2014

# Where Design Meets Occupant Engagement: Studying the Importance of Occupant Engagement for Green Buildings, LEED and Pomona College

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# Where Design Meets Occupant Engagement

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# Acknowledgements

***Many thanks…***

To Rick Hazlett for working tirelessly with so many students, for his dedication, for his affirmations and for his advice.

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To Ginny Routhe for her encouragement, guidance and help. Also, for all of the important information she supplied.

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To my parents and brother for your unconditional love and support, for you insight, and for reading endless drafts.

# Introduction

Think back to your week up to this point. When you woke up Tuesday morning, where were you? When you fell asleep that night, where were you? While you were at work on Thursday, where were you? While you ate dinner on Friday and lunch on Monday, where were you? Odds are you were inside some sort of building at each of these times. On average, Americans spend 90% or more of their time indoors.[1] Not only are buildings where we spend most of our time, they also produce the largest part of our environmental footprint from. Buildings are the single largest consumer of energy and emitter of greenhouse gases, accounting for 41% of total U.S. energy consumption and 44.6% of US $CO_2$ emissions in 2010. Over 70% of all electricity produced in the US is used to operate buildings.[2]

Buildings' high impact makes them a vital focus for the environmental movement. Making changes in building construction and operation has the potential to lead to significant reductions in energy use and $CO_2$ emissions. Environmentally sustainable buildings, and the programs like LEED (Leadership in Energy and Environmental Design) that promote them, are essential to reducing human impact. But constructing a green building is just the start – how we *occupy* that building can have an important effect on its environmental impact too.

A building is not independent of the people who inhabit it. The way people live and work within buildings is critical to how those buildings impact the environment. Infrastructure, design, and technology can be combined with behavior change to reduce the resource consumption and environmental impact of buildings and the people who inhabit them. Building green is an opportunity not only to decrease impact, but also to influence people's relationship with energy use and the environment. This potential can only be fulfilled by connecting residents to the sustainable capacity of the buildings they spend so much time inside of.

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[1] *Report to Congress on Indoor Air Quality*. EPA/400/1-89/001C. Washington, DC: U.S. Environmental Protection Agency, 1989.

[2] "Buildings Energy Data Book." Accessed October 4, 2013. http://buildingsdatabook.eren.doe.gov/ChapterIntro1.aspx.

This connection between residents and the sustainability of the buildings they inhabit is the definition of occupant engagement. Occupant engagement is the process of linking residents with the functionality and environmental sustainability of their building, and fostering awareness of their personal role in a green building. Strategies such as signage, informational displays, goal setting, and feedback help residents understand and support sustainability features, and empower them to help reduce the resource consumption of their building.

Occupant engagement can help building green go beyond simple behavior change. It has the potential to instigate changes in environmental awareness and consciousness. Occupant engagement is the key to creating a culture of sustainability and motivating pro-environmental behavior amongst a building's residents. Research has shown that residents' behavior makes a significant contribution to how much energy a building uses (see Chapter 2), making it important for any green building rating system to include occupant engagement as a key aspect of making the building function as sustainably as possible.

LEED is the preeminent leader in defining and regulating green building – more than 4.3 million people live or work in a LEED certified building.[3] With this influence, LEED has the potential to impact not only how buildings are designed and built, but also how they can be used to best fulfill their green potential. Unfortunately, it currently doesn't include occupant engagement in its definition of a sustainable building and so fails to influence how people are participating in the sustainable goals of the building.

Despite this drawback, LEED has continued to grow in popularity, making it the primary metric for building sustainability. Increasingly small liberal arts colleges such as Pomona College, are requiring LEED certification for new construction projects. Pomona College's green building standards mandate that all new construction projects be built to at least LEED Gold standards.[4] The most recent building projects on campus, Pomona and Sontag Halls, are certified Platinum under LEED for New Buildings and Construction

[3] "New Report: 4.3 Million People Live and Work in LEED-certified Buildings | U.S. Green Building Council." Accessed December 4, 2013. http://www.usgbc.org/articles/new-report-43-million-people-live-and-work-leed-certified-buildings.

[4] "Green Building Standards - Pomona College." Accessed October 4, 2013. http://www.pomona.edu/administration/sustainability/policies-procedures/green-building.aspx.

Version 2009.[5] Pomona has pledged to move towards a more green campus, and building green is an integral part of this goal. But is LEED certification enough to make our buildings and our campus "green"? There is more that can be done with behavior to reduce the buildings' carbon impact.

Pomona and Sontag Halls utilize occupant engagement strategies, including feedback and signage. These features are above and beyond LEED's requirements, highlighting LEED's failure to fully use its influence to encourage occupant engagement. Pomona and Sontag Halls provide a useful case study in incorporating intervention strategies for motivating resident behavior change in the green building process. An exploratory analysis of the effectiveness of occupant engagement in decreasing resource consumption in these dorms can help occupant engagement be applied on a larger scale to both higher education institutions and LEED certification in general. I designed and distributed a survey to gather information on residents' opinions and knowledge of sustainability and occupant engagement strategies in their living situation. This survey, along with energy use data, provides insight into how attempts at occupant engagement affect building sustainability. Drawing from all of this, I propose recommendations for more effective occupant engagement at Pomona College, and a new LEED credit for occupant engagement.

[5] "Pomona College Celebrates Opening of Two of the Nation's Greenest Residence Halls - Pomona College." Accessed October 4, 2013. http://www.pomona.edu/news/2011/09/21-residence-hall-opening.aspx.

# Chapter 1: LEED Background and Goals

LEED (Leadership in Energy and Environmental Design) is the principal green building rating system in the U.S.[6] Common in architectural conversation and understood even outside of design and construction circles, LEED is accepted as the primary sustainability metric for buildings. New construction projects are increasingly requiring LEED certification – more than 200 states, cities, and federal agencies now require LEED certification for new building projects.[7] Because of its widespread use it provides an effective means for changing public knowledge of sustainability and green building. LEED already addresses construction and design well, but is less successful with building usage and connection to the larger environmental conversation. LEED has the power to do two things through occupant engagement: firstly to reduce resource consumption through changes in occupant behavior, and secondly to engage occupants with a larger environmental dialogue.

LEED is a product of the United States Green Building Council (USGBC). Rick Fedrizzi, David Gottfried, and Mike Italiano established the USGBC in 1993[8] with the goal of promoting sustainability in the building and construction industry by changing "…the way buildings and communities are designed, built and *operated*,"[9] implying a focus on how a building is used throughout its lifetime. Less than a year after the USGBC was established, they formed a committee that included architects, building owners, environmentalists, and industry representatives to focus on creating a system to define and measure green buildings. This committee published the first LEED criteria standards in August 1998. This initial set of guidelines has been followed by the release of many

[6] "LEED Green Building Program Remains Preferred Rating System for Use in Federal Buildings | U.S. Green Building Council." Accessed December 4, 2013. http://www.usgbc.org/articles/leed-green-building-program-remains-preferred-rating-system-use-federal-buildings.
[7] "In U.S. Building Industry, Is It Too Easy to Be Green?" Accessed December 4, 2013. http://www.usatoday.com/story/news/nation/2012/10/24/green-building-leed-certification/1650517/.
[8] "History | U.S. Green Building Council." Accessed September 25, 2013. http://www.usgbc.org/about/history.
[9] "About | U.S. Green Building Council." Accessed September 25, 2013. http://www.usgbc.org/about.

extensively modified versions. The current version is LEED v.2009, although a new version has been approved and will be released in Fall 2013.

Through the course of its evolution LEED has developed new initiatives and rating systems for specific types of projects, including LEED for Schools and LEED for Homes, among many others. The most general rating system is LEED for New Construction (LEED-NC), which focuses on new construction projects or major renovations. The Pomona College dorms are certified under LEED-NC, and in 2016 Pomona and Sontag Halls will also be reviewed and certified under LEED Existing Buildings Operations and Maintenance (LEED-EBOM). Many LEED certified projects do not choose to pursue LEED-EBOM, which focuses on ongoing operations throughout a building's lifecycle, as a follow up. This means that there is essentially no ongoing verification concerning the realization of the sustainability potential of a LEED certified building once it is built.

The LEED rating systems consist of seven sections that include prerequisites and a number of possible points. The different rating systems have been standardized to have 100 base points, plus six possible Innovation in Design points and four Regional Priority Points, for a total of 110 points.[10] For basic certification a project needs to garner 40 – 49 points, for Silver 50 – 59 points, for Gold 60 – 79 points, and for Platinum 80 points and above. Credits are available in categories like Energy and Atmosphere, Water Efficiency, and Material and Resources. Within each of these categories there are prerequisite credits, which must be completed in order to receive certification, and credits for further implementation of sustainability features.[11] Basically this means that any project striving for certification must satisfy all prerequisites to even be considered, and then can go above and beyond that for points to achieve different levels of certification. Each credit is worth from 1 – 20 points depending on difficulty and importance. Figure 1, next page, identifies credits and points in the Energy and Atmosphere category. The LEED credits give us a valuable look at some of the important

[10] "LEED | U.S. Green Building Council." Accessed September 25, 2013. http://www.usgbc.org/leed.
[11] "LEED Credit Library | U.S. Green Building Council." Accessed October 4, 2013. http://www.usgbc.org/credits/new-construction/v2009.

aspects of green building, but they also fail to include some vital components, such as occupant engagement.

| Energy and Atmosphere | | 35 Possible Points |
|---|---|---|
| ☑ Prerequisite 1 | Fundamental Commissioning of Building Energy Systems | Required |
| ☑ Prerequisite 2 | Minimum Energy Performance | Required |
| ☑ Prerequisite 3 | Fundamental Refrigerant Management | Required |
| ☐ Credit 1 | Optimize Energy Performance | 1–19 |
| ☐ Credit 2 | On-site Renewable Energy | 1–7 |
| ☐ Credit 3 | Enhanced Commissioning | 2 |
| ☐ Credit 4 | Enhanced Refrigerant Management | 2 |
| ☐ Credit 5 | Measurement and Verification | 3 |
| ☐ Credit 6 | Green Power | 2 |

**Figure 1:** An example of credits and points in the Energy & Atmosphere category[12]; See Appendix 1 for Pomona College's full credit checklist.

The Innovation category is currently the only place where occupant engagement and education could potentially receive points (six maximum). These points are difficult to attain because innovation points are generally only rewarded for going above and beyond an already established criterion, of which engagement is not one.[13] Even EBOM, which focuses on helping a building maintain and improve sustainability throughout its life cycle, fails to incorporate occupant engagement. EBOM includes credits for sustainable purchasing and management, but nothing that references the direct engagement of the building users outside of the management.[14] Both LEED-EBOM and LEED-NC would benefit by including occupant engagement. Strategies for occupant engagement could be included in the design and construction of a building specifically to influence human behavior, making occupant engagement not only important, but also viable and realistic for inclusion in different LEED rating systems.

LEED-NC's mission statement begins to acknowledge the importance of human involvement in ensuring the best building performance: "Upfront planning for green operations and maintenance can help building owners and operators ensure that the

[12] *LEED for New Construction V2009 - Current Version | U.S. Green Building Council*. Accessed September 25, 2013. http://www.usgbc.org/resources/leed-new-construction-v2009-current-version.
[13] "Innovation in Design | U.S. Green Building Council." Accessed October 4, 2013. http://www.usgbc.org/node/1732608?return=/credits/new-construction/v2009/innovation.
[14] "LEED Credit Library | U.S. Green Building Council." Accessed October 4, 2013. http://www.usgbc.org/credits/new-construction/v2009.

building performs to its full potential."[15] Design by itself is not enough – human behavior drives energy use. In its mission statement, LEED-NC seems to consider human behavior in the equation of building sustainability, but then fails to incorporate it into the rating specifications. With this omission LEED neglects to engage its full potential for reaching sustainability through engaging occupants. Strategies like providing feedback about building energy consumption and signage about the use of green features can be pivotal in reducing resource consumption. Perhaps more importantly, failing to engage occupants misses an important opportunity to affect a culture shift towards sustainability mindfulness. Providing information and opportunities to engage would empower residents to build a culture of sustainability and help the building reach its full sustainability potential.

The latest LEED version, launched in November 2013, makes some strides towards incorporating occupant engagement credits. The new version takes one important step by including prerequisites for building-level energy and water metering, but still fails to require the sharing of this metering data with building occupants.[16] Built in metering lays the groundwork for giving residents feedback, but fails to make that final connection.

LEED v4 also includes a "Demand response" credit for up to two points. The intent of this credit is: "To increase participation in demand response technologies and programs…"[17] According to the Federal Energy Regulatory Commission, demand response is defined as: "Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments..."[18] This credit is an initial attempt to engage occupants in some way, but is narrowly focused on demand response, which is only one approach to engaging occupants. Demand response is inextricably tied to financial incentives,

[15] "New Construction | U.S. Green Building Council." Accessed September 25, 2013. http://www.usgbc.org/leed/rating-systems/new-construction.
[16] "Building-level Energy Metering | U.S. Green Building Council." Accessed November 14, 2013. http://www.usgbc.org/node/2613018?return=/credits/new-construction/v4.
[17] "Demand Response | U.S. Green Building Council." Accessed November 14, 2013. http://www.usgbc.org/node/2613001?return=/credits/new-construction/v4.
[18] Balijepalli, Murthy; Pradhan, Khaparde (2011). "Review of Demand Response under Smart Grid Paradigm". *IEEE PES Innovative Smart Grid Technologies*.

which are not applicable in all scenarios, and is a limited approach to engaging occupants generally. Furthermore demand response encourages residents to adjust energy use at different times of day based on price, not to make significant changes in fundamental consumption behavior. It fails to engage LEED's potential to connect building residents to a larger environmental dialogue and movement. Metering and demand response credits are improvements from past rating systems, but there is still a long way to go in engaging occupants.

Unlike LEED v4, LEED-NC and LEED-EBOM v.2009 both fail to include occupant engagement at all. There are examples of ratings systems, within and outside of the USGBC, that include occupant engagement as an important component of the green building equation. LEED for Schools includes education as a specific innovation point.[19] LEED for Homes not only includes credits for homeowner education, but also has it as a prerequisite.[20] This is an important comparison to draw especially when LEED-NC is being applied to a residential building, as it is at Pomona College. The USGBC found providing information to home inhabitants was important enough to make it a prerequisite. Larger scale projects that fall under LEED-NC are not fundamentally different from single homes. Both types of projects inform the way people live and interact with their building. The same logic used in LEED for Homes should be applied to LEED-NC – residents must understand a building in order to use it efficiently. An engagement component is especially important in residential projects at colleges and universities like Pomona College, where occupants are forming living habits for the rest of their lives. Residential transiency in large-scale residence buildings, particularly college dormitories, makes the opportunity for education all the more important, as there is the chance to influence many more people.

Other non-USGBC green building rating systems, such as the Collaborative for High Performance Schools (CHPS) have incorporated occupant education as an important component also. CHPS has an education prerequisite, which requires at

[19] "The School as a Teaching Tool | U.S. Green Building Council." Accessed October 2, 2013. http://www.usgbc.org/node/1732601?return=/credits/schools---new-construction/v2009/innovation.
[20] "LEED Credit Library | U.S. Green Building Council." Accessed October 4, 2013. http://www.usgbc.org/credits/new-construction/v2009.

minimum providing a display of information about the sustainable design of the building and how best to use it.[21]

The above rating systems validate occupant engagement as a key component of building sustainability, and provide models LEED could follow for implementing an occupant engagement criterion. LEED v4 has made steps towards including occupant engagement, but it is just beginning to lay the groundwork. By including more robust occupant engagement credits, LEED has the potential to improve the sustainability of green buildings through behavior changes, and to instigate a more general culture of sustainability.

[21] "CA-CHPS Criteria for New Construction and Major Modernizations | CHPS.net." Accessed October 2, 2013. http://www.chps.net/dev/Drupal/node/32.

# Chapter 2: Occupant Effect on Buildings

Research shows that occupant behavior and activities do have a significant effect on the impact of a building. Intuitively this makes sense. It is humans who drive energy use, not a building itself. In the words of Oxford scholar Kathryn Janda, "… social expectations and consumption patterns of building users can defeat the most careful design."[22] On the positive side, occupant participation in a well-designed building can make it even more sustainable (See Figure 2, below, for some lower energy use behaviors). Efficient technology and design serve an important role in encouraging and facilitating pro-environmental behavior, but must be augmented with the participation of their human counterparts.

| | Energy Usage | Behavior changes to reduce energy consumption |
|---|---|---|
| **Personal Behavior Changes** | Heating and Cooling | • Set thermostat to a comfortable, but not overly toasty or cool temperature<br>• Turn off air conditioning or heating when windows are open<br>• Ensure door is closed to hold in heating or cooling |
| | Water heating | • Wash clothes in cold water |
| | Appliances | • Unplug appliances when possible, or plug into a power strip that is turned off when not in use<br>• Purchase efficient appliances<br>• Use the right sized pot on stove burners |
| | Lighting | • Replace regular lights with CFLs<br>• Turn off lights when not in use<br>• Utilize natural lighting – open the blinds and flip the switch! |
| | Electronics | • Unplug electronics/use a power strip (turned off when not in use)<br>• Power down computers, turn off monitors, don't use screen savers<br>• Use rechargeable batteries • Turn off game consoles |
| **Building Scale Changes** | Heating and Cooling | • Weather stripping • Change air filter regularly<br>• Caulking • Tune up HVAC each year<br>• Efficient HVAC/heat pumps • Seal heating and cooling ducts |
| | Water heating | • Set water heater thermostat to 120°F or lower |
| | Appliances | • Purchase efficient appliances |

**Figure 2:** A look at some of the behaviors that can reduce household energy use.[23] Personal behavior changes are most relevant to the large-scale residence projects this paper focuses on, but building scale changes are important for individual homeowners.

[22] Janda, Kathryn B. "Buildings Don't Use Energy: People Do." *Architectural Science Review* 54, no. 1 (2011): 15–22. doi:10.3763/asre.2009.0050.

[23] "Save Energy at Home : ENERGY STAR." Accessed October 30, 2013. http://www.energystar.gov/index.cfm?c=products.pr_save_energy_at_home&s=mega.

This human participation matters. Even within identical homes designed to be energy efficient, occupant behavior can cause energy consumption to differ by a factor of two or more.[24] By comparing consumption patterns in homes where occupants change (i.e. there are different occupants each year) and those where occupants remain the same, researchers found that 71% of the variation in identical homes is due to occupant consumption patterns. This finding led the researchers to conclude that "…the resident rather than the structure creates most of the observed variation in consumption."[25] These conclusions demonstrate that design is not independent of human use.

Other research on green buildings found comparable variations based on occupant behavior. A study found that electrical consumption varied by a factor of more than three and water consumption by greater than seven amongst low energy homes, even when accounting for typical correlating factors (i.e. number of occupants, floor area). These results suggest that occupant behavior is a determining factor of energy and water use amongst households.[26] Both of these studies indicate that occupants play an important role in determining how sustainable green buildings, like those certified by LEED, are.

Similar variations have been found in the university context, giving more relevant insight into the Pomona College case study. A study of university residences in the United Kingdom found that some apartments use almost three times as much electricity as other identical student apartments, which they attribute to "…how the occupants live within those apartments." Results indicated that specific activities, like watching TV or baking, were key in creating differences in electrical load. The study concluded that the "…impact of watching TV is more energy intensive in one of the high-consuming flats."[27]

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[24] Sonderegger, Robert C. "Movers and Stayers: The Resident's Contribution to Variation Across Houses in Energy Consumption for Space Heating." *Energy and Buildings* 1, no. 3 (1978): 313–324.
[25] *ibid*
[26] Gill, Zachary M., Michael J. Tierney, Ian M. Pegg, and Neil Allan. "Measured Energy and Water Performance of an Aspiring Low Energy/carbon Affordable Housing Site in the UK." *Energy and Buildings* 43, no. 1 (2011): 117–125.
[27] Morley, Janine, and Michael Hazas. "The Significance of Difference: Understanding Variation in Household Energy Consumption." *ECEEE Proceedings of the 2011 Summer Study* (2011). http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.225.7551&rep=rep1&type=pdf.

These studies were not alone in finding variations in energy consumption. The Carbon Trust, based in the UK, found a significant gap between predicted energy performance and actual energy performance in low carbon dwellings. They point to buildings not being operated properly by occupants as one of the biggest contributing factors to this gap.[28] In response to this disparity, the Carbon Trust further found that innovations in building operations, including "…assisting behavioral change by providing users with clear information, incentives and innovative tools with which to interact with buildings," could save up to 32 million tons of carbon by 2050.[29] The significant carbon savings indicate that "…building operation innovations provide the largest carbon savings and the greatest value from energy savings overall [as compared to pre-construction and design, build process, and materials and components]."[30]

These reports highlight operations innovations and behavior change over other technological advances. Despite great efficiency improvements in technology, energy consumption has decreased just slightly per household over the last few decades.[31] Efficiency gains have been outpaced by increases in the size, number and overall use of energy consuming equipment and houses as a whole. The Residential Energy Consumption Survey shows an "increasing number of televisions, computers, and other electronic devices that add to household plug loads."[32] Technology and appliances may be much more efficient, but we also use more of them. One study postulates that "…changes in use of equipment will be the dominant source of change in energy demand."[33]

One way to change use of equipment is turning them off. Not only do electronics like TVs draw on energy while they are being used, but also when they are

[28] "Low Carbon Buildings - Carbon Trust." Accessed October 4, 2013. http://www.carbontrust.com/resources/guides/energy-efficiency/low-carbon-buildings-design-and-construction.
[29] "TINAs: Energy Efficiency Innovation in Buildings, Homes and Industry - Carbon Trust." Accessed October 4, 2013. http://www.carbontrust.com/resources/reports/technology/tinas-energy-efficiency.
[30] *ibid*
[31] "Residential Energy Consumption Survey (RECS) - Analysis & Projections - U.S. Energy Information Administration (EIA)." Accessed October 3, 2013. http://www.eia.gov/consumption/residential/reports/2009/consumption-down.cfm?src=%E2%80%B9%20Consumption%20%20%20%20%20%20Residential%20Energy%20Consumption%20Survey%20(RECS)-f3.
[32] *ibid*
[33] Schipper, L, S Bartlett, D Hawk, and E Vine. "Linking Life-Styles and Energy Use: A Matter of Time?" *Annual Review of Energy* 14, no. 1 (1989): 273–320. doi:10.1146/annurev.eg.14.110189.001421.

idle or even off. Phantom load describes the energy load that comes from plugged in, but off, electronics. It consumes an average of 7 percent of a home's total electricity bill.[34] Research by the Lucid Design Group actually placed the percentage at up to a staggering 50% for commercial buildings.[35] While commercial buildings are certainly different than residential buildings, 50% is a remarkable difference in building energy consumption due solely to human choice. All it takes to avoid the significant energy draw of phantom load is unplugging electronics that aren't being used or connecting them to a power strip (which is then turned off when not in use). This is a simple behavior change that can result in big energy savings.

Simple behavior changes matter. Occupants matter. Decisions that residents make about how to use their technology make significant contributions to how much energy is consumed by buildings. Choices in consumption are based on convenience, need, and emotion, which are all internally controlled. Technological innovations in efficiency must be accompanied by change in consumption patterns and a decrease appliance use. There are many strategies to go about changing this high impact behavior and helping individuals to move towards more efficient lifestyles.

[34] "'Vampire' Appliances -- They Suck Electricity Even When Switched Off -- Cost Consumers $3 Billion a Year, Says Cornell Energy Expert | Cornell Chronicle." Accessed October 30, 2013. http://www.news.cornell.edu/stories/2002/09/vampire-appliances-cost-consumers-3-billion-year.

[35] "Building Occupant Feedback Systems & Plug Loads: Opportunities & Results." *Scribd*. Accessed November 15, 2013. http://www.scribd.com/doc/55037103/Building-Occupant-Feedback-Systems-Plug-Loads-Opportunities-Results.

# Chapter 3: Strategies for Behavior Change

## *Background*

When it comes to energy consumption, consumers get shockingly little information. For most people energy use information comes only once a month as their bill. Kempton and Layne compare this to doing your grocery shopping without any marked prices, and then receiving a monthly bill for aggregate food consumption costs, with no further break down.[36] How would we expect someone to know how to budget under these conditions? This is exactly how energy consumption is set up in most buildings. Intuitively it makes sense that people need to understand how much energy they are using, the costs of certain behaviors, and how to change those behaviors in order to make changes in energy use. Feedback and signage could be the solutions for providing the information needed to budget energy use. Research has shown that both signage and feedback are indeed effective in influencing behavior, and can easily be incorporated into the design of a building specifically to engage occupants, making them ideal for inclusion in LEED.

It is important to have some background on the psychological processes behind the strategies for behavior change. The widely accepted and validated theory of planned behavior, proposed by Icek Ajzen in 1985, provides one perspective on what motivates behavior change. The theory states that three things shape individual intentions and behaviors: feeling of control in affecting a problem, norms, and perceived control over changing behavior. The feeling of control over changing a problem comes from knowledge about the effectiveness of a behavior in addressing the issue. In the context of this paper that means recognizing that changes in behavior can have a meaningful effect on resource consumption within a building. The norms component of the theory weighs both social norms (is this problem important to others?) and subjective norms (is this problem important to me personally? Is it important to my significant others?). These norms can be addressed by compelling signs and

[36] Kempton, Willett, and Linda L. Layne. "The Consumer's Energy Analysis Environment." *Energy Policy* 22, no. 10 (1994): 857–866.

comparative feedback. Finally, perceived control over changing a behavior includes awareness of any factors that may facilitate or impede performance of the behavior.[37] All of these features combine to predict individual behavioral intentions and changes.

According to this model, in order to change their behavior individuals need information, including knowledge of how effective the behavior is, what others' think about it, and level of control over making the changes. In the context of building occupant behavior, all of this information can be communicated effectively through a combination of signage and feedback. Provision of information is one important aspect of influencing behavior that can easily be incorporated into LEED.

## *Feedback Strategies*

Feedback is one way to supply the information necessary for motivating behavior change. In the context of this paper, feedback is defined to be the provision of information on energy use, either through direct feedback (immediate, from a meter or associated display) or indirect feedback (feedback that has been processed in some way before reaching the energy user, often in the form of billing).[38] The information is often given in the form of standard measurements (e.g. kWh), monetary cost, and carbon emissions. Direct feedback reveals these measurements in real time, as the energy is being consumed. This is a very effective way of providing the information individuals need to understand how much energy they are using, and to recognize on a personal level how their behavior directly contributes to that use. For example, a resident might observe that shutting their computer down leads to a dip in overall energy consumption. Feedback creates awareness about the amount of energy different activities consume and provides visibility for the changes produced by adjusting those behaviors. Being able to see the effectiveness of these behaviors gives residents a feeling of control over reducing energy use, and according to the theory of planned behavior, makes them more likely to make the behavior change.

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[37] Ajzen, Icek. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50, no. 2 (1991): 179–211.

[38] Darby, Sarah. "The Effectiveness of Feedback on Energy Consumption." *A Review for DEFRA of the Literature on Metering, Billing and Direct Displays* 486 (2006): 2006.

Over the last three decades studies have consistently shown that feedback motivates behavior change, resulting in energy use decreases of up to 20%. One study, done in 1977, found that households in a feedback group used 10.5% less energy than those in a control group.[39] More recently, Dr. Sarah Darby of the Environmental Change Institute at the University of Oxford found that direct feedback leads to up to 15% savings in energy.[40] Her research highlights direct feedback as the most promising form of feedback for changing behavior patterns. Dr. Fischer reviewed 28 studies that examined the effectiveness of feedback on reducing energy use behavior in residential settings, and corroborated Darby's findings. All but three of the 28 studies showed significantly higher energy savings in groups given feedback. Her study also highlights that computerized, immediate, direct, and specific feedback designs each led to consistently larger reductions in energy use.[41] This research demonstrates that feedback is a very effective strategy for motivating behavior change and leading to reductions in energy consumption.

A study out of Oberlin College (a small liberal arts college very similar to Pomona) studied the effects of feedback on energy use within residence halls. Students were exposed to either real time web-based feedback (high-resolution feedback) or provided with feedback once a week from manual reading of utility meter (low-resolution feedback). The high-resolution feedback was designed in an energy dashboard format, similar to Pomona College's (described in greater detail in Chapter 4), where students could view constantly updated energy and water use on a dorm or floor level for variable time periods (e.g. last minute, last hour, last month). Two dorms received the high-resolution feedback, while the rest of the dorms received low-resolution feedback. Within each high-resolution dorm two of the three floors received floor specific feedback (the third only received building wide feedback to act as a

[39] Seligman, Clive, and John M. Darley. "Feedback as a means of decreasing residential energy consumption." *Journal of Applied Psychology* 62.4 (1977): 363.
[40] Darby, Sarah. "The Effectiveness of Feedback on Energy Consumption." *A Review for DEFRA of the Literature on Metering, Billing and Direct Displays* 486 (2006): 2006.
[41] Fischer, Corinna. "Feedback on Household Electricity Consumption: a Tool for Saving Energy?" *Energy Efficiency* 1, no. 1 (February 1, 2008): 79–104. doi:10.1007/s12053-008-9009-7.

control). The study coincided with an Energy Competition, where the dorms across campus were competing to reduce energy use.

The results showed that both high- and low-resolution feedback resulted in at least a 31% reduction in electricity use. Perhaps more remarkably, there was a 55% reduction in the high-resolution web based group compared to 31% for the manually read group.[42] Within the high-resolution group there was no significant difference in reduction between floors who had floor specific feedback and those who didn't. Students showed higher interest in looking at the feedback in the high-resolution group, averaging 4.8 visits per resident to the dorm energy website compared to 2.5 visits per resident in the low-resolution group over the month.

These results show that feedback is an effective strategy within the context of university residential life, particularly in conjunction with an energy competition. More research is needed to investigate how effective the feedback was outside of the competition. In agreement with Dr.Fischer's findings, web-based real time feedback is indeed especially effective in motivating students to reduce their energy use. This study gives valuable insight into the effectiveness of different types of feedback in influencing behavior in small liberal arts colleges like Pomona and Oberlin Colleges. The results indicate that feedback, particularly direct feedback, is an effective and important strategy. Given this study's uniqueness in looking at feedback in the university context, there is a need for more plentiful and thorough research on this issue.

Feedback is a particularly important strategy both because it has consistently led to significantly reduced energy use, and also because it is a tactic that could easily be incorporated as a LEED credit. Energy use meters and displays are infrastructural attributes – built into the design of a building specifically to influence behavior change. Feedback technology is plentiful and well designed, and therefore easily included in the design process. The installation of meters, and the visibility of the displays for meters, is ripe for inclusion as a credit in LEED.

[42] Petersen, John E., Vladislav Shunturov, Kathryn Janda, Gavin Platt, and Kate Weinberger. "Dormitory Residents Reduce Electricity Consumption When Exposed to Real-time Visual Feedback and Incentives." *International Journal of Sustainability in Higher Education* 8, no. 1 (January 16, 2007): 16–33. doi:10.1108/14676370710717562.

## *Signage Strategies*

Signage is another simple strategy for occupant engagement. It is an easy, cheap, and effective tactic for providing information on overall sustainability goals and specific use of green features, which helps motivate behavior change according to the theory of planned behavior. This information can help motivate participation and engages occupants with the general environmental dialogue and culture. On a practical level, occupants might not know how to use the features of their buildings (e.g. dual flush toilets) without instructive information, and people will not use green features if it is not clear how.

One study demonstrated the effectiveness of signage in motivating usage of dual flush toilets. These toilets are designed to have a handle that if pulled up flushes for liquid waste, and if pulls down flushes for solid waste. During a control period, in which there were no signs, the percentage of up flushes averaged 26.6%. With signs present the percentage averaged 38.8%.[43] This shows higher use of the small flush when signs were present, indicating that signage was effective in motivating more usage. Another study showed that placing signs in washrooms to encourage switching lights off made participants *eight* times more likely to turn off the lights than when there was no sign reminding them.[44]

But not all signs are created equal. Research done by Goldstein et al. encouraged recycling in a hotel through two different types of prompts: one containing a pro-environmental message and the other displaying the number of guests who had previously recycled (a social norm message). The results show that the social norm prompt produced a significantly higher recycling rate (44%) than the standard environmental message (35%).[45] Signs that emphasize social norms appear more effective in encouraging pro-environmental behavior. These signs help address the norm

[43] Arocha, Jade S., and Laura MJ McCann. "Behavioral Economics and the Design of a Dual-flush Toilet." *Journal of the American Water Research Association* 105, no. 2 (2013). http://www.energy.ca.gov/appliances/2013rulemaking/documents/responses/Water_Appliances_12-AAER-2C/Behavioral_Economics_and_the_Design_of_a_Dual-Flush_Toilet_2013-06-03_TN-71105.pdf.

[44] Sussman, Reuven, and Robert Gifford. "Please Turn Off the Lights: The Effectiveness of Visual Prompts." *Applied Ergonomics* 43, no. 3 (May 2012): 596–603. doi:10.1016/j.apergo.2011.09.008.

[45] Goldstein, Noah J., Robert B. Cialdini, and Vladas Griskevicius. "A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels." *Journal of Consumer Research* 35, no. 3 (2008): 472–482.

component of the theory of planned behavior by exerting social pressure on individuals to make more energy conscious decisions.

Signs are an intuitive and effective way to communicate the sustainability goals and features of a building, and how to use them. They help green buildings to instigate a shift towards environmental consciousness, and help reduce impact. Signs could easily be incorporated into LEED as a strategy for engaging residents, as they are simple and easily integrated into a design. Both signage and feedback are incorporated into the design of Pomona College's new residence halls as strategies for occupant engagement.

# Chapter 4: A Case Study of the Pomona College New Dorms

## *Case Study: Background*

Pomona College went above and beyond LEED by incorporating some occupant engagement strategies into its new LEED Platinum certified dorms, Pomona and Sontag Halls, opened in June of 2011. This residence hall project was recognized with not only a LEED Platinum certification (see Appendix 1 for LEED scorecard), but also the 2013 Green Good Design award. The dorms were among 26 projects selected around the world for this prestigious award.[46] At least in design and conception, these are some impressive buildings.

One hundred-fifty students are housed in the buildings in suite-style apartments with 3 – 6 single bedrooms, shared bathrooms, common room and kitchenette. Each floor also has a communal full kitchen and lounge. The three story L-shaped buildings are a combined 78,000 square feet, sitting on a 4.3-acre site. The total project cost was $53 million.[47] The green features of the project are numerous: thermal mass construction (reducing heating and cooling needs), efficient heating and cooling, operable windows, adjustable thermostat, switch to control outlets in bedrooms (to reduce phantom load), solar photovoltaic, solar hot water heating, and dual flush toilets.[48]

[46] "Pomona College Celebrates Opening of Two of the Nation's Greenest Residence Halls - Pomona College." Accessed October 4, 2013. http://www.pomona.edu/news/2011/09/21-residence-hall-opening.aspx.
[47] *ibid*
[48] "Green Building Features: North Campus Residence Hall Project - Pomona College." Accessed October 12, 2013. http://www.pomona.edu/administration/sustainability/initiatives/facilities/ncrh.aspx.


**Figure 3:** (Left) A bird's eye view of the design of Pomona and Sontag Halls[49] and (right) floor plan of the first floor of Sontag Hall[50]

These features seem to be doing their job of decreasing impact relatively well. Pomona and Sontag Halls are using 20% less energy than predicted. The simulated energy use of the project predicted 1,366,652 kWh per year for both buildings combined.[51] According the Annual Sustainability Report from Pomona's Sustainability Integration Office, Pomona and Sontag Halls used 1,106,772 kWh over the 2012 – 2013 academic year.[52]

Instead of just focusing on efficiency, the design also strove to incorporate educational components in order to connect residents with the sustainability of the buildings, even without encouragement from LEED. In discussing motivation for the LEED dorms, college president Dr. David Oxtoby said: "Education of our students about sustainability takes place not only in the classroom but in residence halls and throughout campus."[53] President Oxtoby highlights the educational goals of the buildings over the environmental impacts alone. He recognizes that green buildings, particularly within the university context, are an important tool for educating students and creating awareness around sustainability.

[49] "New-dorm-1-large.jpg (500×375)." Accessed November 2, 2013. http://pomona.edu/news/2009/10/images/new-dorm-1-large.jpg.
[50] "Residence Hall Maps - Pomona College." Accessed November 14, 2013. http://www.pomona.edu/administration/campus-life/room-draw/room-maps.aspx.
[51] *DOE-2 Simulation Output & Input Summary Reports*, September 13, 2009.
[52] *Annual Sustainability Report 2012-2013*. Pomona College, August 2013.
[53] "Pomona College Celebrates Opening of Two of the Nation's Greenest Residence Halls - Pomona College." Accessed October 4, 2013. http://www.pomona.edu/news/2011/09/21-residence-hall-opening.aspx.

In order to support this educational goal, the dorms include informational plaques and real-time energy feedback. These interventions strategies are beyond LEED's requirements, and did not even garner the project Innovation points. There are signs in the residential suites and common spaces of the dorms that explain some of the features of the building. There is a sign in each individual room, suite common room, kitchen and lobby. The signs in the suite common rooms and the shared kitchens (Figure 4, left) are the same. They remind residents to turn off devices, take advantage of daylight, eat sustainably, be mindful of climate settings, utilize efficient appliances and use water wisely (see Appendix 2 for larger image of full sign). The signs in individual rooms highlight many of these same topics, prompting students to turn lights off, switch the power off to outlets, and to be mindful of climate controls. The lobby sign highlights the necessity of occupant participation in making the building green: "…while all these features make sustainable lifestyle choices easier, your effort is still required to make the building and campus sustainable."

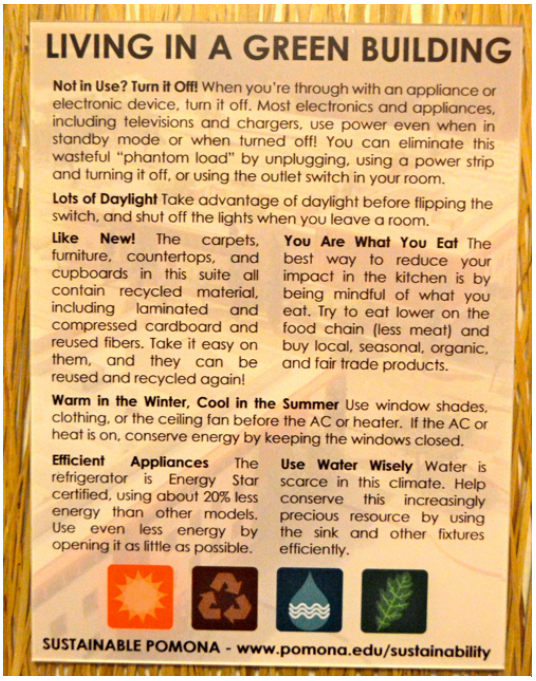


**Figure 4:** Signage from Pomona/Sontag common rooms; Source: Chelsea Fried

Direct feedback is also available to residents in the lobby, on flat screen interactive panels, as well as accessible anywhere online. Pomona utilizes the Lucid Building Dashboard technology for metering and displaying energy and water use.[54] This dashboard presents the information for Pomona and Sontag Halls, in addition to all other dorms on campus. It includes a breakdown of electricity, water, HVAC (heating, ventilation and air conditioning), natural gas, and solar thermal use. Within each of the categories, a viewer can examine use in terms of a common measure (e.g. kilowatt hours or gallons), carbon emissions, or monetary cost over a chosen time period

[54] To view the Lucid Dashboard for Pomona College: http://buildingdashboard.net/pomona

(anywhere from the full year to a minute by minute breakdown). One can also view use in comparison to other buildings across campus.

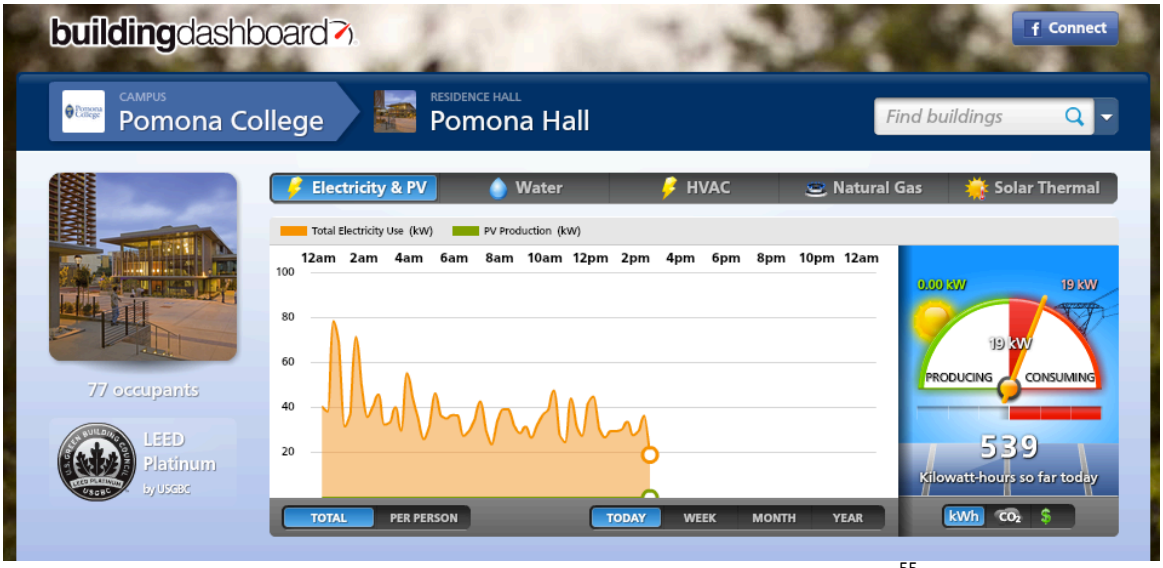


**Figure 5:** A look at the Pomona Hall building dashboard[55]

This dashboard reports that these two dorms (the only LEED certified ones on campus) have the highest rate of energy use per person of any dorm on campus for the year thus far (January 2013 – November 2013).[56] In researching this paper I discovered some inconsistencies in the dashboard's information, which make this statistic questionable. Some of these inconsistencies arise from data loggers being down for periods of time, creating gaps in data for various buildings. Reports from past years show more reliable and slightly different, but still alarming, rates of energy use. As Figure 6 below shows, in the 2012 – 2013 year Pomona and Sontag Halls consumed more energy per resident than all but three of the dorms on campus.[57]

[55, 56] *ibid*

[57] *Annual Sustainability Report 2012-2013*. Pomona College, August 2013.

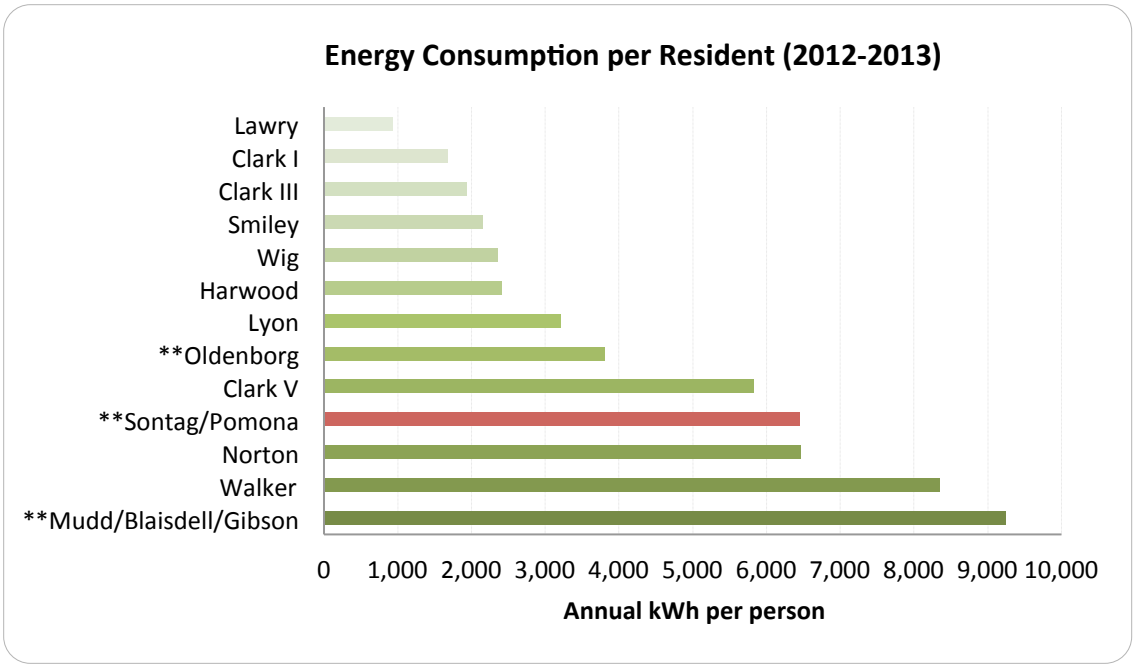


**Figure 6:** ** indicates dorms with air conditioning; Graph: on campus energy consumption. [58]

This could be due in part to the fact that they are one of only three dorm areas on campus that have air conditioning (Oldenborg, Sontag/Pomona, and Mudd/Blaisdell/Gibson). But it still seems that due to their green features they would have lower energy consumption per person than other dorms with air conditioning. In actuality, Sontag and Pomona Halls use significantly more energy per resident than Oldenborg, a non-LEED certified residence hall with air conditioning. These buildings, which are supposed to be on the cutting edge of sustainable building, were projected from the start to consume significantly more energy per person than other non-green buildings on campus. More extensive research is needed to understand why the project was designed to consume more energy than its non-LEED counterparts. This paper focuses only on how we can make them better.

Despite their green features Pomona and Sontag Halls are still consuming a large amount of energy, showing that LEED certification is not enough. How can these supposedly "green" LEED dorms use less energy? As all of the research demonstrated, it could be through changes in human behavior. Residents in these buildings have power over resource consumption. The degree to which they use the air conditioning falls

[58] *ibid*

directly under human control, and there are other significant human behavior contributions as well. The projected energy usage for the project predicted that task lights and miscellaneous equipment would make up 22.6% of total energy consumption.[59] Task lighting (which is lamps and other personal lights) and miscellaneous equipment are provided and used solely by building residents. This means residents have, at minimum, direct control over more than a fifth of total energy consumption. Including occupant engagement, presents a significant opportunity for improvement in resource consumption.

In line with a major goal of the Pomona/Sontag project "…to encourage students to learn how to live more sustainably through sustainability tip cards and making sustainable living practices easy..."[60] Pomona College has made substantial efforts in trying to foster occupant engagement through signage and feedback. But these strategies are not as effective as they could be according to residents of the dorms.

## *Research Strategy: Survey and Results*

Pomona has incorporated these engagement strategies, but are they effective? I designed a survey which conducts a baseline exploration of residents' awareness of the sustainability features and occupant engagement strategies of the two LEED-platinum certified dormitory halls (see Appendix 3 for a full copy of the survey). Based on the research in earlier sections and informed by the responses to this survey, I make recommendations for improving occupant engagement in Pomona and Sontag Halls.

The fourteen-question survey was distributed to residents of Pomona and Sontag Halls through student listservs and Facebook. Forty-one students, or 27% of those living in the buildings, responded to the survey. Respondents answered questions such as: "What do you like about living in the new dorms? Do you think they are well designed?" "How much energy do you think you personally consume compared to past years?" and "Were you aware real time energy use information is available to you?" The survey provides anecdotal evidence about awareness of sustainability interventions

[59] *DOE-2 Simulation Output & Input Summary Reports*, September 13, 2009.
[60] "Pomona College Celebrates Opening of Two of the Nation's Greenest Residence Halls - Pomona College." Accessed October 4, 2013. http://www.pomona.edu/news/2011/09/21-residence-hall-opening.aspx.

(signage and feedback), connection to building sustainability, and sustainable behavior within the buildings.

There are limitations to the conclusions that can be drawn from the survey given the rate of response, possible trends in who chose to respond, and the design of the survey instrument. Students who took the time to respond to the survey might be predisposed to either be environmentally conscious or connected to me in some way. This might create bias in the responses. However nearly a third of residents responded, which allows some meaningful conclusions to be drawn. Furthermore responses to the open ended questions give insight into issues with using green features without prompting students about sustainability. The design of the survey is not intended to produce statistically significant results, but instead to provide a first exploration of resident knowledge and thoughts, which can help to inform my recommendations. More robust survey and study of residents is needed to provide more conclusive evidence, and will be necessary in moving forward with implementing the recommendations.

Answers to the open-ended questions: "What do you like about living in the new dorms? Are they well designed?" and "What could be improved?" show that students generally like living in the new dorms. All of the respondents were able to list things they liked about the dorms, citing the full beds, common spaces, control over air-conditioning and the provided fridge. Complaints however were plentiful as well; students dislike the concrete pillars, heavy doors, amount of card swiping to reach the room, lack of community, and confusing climate control.

Responses to the multiple choice questions showed that signs have a relatively high level of visibility amongst survey participants. 78% of respondents agreed or strongly agreed that they had read the informative plaques about environmental features in their suite. Of those who have read the signs, 81% agreed or strongly agreed that they are informative. This demonstrates that the signs are visible enough that the vast majority of students have stopped to read them. However 20%, a significant percentage, of those who have read them do not find them informative. Only about 14% of respondents agreed with the statement "I have changed my behavior because of

a sign in my suite." These results could indicate a gap between the visibility of signs and the degree to which they influence behavior.

| | Strongly Agree (%) | Agree (%) | Neither agree nor disagree (%) | Disagree (%) | Strongly disagree (%) |
|---|---|---|---|---|---|
| **I have read the signs in my suite** | 19.5 | 58.5 | 9.8 | 7.3 | 4.9 |
| **The signs are informative** | 7.3 | 58.5 | 26.8 | 4.9 | 2.4 |
| **I have changed my behavior because of a sign in my suite** | 0.0 | 14.6 | 19.5 | 41.5 | 24.4 |

**Figure 7:** Survey Results - signage

Despite not all residents reading the signs, there seem to be high levels of knowledge about the green features of the building (see figure 8, next page). Pomona has mostly achieved the goal of creating awareness amongst residents about the sustainable features of the buildings. Not all features appeared equally well known however. Design to utilize natural lighting, low flow water appliances and edible landscaping are not well known by survey respondents. The low flow water appliances operate with or without student recognition, but the others won't serve their purpose without student participation. If students are not utilizing the natural lighting, the energy savings will be negligible. Task lighting was predicted to account for over 20% of total energy consumption[61], and without use of natural lighting that percentage could become even more significant.

[61] *DOE-2 Simulation Output & Input Summary Reports*, September 13, 2009.

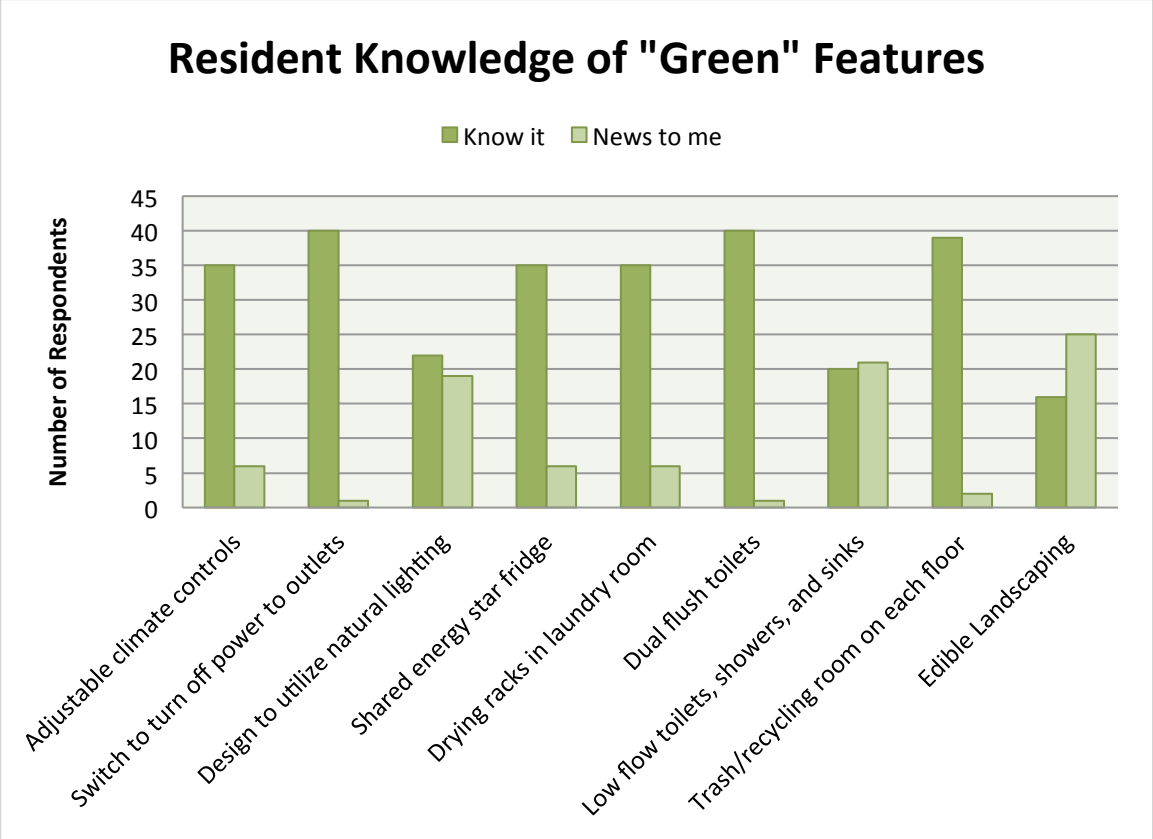


**Figure 8:** Survey results – knowledge of green features

Responses to the survey also give insight into the awareness amongst respondents about energy metering and feedback within the dorms. Pomona and Sontag halls have energy feedback dashboards available online and on a screen in the lobbies, but they don't seem to be highly visible. See figure 9 (next page) for details on student responses about the energy dashboard.

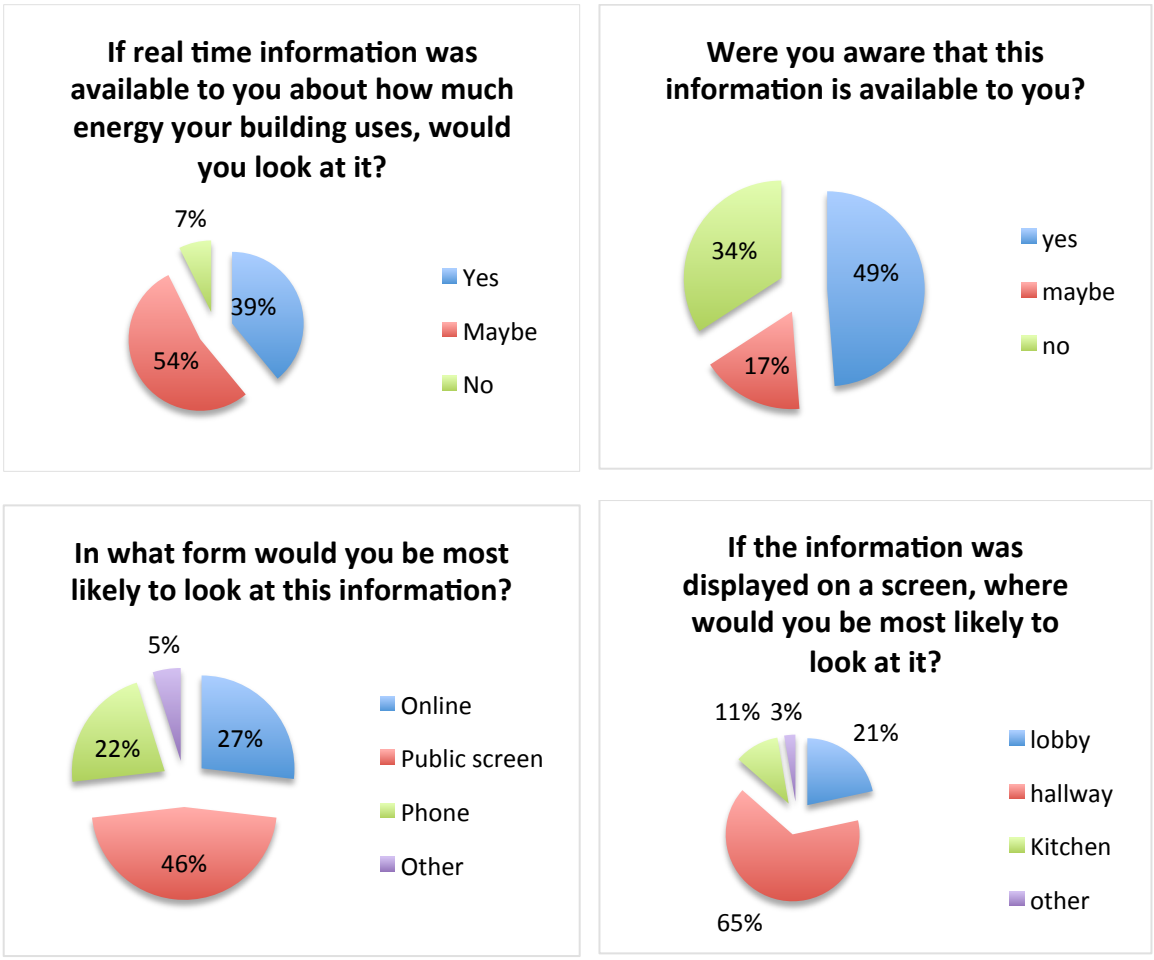


**Figure 9:** Survey results – real time energy information

Only 49% of respondents are currently aware that live energy feedback is available to them. This implies that only 49% or less are actually looking at and have the potential to respond to the feedback. Responses indicate some idea of how to make the dashboard more visible and appealing. Recommendations for making the feedback more visible will be more fully explored in the next section.

The responses to the open ended questions of the survey also brought to light some additional design failures. These design problems inform occupant engagement strategies by indicating where residents are having trouble participating in making the buildings function sustainably. There were four particularly noted issues: climate control, the switch to turn off power to outlets, dual flush toilets, and lighting.

Despite 85% of respondents being aware of adjustable climate controls, issues with utilizing it were raised over and over. In response to "What could be improved

[about your suite]?" one student complained, "How do you use the thermostat? No one that I know is able to get theirs to work. Why do I have controllable AC that I can't control?" Another student shared their strategy for using the climate controls: "… I can't figure out any way to turn them [climate controls] off except by opening a window." Other students did not even realize they had control over their own thermostat, "sometimes I wish I could control the climate myself I get cold/hot very easily." Almost 15% of survey respondents were unaware that they could adjust the temperature in their room, and 30% of respondents specifically mentioned difficulty adjusting the temperature. This could indicate that these students are not using the climate controls, demonstrating poor design and lack of informative signage. Failure to use climate controls, out of ignorance or design barriers, would guarantee that the building is not being used at its full sustainability potential. Facilitating successful use of the climate controls should be an important focus for ensuring success of the project.

Another commonly raised design flaw is the switch to turn off the power supply to all outlets in the room except one. While 98% of respondents were aware of this feature, many students complained that it is not easily usable: "The power switch to turn off electrical outlets is poorly conceived. There is only one outlet that it doesn't affect, and that outlet is not conveniently located for my clock. If I want to keep a clock in my room (which I use as an alarm in the mornings, so it's kind of important), I can't turn off electrical outlets from the switch." This student's response reflected the drawbacks highlighted in others' responses as well. Given student responses to the open ended questions, the switch appears to be used rarely because it is not convenient when students need to leave one or two electronics plugged in.

20% of respondents also independently expressed concern that the dual flush toilets do not work: "If which way you pull the 'dual flush' actually makes a difference, it's news to me because it definitely doesn't seem to," and "…I don't think our dual flush toilet works - it always flushes really strongly." More descriptive and informative signage about how the dual flush works and how to use it would help engage more residents. One student made the suggestion: "potentially place an informative plaque in bathroom (especially about dual flush toilets), I think often people ignore that feature

(does it really make a difference?...the plaques could explain how)." This comment encompasses respondent doubt about the functioning of the dual flush toilet, and a valuable suggestion in how to improve it, further explored in the next section.

Respondents also expressed discontent about the lighting. Respondents are upset that there is no manual off switch for the light in the common room, meaning if someone sleeps there or passes through briefly light is constantly on. It also seems that the hallway light in some suites never turns off, unnecessarily wasting energy. Other respondents requested a motion sensor light for the common room (which actually already exists) because they see the light getting left on all night, indicating that their sensor is not functioning properly. Surveyed students also find that the lighting in rooms is too dim to work by and thus find themselves needing extra task lighting and contributing to a larger energy load by having both on. Additionally, respondents complained that the L-shaped rooms are not designed well to allow natural lighting, and that the difficulty of opening and closing blinds discourages the use of natural lighting.

The survey respondents raised some very valid concerns about the design of the buildings that may have been overlooked or misguided. However, when asked how the sustainability of their suite could be improved many respondents proposed behavior changes, not just design changes. This demonstrates some feeling of agency in reducing the impact of the building. Behavior change suggestions included: "shorter showers, if it's brown flush it down if it's yellow let it mellow, turning off lights more, being even more careful about temp control." Design changes included: "Actual dual-flush toilet and actually adjustable heat in the rooms," and brighter lighting. Note that there are already dual-flush toilets and adjustable climate controls. This answer points to unawareness and lack of effective signage.

Answers to this survey provide a basic exploration of student awareness and use of green features and interventions. Combined with all of the research explored earlier, it can help to guide recommendations for improving occupant engagement at Pomona College. Further study is needed to draw more definitive conclusions on occupant engagement in the buildings as a whole.

## *Case Study: Recommendations for Pomona College*

Pomona College is attempting to engage the residents of Pomona and Sontag Halls with the sustainability of their building, but despite the college's efforts the survey and energy use data suggests that in many ways those strategies have failed. The survey results suggest some areas that might be starting points for change. Recommendations for improvement are informed by the research explored earlier in this paper and student responses to the survey.

| ***Recommendations for better occupant engagement at Pomona College*** | |
|---|---|
| **Signage** | • Rewrite signs to emphasize social norms<br>• More descriptive and directive signs<br>• Better location<br>• More signs |
| **Feedback** | • Better publicity for the website<br>• Better location<br>• Design a feedback phone application<br>• Connection to social media |

**Figure 10:** Recommendations for Pomona College

## *Signage Recommendations*

Signage could be improved by emphasizing social norms, being more descriptive, better located, and more numerous. The signage in the buildings is neither as visible nor as informative and effective as it could be. Drawing from Goldstein's research, signs in Pomona and Sontag Halls could be improved by using social norms.[62] For example, one of the current signs (Figure 11, next page) says "Use window shades, clothing, and the fan before the AC or heater."

[62] Goldstein, Noah J., Robert B. Cialdini, and Vladas Griskevicius. "A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels." *Journal of Consumer Research* 35, no. 3 (2008): 472–482.

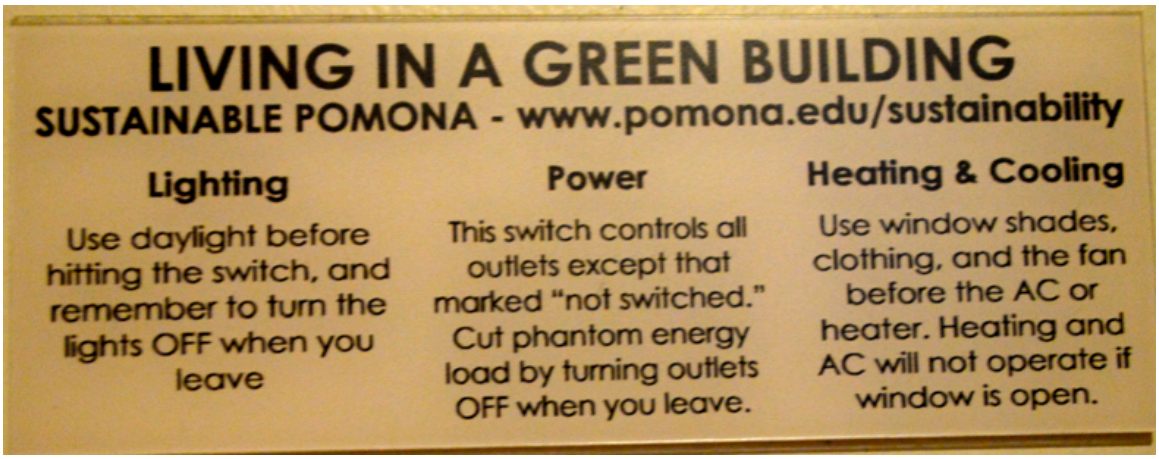


**Figure 11:** A sign from an individual room in Pomona Hall; Source: Chelsea Fried

In line with the normative strategy the sign would be more effective if, for example, it instead said, "75% of your peers who live here use shades, clothing or the fan before turning on the AC or heater," or "75% of your peers keep the temperature above 78° in the summer and below 68° in the winter." It would be helpful to have a follow-up study to capture these percentages accurately. These very small wording changes have the potential to lead to great reductions in resource consumption.[63] Replacing the current signs with socially normative messages would hopefully motivate higher levels of participation.

Some of the signs also seem to fail to communicate effectively the use of the energy and water saving features. Responses to the survey indicate that some respondents doubt that certain green features work, for example low flow and dual flush toilets. More descriptive signs that explain how and why these features work could be helpful in restoring faith in (and use of) these green features. Research shows that more informative signage tends to motivate higher levels of participation.[64] Students might stop bothering to use green features if they don't appear to be working – this is why it is important that the signs make clear the process by which these green elements work. Signs could explain not only technically how to use the feature, but also how much energy or water is actually beings saved.

[63] Goldstein, Noah J., Robert B. Cialdini, and Vladas Griskevicius. "A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels." *Journal of Consumer Research* 35, no. 3 (2008): 472–482.
[64] Arocha, Jade S., and Laura MJ McCann. "Behavioral Economics and the Design of a Dual-flush Toilet." *Journal of the American Water Research Association* 105, no. 2 (2013).

This issue comes up especially often with dual flush and low flow toilets. There are actually no signs in Pomona and Sontag Halls specifically explaining these features, only a tiny sticker (see Figure 12, left) on the handle indicating the directions for more and less water. Beyond just size difficulties, the sticker is also often positioned so that it is unclear which direction produces which kind of flush. This could leave students confused about how to use the flushing mechanism (which way to pull the handle). On a deeper level it allows doubt about the functionality (is it actually working?) and worth of using different types of flush (does it really save water?). As earlier research showed, informative signs were effective in motivating higher use of the dual flush function.[65] A more descriptive sign provides the information necessary for students to understand how their behavior can affect the issue of high water consumption, tying back into the theory of planned behavior by showing the effectiveness of using the dual flush toilet. Simply placing a sign describing the dual flush function (which are present at other locations on campus, Figure 12, right) would lead to greater effectiveness. The bathroom zone of the suits has no signs at all, and seems to be an obvious place for improvement. Not only are some residents confused about the features of their bathroom, it is also a location where students are likely to sit and read the signs.

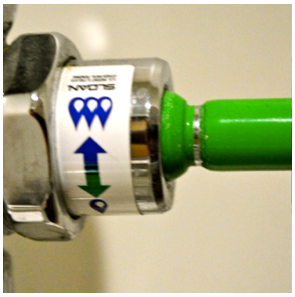

**Figure 12:** Sticker on dual flush toilet; Source: Chelsea Fried


**Figure 12:** Sign describing dual flush function; Source: Chelsea Fried

Location and number of signs is also an important facet of effectiveness. The two signs that are most visible to residents are the one in their own room and the one in their common room. These signs are very general and contain little specific information.

[65] Arocha, Jade S., and Laura MJ McCann. "Behavioral Economics and the Design of a Dual-flush Toilet." *Journal of the American Water Research Association* 105, no. 2 (2013). http://www.energy.ca.gov/appliances/2013rulemaking/documents/responses/Water_Appliances_12-AAER-2C/Behavioral_Economics_and_the_Design_of_a_Dual-Flush_Toilet_2013-06-03_TN-71105.pdf.

Research on signage indicates that signs placed close to feature being used motivate higher levels of use,[66] implying that signs should be posted in more visible locations and closer to operable features.

One ideal location for influencing behavior is near the climate controls, which the survey suggested some students are having trouble using. Placing more detailed instructional signs near the climate controls would help students understand how to use them. This is also a location where residents have direct control over energy use in their suite, which as research indicated, might make the signs more likely to change behavior.[67] Currently there are zero signs about how to use the climate control (pictured on the right). While the building designers may have though the controls were self-explanatory, responses to the survey indicate they might not be. A sign could be installed that details the steps for setting the thermostat and helpful troubleshooting hints.


**Figure 13: Climate controls; Source: Chelsea Fried**

Outside of just directions, students could benefit from a sign that also more specifically suggested temperatures. Students might arbitrarily set their thermostat to warmer or colder, without thinking about the difference one or two degrees can make in energy usage. The signs could say: "A comfortable, and environmentally friendly, temperature is 78° in the summer and 68° in winter. Changing your thermostat by just one degree could save a huge amount of energy." All of these small changes to signage have the potential to help motivate more sustainable behavior.

## *Feedback Recommendations*

Feedback could be improved with better publicity, better location, a phone application, and a connection to social media. Similar to signage, the location of feedback information could use improvement. Less than half of the students who

[66] Sussman, Reuven, and Robert Gifford. "Please Turn Off the Lights: The Effectiveness of Visual Prompts." *Applied Ergonomics* 43, no. 3 (May 2012): 596–603. doi:10.1016/j.apergo.2011.09.008.
[67] *ibid*

responded to the survey are aware that feedback exists, despite the screens in the lobby. This could indicate that the screens are not placed in an optimal location to garner interest, and that the website needs better publicity. Visibility is extremely important in making feedback effective.[68] The survey results suggest that students would be more likely to view the public screen in the hallway than the lobby (where it is currently located). Hallways are a more convenient and frequented area for residents, so a feedback display might attract more interest there.

The online presence of the dashboard seems to be most convenient for students, but it is difficult to find. It is important students have access to the website because the more immediate and direct the feedback is, according to Fischer, the more effective it will be in motivating behavior changes.[69] Given that residents spend more time in their suites than the lobby, the website is more convenient for directly viewing changes in consumption than the public screen. The website is not clearly posted anywhere on the college's website and does not even turn up with a simple Google search making it extremely difficult to find. Students are not going to peruse the dashboard unless it is made convenient and easy to find and use. A simple beginning to making the feedback more effective would be to better publicize the website. The link to the building dashboard should be easily accessible on the sustainability page of the college website, and should be sent out periodically to the building listervs.

The website and public screens are not the only places students are likely to view the feedback. Responses to the survey suggested that students are also likely to look at it on their phone. Given that there is no smart phone application for the building dashboard, the 22% of survey respondents who would like to have the dashboard on their phone do not have their method of choice available. Many students have smart phones, and utilize them for a range of activities. Creation of a simple app that displayed the dashboard could increase traffic to the site and make it even easier for students to engage with their building.

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[68] Fischer, Corinna. "Feedback on Household Electricity Consumption: a Tool for Saving Energy?" *Energy Efficiency* 1, no. 1 (February 1, 2008): 79–104. doi:10.1007/s12053-008-9009-7.
[69] *ibid*

There is another choice technology link not being made. Connecting the building dashboard to social media sites such as Facebook or Twitter would go a long way in garnering student interest. Students made this recommendation in the survey, citing Facebook as a much more visible place for the dashboard's online presence. Students spend a huge amount of time on social media (the average college student spends over 16 hours a week on social media sites)[70], so publicizing feedback on those sites could make it much more visible than even the public screens. Furthermore, publicity on social media could naturally create more competition between different students and dorms, which could in turn lead to greater reductions in resource consumption. Research shows that social pressure is a significant motivator for behavior change[71], and social media is a great way to exert it.

These changes matter, because resource consumption is really about the students. Pomona has done a great job at trying to engage students with the sustainability goals of the building, but there is more that can be done. Small changes can be made that have the potential to motivate behavior change and greater reductions in resource consumptions. Further research should be done to support and validate these specific recommendations and changes. Given the potential for reduction in resource consumption, feedback and signage best practices should be further researched and applied to all sustainable building projects and not just Pomona's.

[70] "College Quarterly - Articles - Impact of Online Social Network on American College Students' Reading Practices." Accessed December 11, 2013. http://www.collegequarterly.ca/2013-vol16-num01-winter/huang-capps.html.
[71] Festinger, Leon. "A theory of social comparison processes." *Human relations*7.2 (1954): 117-140.

# Conclusion: A Proposed LEED Credit for Occupant Engagement

The steps that Pomona College has undertaken to encourage occupant engagement are not required by LEED nor widely utilized by certified projects. The Pomona project did not receive innovation points for these efforts, demonstrating LEED's failure to encourage occupant engagement. LEED needs to recognize and validate the importance of occupant engagement. Clearly, how occupants use a building makes a significant difference in resource consumption, and this use will be dictated by knowledge about how to use the building, and engagement with the sustainability goals of the project and their. For this reason all LEED rating systems should include a credit for occupant engagement. Given that LEED v4 now includes a prerequisite for whole building energy and water metering it shouldn't be too difficult to make the jump to sharing that information with the residents of the building.

There is a proposed credit for occupant engagement in the LEED Pilot Credit Library (see appendix for full credit). The Pilot Credit Library is where proposed credits can be critiqued, tested and championed. Hopefully, with the support of the green building community this occupant engagement credit will be an addition to a future version of LEED.

The intent of the credit is: "To improve the performance of the building by enabling energy efficient behavior in building occupants."[72] The requirements are threefold: consumption feedback, occupant empowerment, and performance. Consumption feedback requires projects to implement one or more feedback processes for informing occupants about the actual energy consumption of the building (using real-time or regular reporting mechanisms). The feedback must be supplied once monthly at minimum, and must include a relevant comparison point (i.e. comparable buildings or historical data for the same space). This requirement touches on the

[72] "Occupant Engagement | U.S. Green Building Council." Accessed November 14, 2013. http://www.usgbc.org/node/2606886?return=/pilotcredits.

importance of feedback, but should be more stringent. The research has shown that the more immediate the feedback is, the more effective it is in affecting behavior change.[73] Feedback that comes only once a month gives us the same issues as billing – occupants will be less aware of specific actions and contributions to the energy use. Requiring a feedback minimum of once monthly gives leniency so more projects can get this credit. But that should not be the point of the credit; if we want to engage occupants through these strategies we should be implementing them in the most effective way possible. LEED should be pushing the boundaries with this credit, and that means requiring feedback, in a manner easily accessible to occupants, more than once a month.

The occupant empowerment portion of the credit requires implementing and maintaining a program for occupant engagement that has three minimum requirements: education, enabling, and feedback management. The educational component consists of the provision of information to occupants about their activities' impacts on the energy use of the building and where potential savings exist. Enabling action is making occupants aware of specific actions they can take to reduce consumption. This part of the credit deals with communicating with residents about what the feedback really means – what their contributions are and how they can change them. This could be done through many different strategies, including signage or awareness talks. As the theory of planned behavior indicated, providing residents with the information about the problem and how to change it will be key in motivating actual behavior change.

The last part of occupant empowerment is feedback management, which requires providing an avenue for occupants to report building-related energy or water inefficiencies, giving residents a feeling of control over factors that may impede behavior changes. This produces a greater feeling of control over behavior and, according the theory of planned behavior, a greater likelihood for behavior change. Finally, the performance element of the credit requires the project to track and

[73] Fischer, Corinna. "Feedback on Household Electricity Consumption: a Tool for Saving Energy?" *Energy Efficiency* 1, no. 1 (February 1, 2008): 79–104. doi:10.1007/s12053-008-9009-7.

document how the occupant engagement initiative performed in comparison to its goals, and share areas for improvement.[74]

This proposed credit includes many aspects of my recommendations: feedback, awareness, and continued education (signage in the Pomona College case study). These strategies are some of the most important factors of motivating behavior change, but the credit fails to require some specific necessary actions. There is nothing included in the credit about signage. Signage is not the only educational strategy, but it is a vital one. On the most basic level signage provides the information to residents necessary to making the building function as sustainably as possible. Signage is powerful because it is consistently visible and can be an immediate prompt close to the green features. Signs that provide information on how to change behavior also enhance the effectiveness of feedback.[75] This proposed occupant engagement credit could be improved by including a more specific requirement about signage as a necessary part of education in the building.

The Pomona College case study shows that just including feedback and signage is not enough – it must be done in the right way. Acknowledging that each project will be different, the credit should require that each project propose a specific plan for feedback and signage that incorporates the most effective strategies for its situation. The wording of the required continued education plan is vague and makes no reference directly to signage or employing specific best practices. Some strategies are universal enough that they could be incorporated into most all projects: signage should be designed to utilize social norms, and placed in the most visible and relevant locations. Feedback should also be as visible and publicized as possible (perhaps using a phone application, social media connections, or placing public screens in the most visible place). These are lessons learned from the shortcomings of the occupant engagement efforts at Pomona College, and should be incorporated into the credit to facilitate more successful implementation in future projects.

[74] "Occupant Engagement | U.S. Green Building Council." Accessed November 14, 2013. http://www.usgbc.org/node/2606886?return=/pilotcredits.
[75] Fischer, Corinna. "Feedback on Household Electricity Consumption: a Tool for Saving Energy?" *Energy Efficiency* 1, no. 1 (February 1, 2008): 79–104. doi:10.1007/s12053-008-9009-7.

Despite its shortcomings, LEED has taken an important step towards including an occupant engagement by allowing this as a pilot credit. The hope is that through testing and trial it will be approved to be a credit in the next version of LEED following v4. LEED is incomplete and misses a huge opportunity to make significant changes in building resource consumption and sustainability culture without this component. In order to be a true leader, LEED must engage its buildings' occupants. It has the opportunity to use human behavior as a powerful tool for reducing resource consumption within buildings and overall human impact. Given the amount of time we spend indoors, and the amount of energy buildings consume, green buildings must be an integral component in lowering human environmental impact. To have green buildings we must have green occupants. In the end, buildings don't use energy, people do.[76]

[76] Janda, Kathryn B. "Buildings Don't Use Energy: People Do." *Architectural Science Review* 54, no. 1 (2011): 15–22. doi:10.3763/asre.2009.0050.

# Works Cited


"About | U.S. Green Building Council." 2013. Accessed September 25. http://www.usgbc.org/about.

Ajzen, Icek. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50, no. 2 (1991): 179–211.

"Annual Sustainability Report 2012-2013." 2013. Pomona College.

Arocha, Jade S., and Laura MJ McCann. 2013. "Behavioral Economics and the Design of a Dual-flush Toilet." *Journal of the American Water Research Association* 105 (2). http://www.energy.ca.gov/appliances/2013rulemaking/documents/responses/Water_Appliances_12-AAER-2C/Behavioral_Economics_and_the_Design_of_a_Dual-Flush_Toilet_2013-06-03_TN-71105.pdf.

"Building Occupant Feedback Systems & Plug Loads: Opportunities & Results." 2013. *Scribd*. Accessed November 15. http://www.scribd.com/doc/55037103/Building-Occupant-Feedback-Systems-Plug-Loads-Opportunities-Results.

"Building-level Energy Metering | U.S. Green Building Council." 2013. Accessed November 14. http://www.usgbc.org/node/2613018?return=/credits/new-construction/v4.

"Buildings Energy Data Book." 2013. Accessed October 4. http://buildingsdatabook.eren.doe.gov/ChapterIntro1.aspx.

"CA-CHPS Criteria for New Construction and Major Modernizations | CHPS.net." 2013. Accessed October 2. http://www.chps.net/dev/Drupal/node/32.

"College Quarterly - Articles - Impact of Online Social Network on American College Students' Reading Practices." 2013. Accessed December 11. http://www.collegequarterly.ca/2013-vol16-num01-winter/huang-capps.html.

"Current LEED Version | U.S. Green Building Council." 2013. Accessed September 25. http://www.usgbc.org/about/leed/current-version.

Darby, Sarah. 2006. "The Effectiveness of Feedback on Energy Consumption." *A Review for DEFRA of the Literature on Metering, Billing and Direct Displays* 486: 2006.

"Demand Response | U.S. Green Building Council." 2013. Accessed November 14. http://www.usgbc.org/node/2613001?return=/credits/new-construction/v4.

"DOE-2 Simulation Output & Input Summary Reports." 2009.

Faruqui, Ahmad, Sanem Sergici, and Ahmed Sharif. 2010. “The Impact of Informational Feedback on Energy consumption—A Survey of the Experimental Evidence.” *Energy* 35 (4): 1598–1608.

Festinger, Leon. 1954. “A Theory of Social Comparison Processes.” *Human Relations* 7 (2): 117–140.

Fischer, Corinna. 2008. “Feedback on Household Electricity Consumption: a Tool for Saving Energy?” *Energy Efficiency* 1 (1) (February 1): 79–104. doi:10.1007/s12053-008-9009-7.

Gill, Zachary M., Michael J. Tierney, Ian M. Pegg, and Neil Allan. 2011. “Measured Energy and Water Performance of an Aspiring Low Energy/carbon Affordable Housing Site in the UK.” *Energy and Buildings* 43 (1): 117–125.

Goldstein, Noah J., Robert B. Cialdini, and Vladas Griskevicius. 2008. “A Room with a Viewpoint: Using Social Norms to Motivate Environmental Conservation in Hotels.” *Journal of Consumer Research* 35 (3): 472–482.

“Green Building Features: North Campus Residence Hall Project - Pomona College.” 2013. Accessed October 12. http://www.pomona.edu/administration/sustainability/initiatives/facilities/ncrh.aspx.

“Green Building Standards - Pomona College.” 2013. Accessed October 4. http://www.pomona.edu/administration/sustainability/policies-procedures/green-building.aspx.

“History | U.S. Green Building Council.” 2013. Accessed September 25. http://www.usgbc.org/about/history.

“In U.S. Building Industry, Is It Too Easy to Be Green?” 2013. Accessed December 4. http://www.usatoday.com/story/news/nation/2012/10/24/green-building-leed-certification/1650517/.

“Innovation in Design | U.S. Green Building Council.” 2013. Accessed October 4. http://www.usgbc.org/node/1732608?return=/credits/new-construction/v2009/innovation.

Janda, Kathryn B. 2011. “Buildings Don’t Use Energy: People Do.” *Architectural Science Review* 54 (1): 15–22. doi:10.3763/asre.2009.0050.

Kempton, Willett, and Linda L. Layne. 1994. “The Consumer’s Energy Analysis Environment.” *Energy Policy* 22 (10): 857–866.

"LEED | U.S. Green Building Council." 2013. Accessed September 25. http://www.usgbc.org/leed.

"LEED Credit Library | U.S. Green Building Council." 2013. Accessed October 4. http://www.usgbc.org/credits/new-construction/v2009.

"LEED for New Construction V2009 - Current Version | U.S. Green Building Council." 2013. Accessed December 10. http://www.usgbc.org/resources/leed-new-construction-v2009-current-version.

"LEED Green Building Program Remains Preferred Rating System for Use in Federal Buildings | U.S. Green Building Council." 2013. Accessed December 4. http://www.usgbc.org/articles/leed-green-building-program-remains-preferred-rating-system-use-federal-buildings.

"Low Carbon Buildings - Carbon Trust." 2013. Accessed October 4. http://www.carbontrust.com/resources/guides/energy-efficiency/low-carbon-buildings-design-and-construction.

Morley, Janine, and Michael Hazas. 2011. "The Significance of Difference: Understanding Variation in Household Energy Consumption." *ECEEE Proceedings of the 2011 Summer Study*. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.225.7551&rep=rep1&type=pdf.

Murthy Balijepalli, V. S. K., Vedanta Pradhan, S. A. Khaparde, and R. M. Shereef. 2011. "Review of Demand Response Under Smart Grid Paradigm." In *Innovative Smart Grid Technologies-India (ISGT India), 2011 IEEE PES*, 236–243. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6145388.

"New Construction | U.S. Green Building Council." 2013. Accessed September 25. http://www.usgbc.org/leed/rating-systems/new-construction.

"New Report: 4.3 Million People Live and Work in LEED-certified Buildings | U.S. Green Building Council." 2013. Accessed December 4. http://www.usgbc.org/articles/new-report-43-million-people-live-and-work-leed-certified-buildings.

"New-dorm-1-large.jpg (500×375)." 2013. Accessed November 2. http://pomona.edu/news/2009/10/images/new-dorm-1-large.jpg.

"Occupant Engagement | U.S. Green Building Council." 2013a. Accessed November 14. http://www.usgbc.org/node/2606886?return=/pilotcredits.

Petersen, John E., Vladislav Shunturov, Kathryn Janda, Gavin Platt, and Kate Weinberger. 2007. “Dormitory Residents Reduce Electricity Consumption When Exposed to Real-time Visual Feedback and Incentives.” *International Journal of Sustainability in Higher Education* 8 (1) (January 16): 16–33. doi:10.1108/14676370710717562.

“Pomona College Celebrates Opening of Two of the Nation’s Greenest Residence Halls - Pomona College.” 2013. Accessed October 4. http://www.pomona.edu/news/2011/09/21-residence-hall-opening.aspx.

“Report to Congress on Indoor Air Quality.” 1989. Volume 2. EPA/400/1-89/001C. Washington, DC: U.S. Environmental Protection Agency.

“Residence Hall Maps - Pomona College.” 2013. Accessed November 14. http://www.pomona.edu/administration/campus-life/room-draw/room-maps.aspx.

“Residential Energy Consumption Survey (RECS) - Analysis & Projections - U.S. Energy Information Administration (EIA).” 2013. Accessed October 3. http://www.eia.gov/consumption/residential/reports/2009/consumption-down.cfm?src=%E2%80%B9%20Consumption%20%20%20%20%20%20Residential%20Energy%20Consumption%20Survey%20(RECS)-f3.

“Save Energy at Home : ENERGY STAR.” 2013. Accessed October 30. http://www.energystar.gov/index.cfm?c=products.pr_save_energy_at_home&s=mega.

Schipper, L, S Bartlett, D Hawk, and E Vine. 1989. “Linking Life-Styles and Energy Use: A Matter of Time?” *Annual Review of Energy* 14 (1): 273–320. doi:10.1146/annurev.eg.14.110189.001421.

Seligman, Clive, and John M. Darley. 1977. “Feedback as a Means of Decreasing Residential Energy Consumption.” *Journal of Applied Psychology* 62 (4): 363.

Sonderegger, Robert C. 1978. “Movers and Stayers: The Resident’s Contribution to Variation Across Houses in Energy Consumption for Space Heating.” *Energy and Buildings* 1 (3): 313–324.

Sussman, Reuven, and Robert Gifford. 2012. “Please Turn Off the Lights: The Effectiveness of Visual Prompts.” *Applied Ergonomics* 43 (3) (May): 596–603. doi:10.1016/j.apergo.2011.09.008.

“Table 2.5 Household Energy Consumption and Expenditures by End Use, Selected Years, 1978-2005.” 2013. Accessed October 4. http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0205.

"The School as a Teaching Tool | U.S. Green Building Council." 2013. Accessed October 2. http://www.usgbc.org/node/1732601?return=/credits/schools---new-construction/v2009/innovation.

"TINAs: Energy Efficiency Innovation in Buildings, Homes and Industry - Carbon Trust." 2013. Accessed October 4. http://www.carbontrust.com/resources/reports/technology/tinas-energy-efficiency.

"'Vampire' Appliances -- They Suck Electricity Even When Switched Off -- Cost Consumers $3 Billion a Year, Says Cornell Energy Expert | Cornell Chronicle." 2013. Accessed October 30. http://www.news.cornell.edu/stories/2002/09/vampire-appliances-cost-consumers-3-billion-year.

# Appendix 1: Pomona/Sontag's Final LEED Checklist

0010357242, Claremont, CA

## Sontag & Pomona Hall

**LEED for New Construction and Major Renovations (v2.2)** — **PLATINUM, AWARDED OCT 2011**

### SUSTAINABLE SITES — AWARDED: 10 / 14

| | | |
|---|---|---|
| SSc1 | Site selection | 1 / 1 |
| SSc2 | Development density and community connectivity | 1 / 1 |
| SSc3 | Brownfield redevelopment | 0 / 1 |
| SSc4.1 | Alternative transportation - public transportation access | 0 / 1 |
| SSc4.2 | Alternative transportation - bicycle storage and changing rooms | 1 / 1 |
| SSc4.3 | Alternative transportation - low emitting and fuel efficient vehicles | 1 / 1 |
| SSc4.4 | Alternative transportation - parking capacity | 1 / 1 |
| SSc5.1 | Site development - protect or restore habitat | 0 / 1 |
| SSc5.2 | Site development - maximize open space | 1 / 1 |
| SSc6.1 | Stormwater design - quantity control | 1 / 1 |
| SSc6.2 | Stormwater design - quality control | 1 / 1 |
| SSc7.1 | Heat island effect - non-roof | 1 / 1 |
| SSc7.2 | Heat island effect - roof | 1 / 1 |
| SSc8 | Light pollution reduction | 0 / 1 |

### WATER EFFICIENCY — AWARDED: 3 / 5

| | | |
|---|---|---|
| WEc1.1 | Water efficient landscaping - reduce by 50% | 1 / 1 |
| WEc1.2 | Water efficient landscaping - no potable water use or no irrigation | 0 / 1 |
| WEc2 | Innovative wastewater technologies | 0 / 1 |
| WEc3.1 | Water use reduction - 20% reduction | 1 / 1 |
| WEc3.2 | Water use reduction - 30% reduction | 1 / 1 |

### ENERGY & ATMOSPHERE — AWARDED: 16 / 17

| | | |
|---|---|---|
| EAc1 | Optimize energy performance | 10 / 10 |
| EAc2 | On-site renewable energy | 3 / 3 |
| EAc3 | Enhanced commissioning | 1 / 1 |
| EAc4 | Enhanced refrigerant Mgmt | 1 / 1 |
| EAc5 | Measurement and verification | 1 / 1 |
| EAc6 | Green power | 0 / 1 |

### MATERIAL & RESOURCES — AWARDED: 6 / 13

| | | |
|---|---|---|
| MRc1.1 | Building reuse - maintain 75% of existing walls, floors & roof | 0 / 1 |
| MRc1.2 | Building reuse - maintain 95% of existing walls, floors & roof | 0 / 1 |
| MRc1.3 | Building reuse - maintain 50% of interior non-structural elements | 0 / 1 |
| MRc2.1 | Construction waste Mgmt - divert 50% from disposal | 1 / 1 |
| MRc2.2 | Construction waste Mgmt - divert 75% from disposal | 1 / 1 |
| MRc3.1 | Materials reuse - 5% | 0 / 1 |

### MATERIAL & RESOURCES — CONTINUED

| | | |
|---|---|---|
| MRc3.2 | Materials reuse - 10% | 0 / 1 |
| MRc4.1 | Recycled content - 10% (post-consumer + 1/2 pre-consumer) | 1 / 1 |
| MRc4.2 | Recycled content - 20% (post-consumer + 1/2 pre-consumer) | 0 / 1 |
| MRc5.1 | Regional materials - 10% extracted, processed and manufactured regionally | 1 / 1 |
| MRc5.2 | Regional materials - 20% extracted, processed and manufactured regionally | 1 / 1 |
| MRc6 | Rapidly renewable materials | 0 / 1 |
| MRc7 | Certified wood | 1 / 1 |

### INDOOR ENVIRONMENTAL QUALITY — AWARDED: 13 / 15

| | | |
|---|---|---|
| EQc1 | Outdoor air delivery monitoring | 0 / 1 |
| EQc2 | Increased ventilation | 0 / 1 |
| EQc3.1 | Construction IAQ Mgmt plan - during construction | 1 / 1 |
| EQc3.2 | Construction IAQ Mgmt plan - before occupancy | 1 / 1 |
| EQc4.1 | Low-emitting materials - adhesives and sealants | 1 / 1 |
| EQc4.2 | Low-emitting materials - paints and coatings | 1 / 1 |
| EQc4.3 | Low-emitting materials - carpet systems | 1 / 1 |
| EQc4.4 | Low-emitting materials - composite wood and agrifiber products | 1 / 1 |
| EQc5 | Indoor chemical and pollutant source control | 1 / 1 |
| EQc6.1 | Controllability of systems - lighting | 1 / 1 |
| EQc6.2 | Controllability of systems - thermal comfort | 1 / 1 |
| EQc7.1 | Thermal comfort - design | 1 / 1 |
| EQc7.2 | Thermal comfort - verification | 1 / 1 |
| EQc8.1 | Daylight and views - daylight 75% of spaces | 1 / 1 |
| EQc8.2 | Daylight and views - views for 90% of spaces | 1 / 1 |

### INNOVATION — AWARDED: 5 / 5

| | | |
|---|---|---|
| IDc1 | Innovation in design | 4 / 4 |
| IDc2 | LEED Accredited Professional | 1 / 1 |

**TOTAL** — **53 / 69**

## Appendix 2: Image of full dorm sign

# Appendix 3: Pomona/Sontag Resident Survey

### New Dorms Thesis Survey

Please fill out as many questions as you can. If the open boxes scare you, feel free to skip them (although I would greatly appreciate your responses).

**Which dorm do you live in?**

- Pomona Hall
- Sontag Hall

**What do you like about living in the new dorms? Do you think they are well designed?**
Feel Free to list or bullet point this answer.

**What could be improved?**
Again, feel free to list or bullet point.

| | Significantly less | A little less | About the same | A little more | Significantly more |
|---|---|---|---|---|---|
| How much energy do you think you personally consume compared to past years? | | | | | |
| How much energy do you think your dorm consumes compared to other dorms on campus? | | | | | |

| | Strongly Disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| I live in an environmentally "green" building | | | | | |
| My behavior doesn't really affect how much energy is used in the new dorms | | | | | |
| I am in control of how much energy my building consumes | | | | | |
| The college is in control of how much energy my building consumes | | | | | |
| I have read the signs (informative plaques about environmental features) in my suite | | | | | |
| The signs are informative | | | | | |
| I changed my behavior because of a sign in my suite | | | | | |

**How do you think the signs could be improved?**

- More descriptive
- Simpler
- Smaller
- Larger
- Placed in different locations
- More images
- Other: _____

**What green features of your building do you know about?**

| | Know it | News to me |
|---|---|---|
| Adjustable heat and air conditioning | | |
| Switch to turn power to outlets off | | |
| Design to utilize natural lighting | | |
| Energy star fridge cutting out the need for personal fridges | | |
| Laundry drying racks in laundry room | | |
| Dual flush toilets | | |
| Low flow toilets, showers and sinks | | |
| Trash and recycling room on each floor | | |
| Edible landscaping | | |

**If real time information was available to you about how much energy your building uses, would you look at it?**

- Yes
- Maybe
- No

**In what form would you be most likely to look at the information?**

- **Online**
- A public screen in the lobby or kitchen of the building
- On your phone
- Other: _____

**If the energy information was displayed on a screen, where would you be most likely to look at it?**

- Lobby
- Kitchen
- Hallway
- Other: _____

**Were you aware that this information is available to you?**

- Yes
- Maybe
- No

**How many appliances do you have?**

*Excluding the provided fridge and microwave. Include things like TVs, personal fridges, etc.*

- 0
- 1 – 2
- 3 – 4
- More than 4

**How do you think the sustainability of your suite could be improved?**

*List any features you think inhibit sustainability, or features that could be added to make it easier to be environmental*

**Any other complaints or compliments?**

# Appendix 4: Proposed Occupant Engagement Credit

## Requirements

**Establishment**

**Consumption feedback**

Implement one or more modes of communication to inform occupants about the actual energy consumption of the building and/or their workspace. This may be done in real-time, or through regular reporting mechanisms, but must be communicated at least on a monthly basis. Occupants must be given information with a relevant comparison point; the comparison point(s) may either be comparable buildings or spaces, or historical energy consumption data for the same space (at least 1 years worth of data, or predicted usage if 1 years data is not yet available).

**Occupant empowerment**

Implement and maintain an occupant engagement program that involves communicating with, enabling and empowering building occupants to help meet the sustainability goals for the building. The occupant engagement initiative(s) must include the following minimum requirements:

1. Education – provide accurate, up-to-date, and catered information to building occupants about what their largest impacts are on the energy use of the building and where the largest areas for potential savings exist. This may be achieved through a one-time event like a competition or awareness week or month, but also must include some permanent educational components, which must be updated to account for any seasonal variations in energy consumption and building performance.
2. Enabling – occupants must be made aware of specific actions they can take to improve the performance of the building, not just the impacts they have on resource use in their building
3. Feedback to management – occupants must be provided a clear avenue for reporting building-related energy or water inefficiencies to building management

Establish performance goals and develop a way to effectively track the success of the program.

The engagement program must also address more than one building system: lighting, HVAC, plug loads. If occupants do not have direct control over lighting and/or central HVAC systems, alternative methods and strategies that support energy conservation for these systems are acceptable (e.g., window shade control and use).

The engagement program must not encourage behaviors that significantly affect the productivity of occupants or their comfort, such as lighting quality and thermal comfort.

**Performance**

Track and document the results of the occupant engagement initiative(s) against the established performance goals and identify areas for improvement. These results must be recorded on a regular basis and summarized for the performance period.

# Appendix 5: Survey Results

| Which dorm do you live in? | |
|---|---|
| Pomona Hall | 25 |
| Sontag Hall | 16 |

| | Significantly less (%) | A little less (%) | About the same (%) | A little more (%) | Significantly more (%) |
|---|---|---|---|---|---|
| How much energy do you think you personally consume compared to past years? | 7.31 | 43.9 | 39.02 | 9.76 | 0 |
| How much energy do you think your dorm consumes compared to other dorms on campus? | 14.63 | 60.98 | 9.76 | 12.2 | 2.44 |

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I live in an environmentally "green" building | 17.07 | 56.10 | 21.95 | 0 | 0 |
| My behavior doesn't really affect how much energy is used in the new dorms. | 2.44 | 2.44 | 4.88 | 63.41 | 21.95 |
| I am in control of how much energy my building consumes. | 2.44 | 24.39 | 31.71 | 36.59 | 0 |
| The college is in control of how much energy my building consumes | 2.44 | 51.22 | 21.95 | 19.51 | 0 |

| | Strongly Agree (%) | Agree (%) | Neither agree nor disagree (%) | Disagree (%) | Strongly disagree (%) |
|---|---|---|---|---|---|
| I have read the signs in my suite | 19.5 | 58.5 | 9.8 | 7.3 | 4.9 |
| The signs are informative | 7.3 | 58.5 | 26.8 | 4.9 | 2.4 |
| I have changed my behavior because of a sign in my suite | 0.0 | 14.6 | 19.5 | 41.5 | 24.4 |

| | Know it (%) | News to me(%) |
|---|---|---|
| Adjustable climate controls | 85.37 | 14.63 |
| Switch to turn off power to outlets | 97.56 | 2.44 |
| Design to utilize natural lighting | 53.66 | 46.34 |
| Shared energy star fridge | 85.37 | 14.63 |
| Drying racks in laundry room | 85.37 | 14.63 |
| Dual flush toilets | 97.56 | 2.44 |
| Low flow toilets, showers, and sinks | 48.78 | 51.22 |
| Trash/recycling room on each floor | 95.12 | 4.88 |
| Edible Landscaping | 39.02 | 60.98 |

| | Yes (%) | Maybe (%) | No (%) |
|---|---|---|---|
| If real time information was available to you about how much energy your building uses, would you look at it? | 39.02 | 53.66 | 7.32 |
| Were you aware that this information is available to you? | 48.78 | 17.07 | 34.15 |

**In what form would you be most likely to look at the information?**

| Online (%) | A public screen in the lobby or kitchen of the building (%) | On your phone (%) | Other (%) |
|---|---|---|---|
| 26.83 | 46.34 | 21.95 | 4.88 |

**If the energy information was displayed on a screen, where would you be most likely to look at it?**

| Lobby (%) | Kitchen (%) | Hallway (%) | Other (%) |
|---|---|---|---|
| 24.39 | 9.76 | 63.41 | 2.44 |

**How many personal appliances do you have?**

| 0 (%) | 1 to 2 (%) | 3 to 4 (%) | More than 4 (%) |
|---|---|---|---|
| 26.83 | 43.90 | 12.20 | 12.20 |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| - Really nice buildings in general, especially for college dorms<br>- The weird concrete columns in every room are kind of inconvenient | - The air conditioning/heating system is kind of inconsistent (I can't figure out how to turn the air conditioning on/off without opening the windows, sometimes it's freezing, sometimes it's really hot, etc.)<br>- The toilets flush kind of violently (they're really loud and it seems unnecessary) | - The dual flush toilets don't seem to be working right<br>- I think the air conditioning system could be improved<br>- The motion-sensitive light in the hallway doesn't seem to ever turn off | |
| Things I like:<br>-Kitchens on every floor<br>-Suites<br>-Windows<br>-Location<br>-Parking<br><br>I think overall they are well designed, but it seems like a few elements were poorly chosen. e.g. floors that don't hold up very well, doors that don't work, water pooling on the bathroom floors | More resilient floors in suites. Better designed bathrooms, doors that work. Fewer swipes. | TV/Xbox left on a lot. Lights left on a lot. Probably could use less water. Two mini-fridges in addition to main fridge. | |
| Yes, I really like that the AC is regulated based on whether the windows are open, smart! It is also quite nice to have fridge available. The common rooms are generally a well-designed space as are the individual ones (at least mine is). I really love the kitchens--they are very useful and offer a lot. | There are some things like halfway light that seem inefficient--the hallway light in our suite never turns off. This may be because the motion-sensor is broken, but it seems silly to always have that light on. Also some of the columns in rooms/common room seem bulky for the generally light and airy design. | Previously mentioned lighting in suites; potentially place an informative plaque in bathroom (especially about dual flush toilets), I think often people ignore that feature (does it really make a difference?...the plaques could explain how) | Overall, really good place to live; feel a little less homey than some places but very very nice generally! |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I love the common areas and the nice kitchens and lounges. It's nice to have lots of space apart from your personal room. I also appreciate that the toilet, sinks, and showers are all separate. I'm not a design expert but I think they are well designed, apart from the face that the suites are considered common space causing RA's to swipe in. | The air conditioning should automatically turn off when windows are open. | We have many string lights and appliances, although we only have the appliances on when we need to use them. Sometimes people leave lights turned on when they don't need to be. | |
| Lounges are awesome.<br><br>Having a full size fridge is great.<br><br>Not having twin beds is fantastic.<br><br>Lounges are still awesome. | Too many doors to swipe into/have to open to get into my room (and the stairway ones are ridiculously heavy).<br><br>The poles in the rooms are awkward.<br><br>The blinds don't do anything to keep sunlight out. | | |
| pretty rooms, really nice kitchens and lounges, nice fountain, relative cool when it gets hot | echo-y vents, also if anyone smokes you can smell weed in every room | | |
| I like the suite aspect and I like having a large common room. I love the high ceilings and the amount of plugs in each room. I love the full size bed and the dark wood. I love how close I am to so many nice kitchens and also super close to Collins and classes at other schools. | Lots of people say they want less swiping to get to their room but I don't think that's a huge deal. More bulletin boards in the rooms and common room would be nice. | We could use our energy switches in our rooms more. | I look at the screen in the lobby all the time and play around with its different features. Constantly, Sontag comes up as using considerably more energy and resources than Pomona. I can't figure out any reasons why this should be. It's such a large difference that it can't just be about individual usage. Why!!! |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| -soundproofing in rooms<br>-suite style setup<br>-comes with fridge and microwave | -space could be used more efficiently | -compost in the trash rooms<br>-less wasted space | |
| It's quite nice, there's AC and a common room space which means we have a fridge and microwave included.<br><br>I like how the parking lot is also extremely close to us. | It'd be nice if we can actually adjust the AC. Most of the time, it's the designated temperature of 76F or off. | | |
| I love living in a suite. Having my own room is a blessing but I am so close to my best friends and it is wonderful to have a shared space that no one else has access to. It makes me much happier to come home to at night than where I was living last semester in Walker (2nd floor).<br><br>After realizing this is an energy survey - I also like a lot of the designs such as the lighting situation, I get tons of light in my room but not too much heat which is great! | I wish there were more of a community in the new dorms. Because of the layout, it is rare to see other residents which can make the dorm feel very closed off. This is especially true during the week when parties are not in abundance.<br><br>In reference to energy - I know too many people who take advantage of the elevator instead of using the stairs. I like that it is there, especially when we moved in, but it frustrates me every time I see people taking the elevator two flights of stairs. No suggestions for improvements on that one, unfortunately. | I love that we have our own shared refrigerator, though I've never owned my own anyway. I don't know why we have multiple sinks though, that seems pretty unnecessary to me.<br><br>The lighting is not quite bright enough in the overhead fan/lamps which means that I am using a second lamp in my room, which adds more energy usage to the room whenever I'm studying in there at night. (Which is often.)<br><br>It doesn't seem to me like we need so many trash cans and recycling bins. Our group bins are pretty unused, so we were essentially a waste of plastic, both the bin itself as well as the replacement bag every time housekeeping changes it when there's one or two items in each bin rather than it being full. Could suites check out bins in the case of a party or something rather than having them in their suites all the time? | If you really want to encourage people to use drying racks, the use of the drying machine in the laundry room ought to cost much more than $0.50. Just saying.<br><br>Also, kitchens should have their own compost buckets. |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| Full Bed<br>Single Rooms<br>AC<br>Fan<br>Big Closets<br>Common Room with fridge and microwave | | | |
| They're pretty and clean and the rooms are big. And the bathroom is nice. It's a pretty cool place. | The cement columns/walls are fug. And everything is orange. And it's freezing cold all the time. Overall it's super nice though. | I think that the fridge in the common room is too small to replace 6 mini fridges. A bigger one would be more effective because we still need to use a few of ours. | |
| -Love the fact that they are suites; yay common rooms!<br>-Nobody has to have a double<br>-Big fridge and microwave provided<br>-Control over temperature<br>-AC turns off when windows are open | -Toilets flush very loud/seem to use a lot of water. If which way you pull the "dual flush" actually makes a difference, it's news to me because it definitely doesn't seem to<br>-Curtains suck - they let in all the light, what's the point?<br>-A bigger sink for dishes, located in the suite itself, would be nice<br>-More accessible compost bins<br>-More windows on ALL floors, not just the top floor | -The common room lights often get left on all night and it's super frustrating! They should have an automatic shut-off feature, like the ones by the sinks do, because my suitemates are not as committed to saving energy as I am and that makes all the difference.<br>-Make it easier to open/close the blinds - they're annoying to operate because they often stick and are hard to use. If they worked better we'd be more likely to open them every morning and use natural light.<br>-Like I said earlier, toilets do not appear to be low-flow at all. And if they are, could they be MORE low-flow? They definitely use a lot of water.<br>-Why does only the top floor have lots of windows? More windows for bottom floors! More natural light! | -Not sustainability related, but why are some of the entrance doors always locked? (only 1 of the 2 doors lets you pull it open?)<br>-Good job on low lighting in the hallways!!<br>-Also good job not over-air conditioning the building, or letting individual rooms turn their air conditioning up too much :) |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I like living in the new dorms, and they are mostly very comfortable (I love the suite arrangement with the private common room), as well as aesthetically quite nice.<br>However, there are a few rather frustrating specific design flaws. | - I hate all the internal doors that you have to swipe to unlock, mostly coming out of the stairwells. They're also really really heavy/hard to open, and combined it's just a hassle, especially when I'm carrying something<br>- The climate controls are very confusing, and I can't figure out any way to turn them off except by opening a window<br>- The showers need soap dishes<br>- There is a concrete pillar in the common room that leaves a completely inaccessible gap behind it - if something falls down there it's impossible to retrieve, and there's no barrier between the gap and the counter to keep things from falling<br>- More counter space and cupboard space in the kitchenette in the common room would be very useful | The AC / heat controls are too confusing | Maria from housekeeping is amazing :) |
| - Common room<br>- Provided furniture/microwave/fridge<br>- Bathrooms<br>- Full size beds<br>- Outdoor space<br>- Air conditioning | - The rooms could be bigger<br>- More storage<br>- Air conditioning could be easier to operate | - More recycling by members<br>- Lower use of red cups<br>- Reducing phantom load by unplugging appliances<br>- Turning off lights when not in use | |
| 6 people in one suite | why are there huge cement pillars in most of the rooms? messes up the aesthetics | | |
| Comfortable<br>AC<br>Common room<br>Nice view | The use of mainly recycled materials is nice, but is highly susceptible to wear and tear | Turn off lights<br>take shorter showers<br>minimize ac usage<br>close windows | n/a |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| Things I like:<br>-Common space<br>-Fairly quiet<br>-Easy access to nice kitchens<br>-Rooftop garden<br><br>Overall, the design is nice, yes! | The dorms feel more hotel-like than home-like an there is very little (essentially no) hall or building community. I think more common spaces and accessibility of rooms would help with the community feel. | -Our dual flush toilet doesn't work--it only works on the higher water use setting (and I think this is pretty common).<br>-Encouraging use of room power switches (maybe having two non-switched outlets in each room instead of one?)<br>-Thermometer for outdoor temperature to make it easier to see when opening the windows would be more effective than the A/C | |
| -Full beds<br>-Common room with large fridge<br>-More sustainable<br>-Roomy rooms<br>-Climate control | Not a very "cozy" feeling - don't really like the concrete exposure. Doesn't really feel like a bedroom.<br><br>Less community feel with people who live in other suites<br><br>The bathroom lights are extremely dim until I finish going to the bathroom.<br><br>Also, I don't think our dual flush toilet works - it always flushes really strongly. | Lose the extra minifridge, if everyone used their power switches... | My room light is pretty dim for awhile, so I usually turn on an extra lamp as well, contributing to my energy use |
| '+ New, clean space<br>+ Big beds<br>+ Good common areas<br>+ Localized group of friends<br>- Heating and cooling is not perfect<br>- Doors are unnecessarily heavy<br>- No history/culture | '+ Doors | | |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I like the autonomy of the suite design; my suitemates and I can feel at times that we're in our own apartment.<br><br>I like the number of kitchens. Whereas the other dorms' kitchen setup leads to more conflict with other residents, having one kitchen per floor here allows us to feel that we're welcome in a public space while still giving us plenty of room to establish our own private space if we so choose. | The interior artwork makes me feel like I'm in a cheap hotel.<br><br>The power switch to turn off electrical outlets is poorly conceived. There is only one outlet that it doesn't affect, and that outlet is not conveniently located for my clock. If I want to keep a clock in my room (which I use as an alarm in the mornings, so it's kind of important), I can't turn off electrical outlets from the switch. What I really need is outlets that I can choose to be connected or not be connected to the switch. Then the room would be responsive to actual user requirements. | The windows let in quite a bit of light (perhaps more than in other suites, since we're on the top floor), but they're not as effective as they could be because the screens act as a shade. Because our screens cannot be removed, we're left with sub-par natural illumination.<br><br>I think the rooftop garden could be better integrated into the living experience. It's there, and maybe there's stuff growing there, but I wouldn't know.<br><br>Same goes for the edible landscape. Sure, we've got pomegranates right outside, but I bet half of the dorm never notices them. There might even be other foods that I haven't noticed. | |
| I like being able to turn off the power and AC/Heating in my room.<br>I love all the windows<br>I think that the space is both aesthetically pleasing and functional<br>The furniture is nice<br>This is the biggest bed I've ever slept in<br>The rooms are a nice size<br>I like that it's not carpet<br>Yay big fridge!<br>Yay window screens that open!<br>Yay high ceilings! | Uhhhhh. | | I love the new dorms. It's the nicest place I've ever lived. |
| Suite-style living arrangements - the common rooms are really nice for hanging out and stuff. Communal fridge was a good idea. Power switches are great too. | what's with the insanely heavy doors to the stairwells? Do we really need to swipe to get into hallways? | People turning off the lights/not turning them on as much and using natural light | why did lawry get those nifty tap-card-readers and we're still stuck with the lowly swipe-card-readers to get into our suites? |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I should really like being in the new dorms, but I don't think they are well designed. My room is a good size, however, and I don't have to share a bathroom/shower with too many people. I really enjoy the microwave and fridge in every suite. | Why is the bed frame so big that I can't move it around? And it blocks my non-switched outlet. How do you use the thermostat? No one that I know is able to get theirs to work. Why do I have controllable AC that I can't control? Why are the doors so heavy? They move too slowly to open and too quickly when they close. Only the first levels are handicap accessible, so it's a struggle to open the doors on the upper levels. Why do I have to swipe in so many times? Swipe into the building, then into the hall, then into the suite. I don't think it's a deterrent, just an annoyance. Why aren't the card readers tap-able? When your hands are full, it's a hassle to swipe once, then get hit by the heavy-ass door while you're trying to lug your stuff in, then swipe a second and third time. Weren't the new dorms built around the time everywhere else moved to the tap-able readers? So why aren't the new dorms tap-able? | | |
| -I have my own room<br>-There's lots of space<br>-We have a common room<br>-We have a large fridge/freezer as well as microwave<br>-Could be designed better - there are random corners that could be eliminated or better utilized<br>-The ceilings are also unnecessarily high | -They could have built shelfs into the walls to utilize the high ceelings | -we coordinate so that there's only 1 coffee maker in the suite | |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I love the beds<br>I like the fan<br>Great furniture and stuff in the common room | I wish the windows actually kept out the cold<br>Walls are super thin | Actual dual-flush toilet and actually adjustable heat in the rooms (my thermostat does not let me control anything) | |
| Full-sized beds are great for smangin | The concrete poles and the floors both look like shit, for different reasons | We're pretty good | Keep on keepin on ;) |
| Large windows in room<br>Common Area<br>Personal Space (i.e., single room)<br>Fridge and microwave are a nice touch<br>A/C<br>Overall good design | Wish there was cork board on all walls (both to hang stuff and muffle sound) | Lights in room are way too dim. I have to use several more lamps/lights to provide enough light to work at night. | no |
| -big beds<br>-apartment style living<br>-AC/heat<br>-common room (fridge and microwave)<br>-projector<br>-rooftop gardens<br>-outdoor classroom | -doors are wayyy too heavy! It makes no sense<br>-sometimes I wish I could control the climate myself i get cold/hot very easily<br>-noise (swiping sounds are annoying and loud) | turn off lights when we leave | |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | (n/a) |
|---|---|---|---|
| -Love the number of windows, dislike the shades (they let the light through completely... darker, thicker shades should have been added)<br><br>-Love the common space for the suite. I slightly miss the culture of propping open your door so that when people pass by in the hallway they can just pop in, but there are so few suites on each hall in the new dorms... even if we did prop open our common room doors while here, that culture still wouldn't exist. And that culture is probably more important for first and second years than it is for fourth years.<br><br>-Dislike the amount of swiping. I have to swipe three times to get to my room. Also the doors are heavy. I know this building is supposed to be accessible, but there are only autmoatic doors on the first floor, and the doors are way too heavy to be accessible if they're not automatic. Why build an elevator and have the hallways so wide if someone can't even get through the doors?<br><br>-The columns are a bit awkward, they cut up rooms into weird spaces, so that one almost always has an awkward corner. Also the side trays on the beds are also awkward and hard to deal with.<br><br>-I sort of wish there was some sort of covering for the closet... curtains or doors or something.<br><br>-It would have been nice if the A/C with windows open/closed thing could have been coordinated with doors being open/closed too, since someone can blast A/C in the common room while someone in their own room is letting in a ton of heat through the windows. | See previous question, I combined them. | shorter showers, if it's brown flush it down if it's yellow let it mellow, turning off lights more, being even more careful about temp control... these are all things WE could change. I guess it would have been helpful if there were lights that would automatically turn off in EVERY room. It would also be helpful if the "turn off all the plugs" switch turned of every plug except one, because i don't want to have to reset my alarm clock each time, so I never use that switch. Maybe some sort of waterproof digital clock in the shower that started every time the water started so you could see how long you've been in there... | nah |

| What do you like about living in the new dorms? Do you think they are well designed? | What could be improved? | How do you think the sustainability of your suite could be improved? | Any other complaints or compliments? |
|---|---|---|---|
| I think the new dorms are spacious and well designed. | 1. I think the layout of the rooms are in some cases suboptimal. For instance, a pillar juts out in my room creating dead space on either side.<br><br>2. The bathrooms are dimly lit. This is especially obvious in the showering room. | | |
| I like the common space and the fridge and the big beds and the ceiling and the air conditioning. | I wish the doors were a little more quite. Noise gets through the doors pretty easy, which is too bad because the wall are, for the most part, nice and thick. I absolutely HATE the window treatments. If you have an east facing room, the tissue paper that they've tried to pass off as a window treatment lets in SO MUCH SUNLIGHT. Terrible. | You mention that energy information is already available to students. However, I have never tried to use the touch screen TV in the lobby and had it actually work or provide me with any data. After a while, you just stop checking for data because there usually isn't any. | See above. Terrible window treatments. |
| I think the new dorms are well designed yet lack a certain feeling of "home" to them. Even so, I like living in them because it provides a private space where my roommates and I can share the living room in peace. | | | |
| | | I think our low flow toilets are not actually low flow. I think the motion sensors on the lights could be more energy efficient. I don't know how to solve this but the lights (the ones with switches) are frequently left on in the common room at night. | |