECS counterparts.[73] However, Gifford's methods have statistical problems of their own: for a dataset with such a wide spread, a median presents a much more reliable average value than a mean, given the mean's tendency to be skewed by large outlying numbers. Furthermore, the CBECS dataset contains fewer High Energy Type buildings and more low-energy buildings, as described before. While measuring LEED's median against CBECS' mean creates an admittedly less-than-ideal comparison, Turner and Frankel's use of the median to describe the LEED buildings' average is the more statistically valid choice, as verified by their peer reviewers from various respected institutions. Rob Watson has even noted that CBECS could benefit from using median values as well, given the level of variability within its own dataset.[74]

Despite Gifford's questionable attempts at debunking the *Energy Performance* study, his response's more general critiques of LEED are hard to refute. As an energy-efficiency specialist, he was especially irked by LEED's method of awarding points for energy savings modeling, writing that "attention is focused on the *appearance* of energy efficiency, not its accomplishment. The LEED system does this by rewarding designers for *predicting* that a building will save energy, not for proving that a building actually saves energy."[75] As an example of this focus on appearance, Gifford mentioned the popularity of solar panels on buildings. As one of the few visible markers of a building's sustainable nature, solar panels present a "perfect photo

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[73] Gifford, "A Better Way," 4.

[74] Watson, *Green Building Report*, 22.

[75] Gifford, "A Better Way," 5.

opportunity, which makes them a publicist's dream."[76] (After all, one of the economic draws of LEED certification is its generation of positive publicity, as explained earlier.) To reiterate this point Gifford described a residential high-rise in New York City that has "solar panels mounted vertically on its facades where everyone can see them," a design choice that drastically reduces their energy output; even worse, these panels are not facing due south (the direction that receives most sunlight in the Northern Hemisphere): some are facing southwest, while others are facing northwest, and one group of panels is even blocked from the sun entirely by unfortunately placed rooftop equipment.[77] (This building, paradoxically named The Solaire, is rated Gold under LEED-NCv.2, and it uses its "green building" publicity to attract the wealthiest residents of Battery Park City.[78]) Gifford's general argument was that LEED cannot reliably produce energy-efficient buildings, since LEED ratings are not based on real-world energy efficiency. He stated:

> Rated buildings should mount award plaques with removable screws, because each year the building's energy bills would have to be reviewed. Buildings that did not continue to perform would lose their ratings, and those that performed well could continue to have something to be proud of.[79]

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[76] *Ibid*, 5.

[77] *Ibid*, 6-7.

[78] Steven Winter Associates, Inc., "Battery Park City's Gold Standard: The Solaire Residential High Rise," *www.swinter.com*, http://www.swinter.com/services/documents/Solaire_Case_Study.pdf

[79] Gifford, "A Better Way," 8-9.

Ironically enough, this notion of rescindable ratings was considered from the early days of LEED, but it was rejected both for its impracticality and its punitive nature.[80] However, the concept is working its way into the system, since LEED 2009 now requires buildings from all LEED systems (not just NC) to report energy and water use values for the first five years of occupancy, though no definite penalty is in place for buildings that underperform.[81] This new requirement addresses multiple issues in that it creates a ready-made data pool for future studies of LEED's energy efficiency in addition to creating a sense of responsibility for buildings' energy usage.[82] The USGBC's accompanying Building Performance Partnership will monitor usage data and "help underachieving projects identify and fix performance problems," hopefully fixing energy and water use hemorrhages without actually penalizing participants.[83] However, this was only a small step in remedying LEED's relatively low energy efficiency, and it was not able to silence Henry Gifford's accusations.

On October 8, 2010, Gifford filed a class-action lawsuit against the USGBC and many of its founding members. The suit alleges that the USGBC's claims of improved energy efficiency are "false and intended to mislead the consumer and monopolize the market for energy-efficient building design," using Gifford's critique of the *Energy Performance* report as evidence

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[80] Malin, "Lies, Damn Lies, and…"

[81] USGBC, *LEED 2009*, xvii.

[82] Watson, *Green Building Report*, 19.

[83] Tristan Roberts and Allyson Wendt, "USGBC Expands Data Collection from LEED Buildings," *BuildingGreen.com*, August 20, 2010, http://www.buildinggreen.com/auth/article.cfm/2010/8/20/USGBC-Expands-Data-Collection-from-LEED-Buildings/

of subterfuge.[84] The suit invokes the Sherman Anti-Trust Act and the Lanham Act, among others, in accusing the USGBC of "deceptive marketing and unfair competition" as well as "deceptive business practices and false advertising," and it demands that the organization "cease deceptive practices and pay $100 million in compensation to victims, in addition to legal fees."[85] The plaintiffs listed include Gifford himself, "owners who paid for LEED certification on false premises, professionals like Gifford whose livelihoods have allegedly been harmed by LEED, and taxpayers whose money has subsidized LEED buildings," though the extent to which Gifford's livelihood has been harmed is subject to dispute.[86] Gifford himself states that "[n]obody hires [him] to fix their buildings…[because u]nless you're a LEED AP you're not going to get work," but green building lawyer Shari Shapiro suspects that Gifford may have actually benefited from the increased environmental awareness LEED has engendered; nonetheless, Gifford asserts that LEED's supposed dishonesty is detrimental to the world as a whole, "harming the environment by leading consumers away from using proven energy-saving strategies" (like those he employs in his own practice).[87]

While Gifford's accusations of monopoly and deception are doubtful at best, his wariness of LEED's penetration into building legislation is somewhat merited, as explained in a report by public policy professor David M. Hart, who wrote:

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[84] Tristan Roberts, "USGBC, LEED Targeted by Class-Action Suit," *BuildingGreen.com*, October 14, 2010, http://www.buildinggreen.com/auth/article.cfm/2010/10/14/USGBC-LEED-Targeted-by-Class-Action-Suit/

[85] *Ibid.*

[86] *Ibid.*

[87] *Ibid.*

> LEED is widely perceived to be…a 'perfect example of an energy/environment standard that did not come from government down, but from society up.' Yet government agencies, in their roles as buyers and owners of buildings, as land use and taxing authorities, and as regulators of construction, undoubtedly helped to catalyze LEED's explosive growth in the past decade.[88]

He went on to note that "[i]n just one short decade, aided by a push from all levels of government, USGBC has defined 'green building' in the U.S. To the extent that LEED mandates spread, it will have attained a *de facto* position as national legislator of building standards."[89] Hart detailed how the USGBC was founded at a time when the government "went to sleep for fifteen years," neglecting the topic of energy efficiency after several ineffective attempts at efficiency legislation. In 1977 Congress had established the Department of Energy (DOE) and charged it with the task of developing building standards "designed to achieve the maximum practicable improvements in energy efficiency," but upon their implementation the backlash was so strong that they were no longer enforced. In 1982 DOE sought to strengthen its efficiency standards, choosing to contract ASHRAE for the job rather than face a second round of censure. DOE asked ASHRAE to revise its 90.1 standard for use as a basis of building codes, leading to the creation of ASHRAE standard 90.1-1989, and in 1992 Congress required states to adopt it as the basis of their local building codes (implementing any future revisions DOE deemed

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[88] David M. Hart, *Don't Worry About the Government? The LEED-NC "Green Building" Rating System and Energy Efficiency in U.S. Commercial Buldings*, MIT Industrial Performance Center, (Cambridge, MA: Massachusetts Institute of Technology, 2009), 2-3, http://web.mit.edu/ipc/research/energy/pdf/EIP_09-001.pdf

[89] *Ibid*, 13.

necessary).[90] However, no disciplinary measures were put in place for states that failed to create a 90.1-based building code, and even today nine states (including places like Alaska, Wyoming, and Arizona) lack a statewide code altogether.[91]

These halfhearted attempts at energy efficiency are typical of the post-energy-crisis era, during which "carbon emissions of the commercial building sector in North America grew about 25% faster than carbon emissions of the overall economy," and building efficiency "remained unchanged from 1986 to 1999."[92] In this environment the USGBC's founders saw a niche waiting to be filled, and with their fortuitous timing combined with keen business sense, the LEED system began working its way into government building requirements even before version 2.0 was released. As Hart revealed, "[o]ne of the first adopters of LEED-NC was the U.S. General Services Administration (GSA), which manages much of the federal government's real estate portfolio. The federal government is the nation's largest real estate owner and lessee."[93] In January of 2000 GSA required all of its new buildings to be LEED certified, and many other governmental agencies – federal, state, and local – followed suit. By the end of 2005 "41% of all LEED-NC registrations … were government buildings."[94] (An additional 21% was made up mostly of buildings for private schools and universities, including Pomona College – a fact to

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[90] *Ibid*, 4-5.

[91] DOE, "Status of Codes."

[92] Hart, *Don't Worry About the Government?* 6.

[93] *Ibid*, 11.

[94] *Ibid*, 11-12.

which I will return later.) In addition to these requirements, some governments also enacted incentives for commercial buildings that pursued LEED certification: tax credits, reduced fees, expedited permits, and even exemptions from certain zoning requirements (such as maximum height or density). San Francisco has even gone so far as to require LEED-NC Silver certification for all commercial buildings by 2009 and Gold by 2012. Furthermore, some jurisdictions' "'green building' codes require projects to meet LEED standards, but not necessarily receive formal certification, creating a LEED 'shadow effect' of uncertain proportions."[95] This mass implementation of the LEED-NC system has helped it expand exponentially in the past ten years, but at the same time, it has placed the USGBC in the peculiar position of *de facto* standards legislator. As Hart wrote, acting as "primary arbiter of building energy codes … undermine[s] its own capacity to achieve its mission, which is to push the upper bounds of the industry mainstream."[96]

Being entangled with government standards makes it harder for LEED to "lead the 'revolution,'" since any significant changes will ripple out to public policy and likely be met with the same opposition that halted DOE's efforts in 1977.[97] In addition, LEED's position as "unelected policy-maker" shifts the responsibility of enforcing energy efficiency away from the government, which is the only entity capable of imposing the prescriptive requirements that are

[95] *Ibid*, 12-13.

[96] *Ibid*, 22.

[97] *Ibid*, 21.

necessary to "pull along the trailing edge of 'brown building' practice."[98] Hart concluded that "a voluntary approach to building energy efficiency is inevitably limited in reach," and though the USGBC has helped catapult the field of green building into the limelight, it cannot force a sustainable level of CO_2 emissions on its own.[99] In order to expand its role as market shift leader, LEED must not be bogged down in issues of policy; Hart's report seems to suggest that the government must respond with stricter energy efficiency measures to ensure that sustainability becomes the norm, not the exception.

LEED at Pomona College: A Lincoln-Edmunds Case Study

During the time since the LEED certification system was created, Pomona College has become increasingly conscious of environmental issues. In May of 2003, its Board of Trustees mandated that all new construction and major renovation on campus must be built to LEED Silver standards, though not necessarily certified as such.[100] This first took effect with the construction of the Richard C. Seaver Biology Building, which was certified LEED Silver in 2004. Because the Seaver Biology Building is metered along with the rest of the Seaver complex, energy use data for only the LEED-certified portion is not available; according to design specifications the building should be using 25% less energy than one meeting Title-24, California's relatively stringent building construction code which can be used in lieu of

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[98] *Ibid*, 3.

[99] *Ibid*, 22.

[100] "History of Sustainability at Pomona," *Pomona College*, http://www.pomona.edu/administration/sustainability/about/history.aspx

ASHRAE 90.1 when assessing LEED credits.[101] Shortly after the completion of the Seaver Biology Building, construction was started on a second LEED project: the Lincoln-Edmunds Buildings, which were rated Gold. This complex now houses the Geology, Computer Science, Linguistics and Cognitive Science (LGCS), Neuroscience, Psychology, Chicano/a~Latino/a Studies, Black Studies, Asian American Studies, and Environmental Analysis departments.[102] While taking classes in these departments I had heard whispers of discontent about the design of the buildings, but I was never quite sure what had gone wrong. To get a better picture of the faculty's opinions, I contacted professors within these departments who had been employed by the College at the time of the buildings' construction and whose offices are currently located within the complex. I began by interviewing two such professors in person – Eric Grosfils and Linda Reinen – and then emailed eleven others with a survey of comparable questions,[103] receiving responses from seven of them. As a result the Black Studies and Asian American Studies departments are not represented, which no doubt skews the nature of the opinions I have heard to a certain degree. However, only one Asian American Studies professor has an office located within Lincoln-Edmunds, and no Black Studies professors' offices are within the complex at all, so it seems these two departments do not have as strong a presence in the buildings as others might. Another factor that skews the tone of responses I received is that six

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[101] "Green Building Features: Richard C. Seaver Biology," *Pomona College*, http://www.pomona.edu/administration/sustainability/initiatives/facilities/seaver-bio.aspx

[102] Mark Kendall, "The Lincoln and Edmunds Buildings Are Now Open," *Pomona College*, January 12, 2007, http://www2.campus.pomona.edu/news/2007/01/12-lincoln-edmunds-buildings-now-open.aspx

[103] See Appendix 2

of the seven professors who responded by email are Psychology professors, although three of the six also have appointments in other departments. This could result in the information being more representative of the Psychology department's space than the buildings as a whole. Nonetheless, in spite of these limitations, the opinions I received provide an interesting starting point in examining the Lincoln-Edmunds buildings; while many comments are not directly related to the LEED certification process, the issues that arose are a real-world reminder of the fact that a LEED plaque does not necessarily mean a building is sustainable or well designed.

All of the professors interviewed and surveyed were at least somewhat involved in the design process of the buildings, and one respondent was an Associate Dean of the College at the time. Several participants voiced dissatisfaction with the experience, saying that it was at times secretive and disorganized, with many requests being either ignored or misinterpreted. One Geology professor found it necessary to write up a lengthy list of corrections and notes after seeing the final plans for his workspace, and the LGCS faculty were so dissatisfied with their space's initial design that they took matters into their own hands and drew up a plan of their own. Other professors who were not as vocal during the design process were not so lucky; a professor from the Psychology department said that she had assumed student-faculty interactivity would have been a core value integrated into the building's design, but because she did not specifically request this quality her department's offices were all placed in a corridor that makes them "invisible … from the flow of students."[104] Other issues arose from the "veil of silence" under which faculty were not allowed to know how other departments' spaces were

[104] Patricia Smiley, e-mail message to author, November 13, 2010.

being designed, resulting in a fragmented planning process unaware of the bigger picture. One glaring example of this lack of integration is the fact that the Geology department's rock saw lab, a space so dirty that it requires its own air filtration system, is located immediately adjacent to Computer Science's server room, a space which requires clean, cool air to keep its many computers from overheating. Because of this oversight, a positive-pressure air filtration system had to be installed in the server room after the fact in order to prevent it from accumulating Geology's dust and dirt.[105] Unfortunately this poor design choice is only one of many.

Six of the nine professors with whom I communicated felt that their department's needs were not quite met in the building's design, and one of the three professors who answered positively was a member of the LGCS department (which designed its own space). Several professors listed small classrooms and poorly designed public spaces as some of their major problems, while others mentioned a lack of storage space and improper classroom furniture, specifically large immobile tables rather than individual desks. Over half pointed out the scarcity of electrical outlets in offices – only one panel of six outlets for the entire workspace – which was evidently more of a financial decision than an energy-conserving one. Three professors mentioned problems with lights that never turn off: the LGCS suite is permanently lit even to this day, a problem that initially plagued the Geology lounge as well. Although the lighting was designed in banks in order to allow better controllability, no light switches were installed until 18 months after occupancy; strangely enough, a storage closet's lighting was wired along with one of the banks in the lounge, meaning it was perpetually illuminated as

[105] Eric Grosfils and Linda Reinen, personal interview, September 14, 2010.

well.[106] A Psychology professor noted that the observation space for the department's one-way vision room was initially equipped with emergency lighting that could not be turned off, rendering the space unusable for its purpose.[107] Another point of contention with several professors was plumbing: four expressed annoyance with the automatic faucets initially installed in all spaces (even labs and pantries), which are inefficient for anything other than hand-washing and can often be triggered unintentionally. One Geology professor described how the sink in her lab was positioned next to the door and would turn on every time someone entered or exited the room; this problem was not remedied until 18 months after occupancy, when the sink was replaced with a traditional, manual one. This same professor told me that during the construction process, she realized that no sinks were being installed in what had been designated the department's "wet lab," a peculiar oversight that would have been costly to fix. A similar issue occurred in the rock saw lab, which was designed by a special lab consultant because it was intended to house many different types of large equipment. However, the consultant's design was later modified without the department's knowledge: the building's main electrical panel was placed behind the spot where a two-ton saw was intended to be located, and several plumbing fixtures were shifted in ways that required a total redesign of the room. Furthermore, while moving into the building, the department discovered that the door of the room was too small to accommodate a multi-use piece of equipment. As a result, the

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106 *Ibid*.

107 Smiley, e-mail message.

College had to purchase three smaller pieces of equipment just to replace the one that should have been included in the design specifications.[108]

Interior décor was another subject of disagreement; the Geology department requested rubberized floors in its labs and public spaces, knowing they were likely to be dirty, but the College required public spaces to be carpeted to match the rest of the building, even though this would require more cleaning. Several offices were initially designed with rubberized flooring instead, and some lab spaces were even unintentionally carpeted when the building was constructed. Faculty research labs were only furnished with one lab bench, one sink, and one set of cabinets, making work a challenge. To remedy this problem, the faculty suggested that they salvage furnishings from the old Seaver building, slotted to be remodeled in the near future. However, the College argued that the older, light wood pieces from Seaver would not match the new, dark wood furniture of Lincoln-Edmunds and that they could just buy new furnishings, presumably throwing away the ones from Seaver. Fortunately the faculty was able to persuade the College that reusing was the more economical option, preventing a colossal waste of still-usable furniture and cabinetry.[109] The design of Lincoln-Edmunds was certainly not all bad; all but one of the professors I contacted noted that they enjoy working in the buildings despite their shortcomings, listing the incorporation of natural light, high ceilings, and pleasing views as several of the things they like best. Many of the most obvious issues have

[108] Grosfils and Reinen, personal interview.

[109] *Ibid*.

also been remedied, and for the ones that remain, one professor glibly stated that Lincoln-Edmunds' inhabitants are "happily making lemonade from the lemons."[110]

Many of the professors I contacted seem to be under the impression that the buildings are energy efficient (if they were not ambivalent on the topic), but unfortunately historical energy use data for the Lincoln-Edmunds complex tells another story. This data is readily available on Pomona's website, and a page describing the building's green features proudly states that the building "performs 38.9% better than Title-24 energy efficiency requirements" and generates part of its own energy through an 88.2 kW solar photovoltaic panel installation on its roof.[111] However, the actual energy-use projections upon which this 38.9% figure are based are not as easily accessible. Thanks to Mark Matsumoto, a project manager at the Office of Facilities and Campus Services, I was able to peruse the original LEED certification documents for the buildings, which contained the Title-24 baseline energy usage, projected energy usage, and projected energy generation by the photovoltaic panel array.[112] Because of the way LEED points are written, Lincoln-Edmunds was awarded 10 out of 10 points for optimizing energy performance, with a predicted energy savings of 52.6% over Title-24 (22.4% in renewable savings, as determined by price rather than kilowatt-hours (kWh), and the rest in energy use reduction), but on comparing the projected values to actual data during the building's lifetime, I

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[110] *Ibid*.

[111] "Green Building Features: Lincoln-Edmunds Buildings," *Pomona College*, http://www.pomona.edu/administration/sustainability/initiatives/facilities/leb.aspx

[112] Mark Matsumoto, e-mail message to author, August 20, 2010.

found a large disparity. Even in the first year after the building was built, during which it was only partially occupied, Lincoln-Edmunds used more energy than its Title-24 baseline allotment (see Figure 6). In fact, it was already using nearly twice as much as projected. Energy use has only grown since then, reaching nearly three times the projected usage and almost twice the Title-24 budget during the 2008-2009 school year.[113] Fortunately the rooftop photovoltaic array is producing almost as much as predicted (91%), but because of the greater overall energy usage it represents a much smaller percentage of total energy in kWh than initially planned – 3.2% as opposed to 9.4% (see Figure 7). The disparity in production can likely be attributed to the fact that the panels are cleaned three times a year rather than the recommended four, reducing their output slightly.[114]

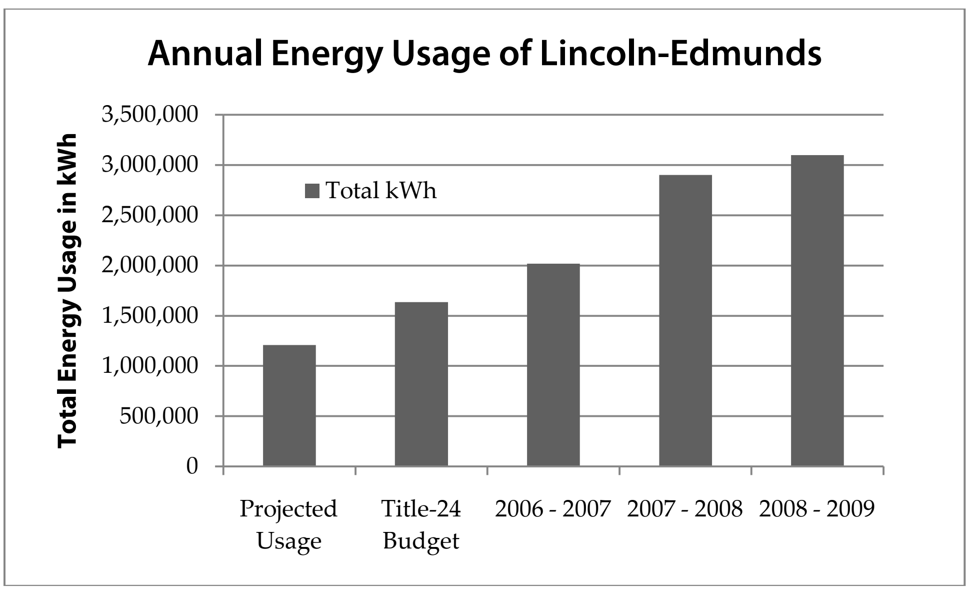

Figure 6. Reported annual energy usage as compared to projected usage and Title-24 limit

[113] "Campus Sustainability Data," *Pomona College*, http://www.pomona.edu/administration/sustainability/resources/datalist.aspx

[114] Judy Brown, e-mail message to author, October 1, 2010.

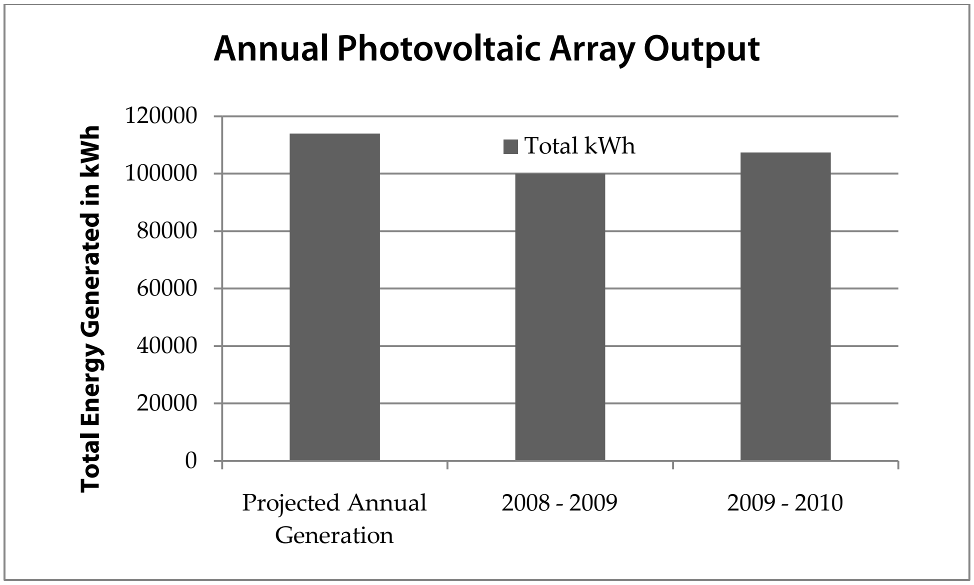

Figure 7. Reported energy generated annually as compared to projected energy generated[115]

Why are the Lincoln-Edmunds buildings using so much more energy than predicted? Unfortunately Pomona's energy use monitoring only divides usage by gas vs. electricity, rather than by end use, so by Pomona's data alone I was only able to surmise that the buildings could be considered High Energy Type because of the presence of several science and computer labs; categorized as such, Lincoln-Edmunds is exceeding its energy use predictions by the same percentage as similar buildings, though this certainly does not excuse its poor performance. From communicating with faculty working in the buildings and taking classes there for the past three years, I suspected that excessive lighting and air conditioning might be at fault for some of the buildings' energy-hogging ways, but without data I could not be certain. Luckily enough, I embarked on this research project around the same time the California Energy Commission's

[115] "Live Renewable Energy Monitoring," *Fat Spaniel Technologies*, http://view2.fatspaniel.net/PV2Web/merge?&view=PV/standard/Simple&eid=1782

Public Interest Energy Research program (PIER) commissioned the NBI and Portland Energy Conservation, Inc. (PECI) to perform an energy performance assessment of the buildings. NBI's Cathy Turner and PECI engineer Erin Rowe were kind enough to share their findings with me, including a breakdown of energy usage by end use and many observations from a site visit.

Table 3. Approximate end use split for projected and actual energy usage[116]

	Plugs and lights	Heating	Cooling	Domestic hot water
Design kBtu/sf	20.5	14.6	4.4	6.0
Design %	45%	32%	10%	13%
Actual kBtu/sf	33.6	40.2	21.8	29.9
Actual %	27%	32%	17%	24%

As seen in Table 3, heating constitutes the largest percentage of actual energy usage, a strange outcome for a building located in sunny southern California. In the Site Energy Performance Assessment Report, Rowe explains that the boiler lockout temperature – the external temperature at which heating equipment can no longer be turned on – is 95° F, meaning the buildings could possibly be heated even when the temperature outside is quite warm. Furthermore, the "deadband" range between heating and cooling modes – the leeway given between temperatures designated to activate heating or cooling – is only 1 degree, resulting in spaces fluctuating between heating and cooling modes unnecessarily; currently, Title-24 requires a 5° deadband. Occupants are also given a relatively wide range of control over

[116] New Buildings Institute, *Energy Performance Overview: Pomona College – Lincoln and Edmunds Buildings*, (Public Interest Energy Research, 2010), 2.

thermostats in each zone (68°-74° F), meaning one HVAC zone can be in cooling mode while the zone next door is in heating mode, each consuming extra energy to counteract their neighbor's temperature change. Heating and cooling will also continue to run even when a zone's windows are open, wasting energy. One other significant contributor to HVAC energy usage is that of exhaust fans and fume hoods in lab spaces, many of which run at all times assuming maximum occupancy. As the report notes, lab spaces make up only 15% of the total square footage of the buildings, suggesting they are not necessarily High Energy Type by nature, but these lab spaces may be using enough energy on their own to suggest otherwise.[117]

Plug loads and lighting are other areas for improvement; although plugs and lights comprise a smaller percentage of total energy usage than predicted in the design phase, they use more energy per square foot. Despite Lincoln-Edmunds' wealth of natural light, no daylight or occupancy sensors were implemented, and as a result many spaces remain artificially lit even when daylight would suffice, or when no one is in the room. Although lights are scheduled to automatically shut off at midnight, this shutoff does not actually occur, causing lights to remain on at all hours unless manually turned off. The addition of occupancy sensors, daylight sensors or photocells, and working lighting schedules would help solve these issues. Plug loads are more difficult to reduce, since they largely depend on the energy efficiency of the appliances used and the number of appliances that are typically running. Because of the departments housed within Lincoln-Edmunds, the building contains several computer labs and many pieces

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[117] New Buildings Institute and Pacific Energy Conservation, Inc., *Site Energy Performance Assessment Report for Pomona College Lincoln-Edmunds Building*, (Public Interest Energy Research, 2010), 7.

of specialty equipment that are likely not designed with energy efficiency as a top priority. The College currently requires that new appliances purchased are EnergyStar certified when possible, but this rating system is not applicable for many lab-specific appliances, and it is unclear whether this requirement was in place when Lincoln-Edmunds was constructed. Given the fact that some equipment pieces were overlooked when planning the layouts of lab spaces, it seems likely that they may have been left out of the energy modeling process as well, resulting in an underestimation for total energy usage.[118]

The Lincoln-Edmunds buildings are far from being a model example of LEED-certified structures, but unfortunately they are also not an anomaly. When a complex that hogs as much energy as Lincoln-Edmunds can be ranked LEED Gold, much less certified in the first place, it is an indicator that the ranking system is in dire need of improvement. Although each iteration of LEED-NC moves closer to sustainability, at its current pace it may be too little, too late.

Conclusion

And so the question stands: is LEED a true leader in energy, environmental design, and sustainability? Or is it merely a way for the building industry to cash in on the "green" trend? Perhaps it is a little of both. LEED has undeniably galvanized the green building industry in a way that would have been unimaginable to American architects twenty years ago, and its popularity has no doubt encouraged criticism and competition as well. Efforts such as Architecture 2030 (which aims for carbon-neutral new construction by 2030), Passivhaus (an

[118] *Ibid*, 4-7.

energy efficiency system imported from Germany in 2003), and Green Globes (an alternative rating system for buildings imported from Canada in 2004) might have never arisen if not for the success of LEED, and their existence encourages all green building standards to raise the bar. One architect with whom I corresponded noted that the LEED rating system has "elevated the social conscious regarding sustainability, which makes it a much easier sell for design professionals trying to lead clients toward better, more thoughtful design" – a change which has likely made it easier for other building standards to enter the market as well.[119]

However, LEED's fame has also made it a tool for builders to garner free publicity and good will without ever having to prove that their structures are actually helping the environment. LEED's celebrity status as the preeminent green building system has created confusion in the eyes of the public, some of whom assume LEED buildings must be fully sustainable or even net-zero carbon emissions. Sadly, an average energy savings of only 25% says otherwise, and as demonstrated by Lincoln-Edmunds, even buildings that claim a 52.6% savings – within the range of what could be considered sustainable – can actually be using even more energy than allowed by state building codes. In its current state, LEED-NC cannot be relied upon to produce sustainable buildings. As my architect correspondent put it, "rating systems [like LEED] … provide the mire for good projects to get stuck in;" he went on to say that "[t]here is little to no incentive for innovation within the LEED system … The factor contributing most to design innovation is probably the economy."[120] Since LEED is a voluntary

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[119] Matt Mori, e-mail message to author, October 18, 2010.

[120] *Ibid*.

system based upon the idea of encouraging market shifts, the USGBC must walk a fine line between effectively stringent requirements and those so strict that no building financier will willingly attempt LEED certification. If LEED were to suddenly lose the support of the building community, this shift would be more harmful to the pursuit of sustainability than low standards could be. Nonetheless, the current glacial pace of change that LEED is encouraging will result in irreversible climate change before those in the business of building will all willingly adopt sustainable practices. For this reason, federal government intervention is likely necessary (and not merely in the form of government-mandated adoption of LEED). If more stringent building codes are put in place – ones that could result in perhaps a 50% savings, a target which architects say is much more achievable than it sounds – LEED could instead target the segment of the market willing to aim for 85% energy use reductions, or even net-zero energy usage. In a country where construction lobbyists are an influential force and 18% of states do not even have a state-wide building code, this may sound ambitious. However, one should not expect saving an entire planet to be easy. The USGBC must encourage more drastic energy efficiency measures both by the government and within its own system if it wants LEED to live up to its name.

Appendix 1: Abbreviations and Technical Terms

LEED – Leadership in Energy and Environmental Design

LEED-NC – LEED for New Construction and Major Renovations

USGBC – United States Green Building Council

VOC – Volatile organic compound

IPCC – Intergovernmental Panel on Climate Change

EAc1 – Energy and Atmosphere credit 1

HVAC – Heating, Ventilation, and Air Conditioning

ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers

NBI – New Buildings Institute

EPA – Environmental Protection Agency

NCv.2 – LEED-NC version 2.0

CBECS – Commercial Building Energy Consumption Survey

EUI – Energy Use Intensity

DOE – Department of Energy

LGCS – Linguistics and Cognitive Science

kWh – kilowatt-hour

PIER – Public Interest Energy Research

PECI – Portland Energy Conservation, Inc.

Btu – British thermal unit

Appendix 2: Lincoln-Edmunds Faculty Survey

1. Were you included in the design process of the Lincoln-Edmunds complex? If so, how would you describe it? To what extent were you involved?

2. Do you feel that your department's needs were met in the design of the buildings? i.e. was all of your equipment accounted for, do you have enough storage space, do your classroom and office spaces accommodate the teaching styles of your department?

3. Do you feel any of your department's design requests were restricted, overlooked, or improperly implemented, either by the design team or the college? If so, how has it impacted you since the building's construction?

4. Have any design elements of the buildings struck you as poorly thought out, either from a human or ecological perspective? e.g. lights with no light switches, not enough electrical outlets

5. Has working in Lincoln-Edmunds increased your environmental awareness? How sustainable do the buildings seem to you?

6. What is your overall impression of the buildings? Do you enjoy working in them?

Appendix 3: LEED-NC Version 2.1 Credits[121]

Credits attained by Lincoln-Edmunds listed in black, others listed in grey

SUSTAINABLE SITES

Prerequisite 1. Erosion & Sedimentation Control – Control erosion to reduce negative impacts on water and air quality.

1. Site Selection – Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

2. Urban Redevelopment – Channel development to urban areas with existing infrastructure, protect greenfields and preserve habitat and natural resources.

3. Brownfield Redevelopment – Rehabilitate damaged sites where development is complicated by real or perceived environmental contamination, reducing pressure on undeveloped land.

4.1. Alternative Transportation, Public Transportation Access – Locate project within 1/2 mile (walking) of a commuter rail, light rail or subway station or 1/4 mile of two or more public or campus bus lines usable by building occupants.

4.2. Alternative Transportation, Bicycle Storage & Changing Rooms – Provide secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5% or more of regular building occupants.

4.3. Alternative Transportation, Alternative Fuel Vehicles – Provide alternative fuel vehicles for 3% of building occupants AND provide preferred parking for these vehicles, OR install alternative-fuel refueling stations for 3% of the total vehicle parking capacity of the site.

4.4. Alternative Transportation, Parking Capacity – Size parking capacity to meet, but not exceed, minimum local zoning requirements OR add no new parking for rehabilitation projects. Also, provide preferred parking for carpools or vanpools capable of serving 5% of the building occupants.

5.1. Reduced Site Disturbance, Protect or Restore Open Space – On greenfield sites, limit site disturbance, OR on previously developed sites, restore a minimum of 50% of the site area by replacing impervious surfaces with native or adapted vegetation.

5.2. Reduced Site Disturbance, Development Footprint – Reduce the development footprint to exceed local zoning's open space requirements for the site by 25%.

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[121] U.S. Green Building Council, *LEED Green Building Rating System For New Construction & Major Renovations (LEED-NC) Version 2.1*, (Washington, DC: U.S. Green Building Council, 2002), http://www.usgbc.org/Docs/LEEDdocs/LEED_RS_v2-1.pdf

6.1. Stormwater Management, Rate and Quantity – Implement a stormwater management plan to reduce rate and quantity of stormwater runoff.

6.2. Stormwater Management, Treatment – Construct site stormwater treatment systems.

7.1. Heat Island Effect, Non-Roof – Provide shade (within 5 years) and/or use light-colored/high-albedo materials and/or open grid pavement for the site's non-roof impervious surfaces; OR place a minimum of 50% of parking spaces underground or covered by structured parking.

7.2. Heat Island Effect, Roof – Use Energy Star compliant AND high emissivity roofing for a minimum of 75% of the roof surface; OR install a vegetated roof for at least 50% of the roof area.

8. **Light Pollution Reduction** – Eliminate light trespass from the building and site, improve night sky access and reduce development impact on nocturnal environments.

WATER EFFICIENCY

1.1. Water Efficient Landscaping, Reduce by 50% – Use high-efficiency irrigation technology OR use captured rain or recycled site water to reduce potable water consumption for irrigation by 50% over conventional means.

1.2. Water Efficient Landscaping, No Potable Use or No Irrigation – Use only captured rain or recycled site water to eliminate all potable water use for site irrigation, OR do not install permanent landscape irrigation systems.

2. Innovative Wastewater Technologies – Reduce the use of municipally provided potable water for building sewage conveyance by a minimum of 50%, OR treat 100% of wastewater on site to tertiary standards.

3.1. Water Use Reduction, 20% Reduction – Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation).

3.2. Water Use Reduction, 30% Reduction – Employ strategies that use 30% less water than the water use baseline.

ENERGY & ATMOSPHERE

Prerequisite 1. Fundamental Building Systems Commissioning – Verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended.

Prerequisite 2. Minimum Energy Performance – Design the building to comply with ASHRAE/IESNA Standard 90.1-1999 or the local energy code, whichever is more stringent.

Prerequisite 3. CFC Reduction in HVAC&R Equipment – Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion.

1. Optimize Energy Performance – Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.
* *Each 5% reduction gains a point, up to a total of 10 possible points for this credit.*

2.1. Renewable Energy, 5% – Supply at least 5% of the building's total energy use (as expressed as a fraction of annual energy cost) through the use of on-site renewable energy systems.

2.2. Renewable Energy, 10% – Supply at least 10% of the building's total energy use through the use of on-site renewable energy systems.

2.3. Renewable Energy, 20% – Supply at least 20% of the building's total energy use through the use of on-site renewable energy systems.

3. Additional Commissioning – Implement additional commissioning tasks above those required by EA Prerequisite 1.

4. Ozone Depletion – Install base building level HVAC and refrigeration equipment and fire suppression systems that do not contain HCFCs or Halons.

5. Measurement & Verification – Provide for the ongoing accountability and optimization of building energy and water consumption performance over time by installing continuous metering equipment.

6. Green Power – Provide at least 50% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract.

MATERIALS & RESOURCES

Prerequisite 1. Storage & Collection of Recyclables – Provide an easily accessible area that serves the entire building and is dedicated to the separation, collection and storage of materials for recycling.

1.1. Building Reuse, Maintain 75% of Existing Shell – Maintain at least 75% of existing building structure and shell (exterior skin and framing, excluding window assemblies and non-structural roofing material).

1.2. Building Reuse, Maintain 100% of Shell – Maintain all of existing building structure and shell.

1.3. Building Reuse, Maintain 100% Shell & 50% Non-Shell – Maintain 100% of existing building structure and shell AND at least 50% of non-shell areas (interior walls, doors, floor coverings and ceiling systems).

2.1. Construction Waste Management, Divert 50% – Develop and implement a waste management plan, quantifying material diversion goals. Recycle and/or salvage at least 50% of construction, demolition and land clearing waste.

2.2. Construction Waste Management, Divert 75% – Recycle and/or salvage 75% of construction, demolition and land clearing waste.

3.1. Resource Reuse, Specify 5% – Use salvaged, refurbished or reused materials, products and furnishings for at least 5% of building materials.

3.2. Resource Reuse, Specify 10% – Use salvaged, refurbished or reused materials, products and furnishings for at least 10% of building materials.

4.1. Recycled Content, Specify 5% (post-consumer + 1/2 post-industrial) – Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 5% of the total value of the materials in the project.

4.2. Recycled Content, Specify 10% (post-consumer + 1/2 post-industrial) – Use materials with recycled content at least 10% of the total value of the materials in the project.

5.1. Local/Regional Materials, 20% Manufactured Locally – Use a minimum of 20% of building materials and products that are manufactured regionally within a radius of 500 miles.

5.2. Local/Regional Materials, of 20% in MRc5.1, 50% Harvested Locally – Of the regionally manufactured materials documented for MR Credit 5.1, use a minimum of 50% of building materials and products that are extracted, harvested or recovered within 500 miles of the project site.

6. Rapidly Renewable Materials – Use rapidly renewable building materials and products for 5% of the total value of all building materials and products used in the project.

7. Certified Wood – Use a minimum of 50% of wood-based materials and products, certified in accordance with the Forest Stewardship Council's Principles and Criteria, for wood building components.

<u>**INDOOR ENVIRONMENTAL QUALITY**</u>

Prerequisite 1. Minimum IAQ Performance – Meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality, and approved Addenda.

Prerequisite 2. Environmental Tobacco Smoke (ETS) Control – Prevent exposure of building occupants and systems to Environmental Tobacco Smoke.

1. Carbon Dioxide (CO_2) Monitoring – Install a permanent carbon dioxide monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments.

2. Ventilation Effectiveness – Provide for the effective delivery and mixing of fresh air to support the safety, comfort and well-being of building occupants.

3.1. Construction IAQ Management Plan, During Construction – Prevent indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants.

3.2. Construction IAQ Management Plan, Before Occupancy – After construction ends and prior to occupancy conduct a minimum two-week building flush-out with 100% outside air OR conduct a baseline indoor air quality testing procedure.

4.1. Low-Emitting Materials, Adhesives & Sealants – The VOC content of adhesives and sealants used must be less than the current VOC content limits of SCAQMD, AND all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District.

4.2. Low-Emitting Materials, Paints – VOC emissions from paints and coatings must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements.

4.3. Low-Emitting Materials, Carpet – Carpet systems must meet or exceed the requirements of the Carpet and Rug Institute's Green Label Indoor Air Quality Test Program.

4.4. Low-Emitting Materials, Composite Wood – Composite wood and agrifiber products must contain no added urea-formaldehyde resins.

5. Indoor Chemical & Pollutant Source Control – Avoid exposure of building occupants to potentially hazardous chemicals that adversely impact air quality by utilizing permanent entryway systems, exhaust systems, and appropriately plumbed drains.

6.1. Controllability of Systems, Perimeter – Provide at least an average of one operable window and one lighting control zone per 200 square feet for all regularly occupied areas within 15 feet of the perimeter wall.

6.2. Controllability of Systems, Non-Perimeter – Provide controls for each individual for airflow, temperature and lighting for at least 50% of the occupants in non-perimeter, regularly occupied areas.

7.1. Thermal Comfort, Comply with ASHRAE 55-1992 – Provide a thermally comfortable environment that supports the productivity and well-being of building occupants.

7.2. Thermal Comfort, Permanent Monitoring System – Install a permanent temperature and humidity monitoring system configured to provide operators control over thermal comfort performance and the effectiveness of humidification and/or dehumidification systems in the building.

8.1. Daylight & Views, Daylight 75% of Spaces – Provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight into the regularly occupied areas of the building.

8.2. Daylight & Views, Views for 90% of Spaces – Achieve direct line of sight to transparent windows for building occupants in 90% of all regularly occupied spaces.

INNOVATION & DESIGN PROCESS

1.1 - 1.4. Innovation in Design – To provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

2. LEED Accredited Professional – Have at least one principal participant of the project team that has successfully completed the LEED Accredited Professional exam.

Appendix 4: LEED-NC 2009 Sample Checklist[122]

LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name

Date

Y	?	N	d/C		Sustainable Sites	Possible Points: 26
0	0	0				
Y			C	Prereq 1	Construction Activity Pollution Prevention	
			d	Credit 1	Site Selection	1
			d	Credit 2	Development Density and Community Connectivity	5
			d	Credit 3	Brownfield Redevelopment	1
			d	Credit 4.1	Alternative Transportation—Public Transportation Access	6
			d	Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			d	Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			d	Credit 4.4	Alternative Transportation—Parking Capacity	2
			C	Credit 5.1	Site Development—Protect or Restore Habitat	1
			d	Credit 5.2	Site Development—Maximize Open Space	1
			d	Credit 6.1	Stormwater Design—Quantity Control	1
			d	Credit 6.2	Stormwater Design—Quality Control	1
			C	Credit 7.1	Heat Island Effect—Non-roof	1
			d	Credit 7.2	Heat Island Effect—Roof	1
			d	Credit 8	Light Pollution Reduction	1

Y	?	N			Water Efficiency	Possible Points: 10
0	0	0				
Y			d	Prereq 1	Water Use Reduction—20% Reduction	
			d	Credit 1	Water Efficient Landscaping	2 to 4
					Reduce by 50%	2
					No Potable Water Use or Irrigation	4
			d	Credit 2	Innovative Wastewater Technologies	2
			d	Credit 3	Water Use Reduction	2 to 4
					Reduce by 30%	2
					Reduce by 35%	3
					Reduce by 40%	4

Y	?	N			Energy and Atmosphere	Possible Points: 35
0	0	0				
Y			C	Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			d	Prereq 2	Minimum Energy Performance	
Y			d	Prereq 3	Fundamental Refrigerant Management	
			d	Credit 1	Optimize Energy Performance	1 to 19

[122] U.S. Green Building Council, "LEED 2009 for New Construction and Major Renovations Checklist," *U.S. Green Building Council*, August 25, 2010, http://www.usgbc.org/ShowFile.aspx?DocumentID=5719

Y	?	N		Credit	Description	Points
					Improve by 12% for New Buildings or 8% for Existing Building Renovations	1
					Improve by 14% for New Buildings or 10% for Existing Building Renovations	2
					Improve by 16% for New Buildings or 12% for Existing Building Renovations	3
					Improve by 18% for New Buildings or 14% for Existing Building Renovations	4
					Improve by 20% for New Buildings or 16% for Existing Building Renovations	5
					Improve by 22% for New Buildings or 18% for Existing Building Renovations	6
					Improve by 24% for New Buildings or 20% for Existing Building Renovations	7
					Improve by 26% for New Buildings or 22% for Existing Building Renovations	8
					Improve by 28% for New Buildings or 24% for Existing Building Renovations	9
					Improve by 30% for New Buildings or 26% for Existing Building Renovations	10
					Improve by 32% for New Buildings or 28% for Existing Building Renovations	11
					Improve by 34% for New Buildings or 30% for Existing Building Renovations	12
					Improve by 36% for New Buildings or 32% for Existing Building Renovations	13
					Improve by 38% for New Buildings or 34% for Existing Building Renovations	14
					Improve by 40% for New Buildings or 36% for Existing Building Renovations	15
					Improve by 42% for New Buildings or 38% for Existing Building Renovations	16
					Improve by 44% for New Buildings or 40% for Existing Building Renovations	17
					Improve by 46% for New Buildings or 42% for Existing Building Renovations	18
					Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovations	19
			d	Credit 2	On-Site Renewable Energy	1 to 7
					1% Renewable Energy	1
					3% Renewable Energy	2
					5% Renewable Energy	3
					7% Renewable Energy	4
					9% Renewable Energy	5
					11% Renewable Energy	6
					13% Renewable Energy	7
			c	Credit 3	Enhanced Commissioning	2
			d	Credit 4	Enhanced Refrigerant Management	2
			c	Credit 5	Measurement and Verification	3
			c	Credit 6	Green Power	2

0	0	0			**Materials and Resources**	Possible Points: 14
Y	?	N				
Y			d	Prereq 1	Storage and Collection of Recyclables	
			c	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
					Reuse 55%	1
					Reuse 75%	2
					Reuse 95%	3
			c	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
			c	Credit 2	Construction Waste Management	1 to 2
					50% Recycled or Salvaged	1
					75% Recycled or Salvaged	2
			c	Credit 3	Materials Reuse	1 to 2
					Reuse 5%	1
					Reuse 10%	2
			c	Credit 4	Recycled Content	1 to 2

Y	?	N				Points
					10% of Content	1
					20% of Content	2
			c	Credit 5	Regional Materials	1 to 2
					10% of Materials	1
					20% of Materials	2
			c	Credit 6	Rapidly Renewable Materials	1
			c	Credit 7	Certified Wood	1

0	0	0	**Indoor Environmental Quality**		Possible Points:	**15**
Y	?	N				
Y			d	Prereq 1	Minimum Indoor Air Quality Performance	
Y			d	Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			d	Credit 1	Outdoor Air Delivery Monitoring	1
			d	Credit 2	Increased Ventilation	1
			c	Credit 3.1	Construction IAQ Management Plan—During Construction	1
			c	Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
			c	Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
			c	Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			c	Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			c	Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			d	Credit 5	Indoor Chemical and Pollutant Source Control	1
			d	Credit 6.1	Controllability of Systems—Lighting	1
			d	Credit 6.2	Controllability of Systems—Thermal Comfort	1
			d	Credit 7.1	Thermal Comfort—Design	1
			d	Credit 7.2	Thermal Comfort—Verification	1
			d	Credit 8.1	Daylight and Views—Daylight	1
			d	Credit 8.2	Daylight and Views—Views	1

0	0	0	**Innovation and Design Process**		Possible Points:	**6**
Y	?	N				
			d/C	Credit 1.1	Innovation in Design: Specific Title	1
			d/C	Credit 1.2	Innovation in Design: Specific Title	1
			d/C	Credit 1.3	Innovation in Design: Specific Title	1
			d/C	Credit 1.4	Innovation in Design: Specific Title	1
			d/C	Credit 1.5	Innovation in Design: Specific Title	1
			d/C	Credit 2	LEED Accredited Professional	1

0	0	0	**Regional Priority Credits**		Possible Points:	**4**
Y	?	N				
			d/C	Credit 1.1	Regional Priority: Specific Credit	1
			d/C	Credit 1.2	Regional Priority: Specific Credit	1
			d/C	Credit 1.3	Regional Priority: Specific Credit	1
			d/C	Credit 1.4	Regional Priority: Specific Credit	1

0	0	0	**Total**	Possible Points:	**110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

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