Quantifying the Greenhouse Gas Impacts of a Green Hotel Certification on the City of Los Angeles

UNIVERSITY OF CALIFORNIA
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As members of the StayGreen team, we hereby authenticate that we are the sole and original authors of this work. We are proud to archive this Final Report on the Bren School website and hereby agree to make our research and findings publically available. Our signatures on the document signify our joint responsibility in fulfilling the archiving standards set by the Bren School of Environmental Science & Management.

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The mission of the Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Group Project is required of all students in the Master of Environmental Science and Management (MESM) Program. The project is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Group Project Final Report is authored by MESM students and has been reviewed and approved by:

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Date

----Signature Page----

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Table of Contents

List of Figures

List of Tables

Abstract

Policies like Assembly Bill 32 and Senate Bill 32 are motivating California to dramatically reduce its statewide emissions to mitigate climate change impacts. In response, Los Angeles has created a Climate Action Plan as it strives to become a leader in green initiatives, setting the goal of reducing its greenhouse gas emissions 45% by 2025. As part of its Climate Action Plan goals, Los Angeles created a Green Lodging Program that helps hotels become more sustainable in their operations. Green Seal was recently named the official eco-certifier for Los Angeles hotels, and its Standard for Lodging Properties encourages hotels to reduce their carbon footprint by transforming their energy system, enhancing the resilience of their buildings, and integrating environmentally sustainable practices into their day-to-day activities. Despite having 49 certified hotels in the United States (with seven in the Los Angeles area), Green Seal currently does not have a method for quantifying the environmental savings directly associated with its hotel certification. This report addresses this knowledge gap by evaluating the greenhouse gas impacts of Green Seal's Standard for Lodging Properties on certified hotels as well as on the overall Los Angeles hospitality sector. Furthermore, this report presents a set of methodologies and tools that allow hotels interested in the certification to calculate the potential costs and benefits associated with required upgrades, and it recommends marketing strategies that could help Green Seal scale up the program in Los Angeles.

Executive Summary

The Intergovernmental Panel on Climate Change's Fifth Assessment Report shows current carbon dioxide (CO_2) levels over 400 parts-per-million, having risen dramatically over the past century.[1] Nations globally are responding by setting targets to reduce greenhouse gas (GHG) emissions, and on a local level, policies like Assembly Bill 32 (AB 32) and Senate Bill 32 (SB 32) are motivating California to dramatically reduce its own statewide emissions to mitigate climate change impacts. In response, Los Angeles has created a Climate Action Plan (CAP) as it strives to become a leader in green initiatives, setting the goal of reducing its GHG emissions 45% below 1990 baseline levels by 2025.[2]

As part of its Climate Action Plan goals, Los Angeles created a Green Lodging Program that helps hotels become more sustainable in their operations. Each day, hotels keep lights on throughout hallways at night and thermostats run even when there are no occupants in the room. Every one of these activities causes hotels to be one of the most energy-intensive and consequently greenhouse gas-intensive building types.[3] To help reduce the hospitality sector's impact on climate change, the Green Lodging Program requires hotels to become green-certified, thus ensuring that hotels are in compliance with environmental requirements as regulated by the City.[4] Green Seal, a U.S.-based non-profit, third-party certification organization that verifies environmental leadership in various private sector industries, was named the official sustainable-certifier for Los Angeles hotels.[5] The Green Seal Standard for Hotels and Lodging Properties (GS-33) requires hotels to reduce their carbon footprint by transforming their energy system, enhancing the resilience of their buildings, and integrating environmentally sustainable practices into their day-to-day operations.

Despite having 49 certified hotels in the United States (with at least seven in the Los Angeles area), Green Seal currently does not have a method for quantifying the environmental savings directly associated with its hotel certification. This report addresses this knowledge gap by evaluating the greenhouse gas impacts of GS-33 on certified hotels as well as on the overall Los Angeles hospitality sector. Furthermore, this report presents a set of methodologies and tools that allow hotels interested in future GS-33 certification to calculate the potential costs and benefits associated with GS-33-required upgrades. This is done by combining a detailed financial calculation tool for energy-efficient investments with survey research on consumer willingness to pay more for environmentally sustainable practices in the lodging industry.

First, this report analyzes the environmental impacts of GS-33's three certification levels – Bronze, Silver, and Gold. Using a statistical model based on the actual monthly electricity consumption data of six GS-33-certified hotels in LA, we find that, on average, the Bronze

[1] Intergovernmental Panel on Climate Change. (2014). Climate change 2014 synthesis report: summary for policymakers. *IPCC.* Retrieved from: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf.
[2] Garcetti, E. (2015). The Plan. *City of Los Angeles*.
[3] Huang, K., Wang, J., & Wang, Y. (2015). Analysis and benchmarking of greenhouse gas emissions of luxury hotels. *International Journal of Hospitality Management*, 51, 56-66.
[4] Los Angeles Green Lodging. (2014). About. *LA Green Lodging.* Retrieved from http://lagreenlodging.webs.com/about.htm.
[5] Green Seal. (2016). About Green Seal. *Green Seal.* Retrieved from http://www.greenseal.org/aboutgreenseal.aspx.

certification level reduces emissions in hotels by 2.8%.[6] Additional upgrades made to move a hotel from Bronze to Silver certification additionally reduce emissions by 8.8%. Furthermore, hotels that move to the Gold level from Silver incrementally reduce emissions by 18.2%. To understand the potential impacts the Green Seal Standard for Hotels and Lodging Properties has on LA's GHG targets, these numbers are then extrapolated out to a Citywide level. Overall, if all of LA's hotels were to become Silver-certified, the City's current level of greenhouse gas emissions would decrease by approximately 0.7%, and if all hotels were to then become Gold-certified, current emissions would decrease by an additional 1.3%, yielding a total decrease of 2%.[7]

Next, this report converts the environmental benefits from GS-33 into financial impacts for certified hotels. By creating a user-friendly Excel-based tool targeted towards hotel general managers, we analyze the environmental savings and financial costs and benefits from equipment upgrades related to GS-33 certification. We input a case study hotel into this financial tool to understand the cost-savings for a lighting efficiency upgrade project. The case study finds that hotels have the potential to see financial gains from lighting projects; these results can help hotels seeking certification target lighting upgrades as "low-hanging fruit," or efficiency upgrades that yield higher benefits than costs. Specifically, our case study highlights the benefits and flexibility of the tool in quantifying a cost-effective approach to pursuing GS-33.

Lastly, this report analyzes how much consumers are willing to pay for environmentally sustainable lodging practices. If consumers are willing to pay more for hotels that demonstrably reduce their carbon footprints, the resulting financial benefits through increased nightly rates may induce more hotels to pursue green certification programs that require investments in energy-efficient initiatives. Previously, claims of such financial benefits could not be made, as greenhouse gas benefits from the Green Seal hotel certification had never been quantified.

Using our empirical estimates of emission reductions associated with Green Seal certification, we design two surveys that analyze consumers' willingness to pay for green-certified hotels, as well as the implications these results have on nightly rates. From the first survey, we find that on average, consumers are willing to pay more for a green-certified hotel than for one that is not certified.[8] Upon adding specific GHG reduction values from our statistical analysis (which uses actual electricity consumption data) into the second survey, we find that consumers would be willing to pay on average 5% more per night for a green-certified hotel with concrete descriptions of its environmental impacts than for a green-certified hotel that only offers vague descriptions of its certification program. This supports the idea that hotel managers could potentially increase nightly rates to offset certification fees or energy efficiency investments if they demonstrate the environmental benefits of the certification in an effective manner.

Based on the results from these surveys, we recommend both Green Seal and green-certified hotels use numerical values and comparisons in their marketing materials. For example, our survey analysis indicates that consumers of hotels may find more support for green initiatives if they demonstrate the impacts of green certification through numbers (e.g., we reduced

[6] Results for Bronze level impacts are not statistically significant, with a *p*-value of 0.4.
[7] These calculations assume that 98% of Los Angeles' 997 hotels are uncertified.
[8] Results from this first survey are not statistically significant, with a *p*-value of 0.17.

greenhouse gas emissions by 10,000 metric tons CO_2 last year) or comparisons (e.g., our energy reductions are roughly equivalent to taking 300 cars off the road for one year).

Going forward, we recommend Green Seal amend its certification requirements and data tracking procedures. Currently, GS-33 is primarily a qualitative certification. By updating its application requirements to be more quantitative, Green Seal can more accurately assess the impacts its green certification has on greenhouse gas emissions. With a more accurate assessment of impacts, hotels could benefit from an increased willingness to pay by consumers. As part of these quantitative updates, we recommend Green Seal continuously gather energy consumption and efficiency upgrade data from certified hotels. Moreover, Green Seal should ensure all hotels are following the appropriate timeline to go from Bronze to Silver certification and, furthermore, it should require that all certified hotels eventually pursue the Gold level. Finally, we recommend Green Seal establish criteria for targeting hotels that have the greatest potential to maximize greenhouse gas emissions reductions, thus ensuring GS-33 more substantially contributes to LA's GHG goals.

Chapter 1

Project Significance & Objectives

Project Significance

Green Seal is a U.S.-based non-profit, third-party certification organization that verifies environmental leadership in various private sector industries.[9] As more businesses attempt to profit from "greenwashing" – or misleading marketing campaigns and tactics to sell consumers supposedly green products – it is important that credible, third-party certification programs be used. Recently, an independent study highlighted Green Seal as one of two major credible certification programs in the lodging industry.[10]

Green Seal's GS-33 certification has three levels – Bronze, Silver, and Gold.[11] Despite having 49 certified hotels in the United States (with seven in the Los Angeles area), Green Seal currently does not have a method for quantifying the environmental savings directly associated with their hotel certification. By demonstrating the environmental benefits that can be achieved from operational changes, upgrades, and retrofits that fall under GS-33, this project examines how different certification levels for hotels in Los Angeles could reduce greenhouse gas emissions in the City, highlighting how the certification can help the City of Los Angeles achieve its climate change mitigation goals.

Additionally, calculating the greenhouse gas emissions and financial savings associated with the GS-33 certification will allow Green Seal to appeal to more hotels by demonstrating the direct benefits associated with its standard. One Los Angeles hotel, the Westin Bonaventure, announced that it saves over $600,000 annually from the GS-33 Silver level certification.[12] If Green Seal can demonstrate both the financial and environmental savings associated with its standard, it will allow GS-33 to gain more visibility and attract more hotels to their program. Furthermore, if additional hotels engage in GS-33 certification to reduce their environmental impacts, it will contribute to efforts to address larger-scale environmental problems like climate change.

Objectives

The mission of Green Seal is to create science-based programs to empower consumers, purchasers, and companies to create a more sustainable world. In support of this mission, this report evaluates the greenhouse gas impacts for the Los Angeles hospitality sector resulting from

[9] Green Seal. (2016). About Green Seal. *Green Seal.* Retrieved from http://www.greenseal.org/aboutgreenseal.aspx.
[10] McMurray, S. (2015). Hotel 'greenwashing' dirties eco-friendly reputation. *Washington State News.* Retrieved from https://news.wsu.edu/2015/10/01/hotel-greenwashing-dirties-eco-friendly-reputation/.
[11] Green Seal. (2016). About Green Seal. *Green Seal.* Retrieved from http://www.greenseal.org/aboutgreenseal.aspx.
[12] Green Seal. (2015). LA Recognized for Most Green Seal-Certified Hotel Rooms of any Major U.S. City. *Green Seal*. Retrieved from http://www.greenseal.org/Portals/0/Documents/Press%20Releases/2015/5000%20LA%20Hotel%20Rooms%20press%20release.pdf.

the adoption of the Green Seal Standard for Hotels and Lodging Properties. By comparing electricity data pre- and post-GS-33 certification, we quantify greenhouse gas reductions from hotels at the three certification levels (Bronze, Silver, and Gold). Moreover, as the official certifier for hotels and lodging properties in the City of Los Angeles, Green Seal has the potential to dramatically contribute to the greenhouse gas emissions reduction goals of the City of Los Angeles' Sustainability pLAn. To explore this potential and to assist Green Seal in scaling up its program, we developed the following project objectives:

1. Quantify the impacts of GS-33 on greenhouse gas emissions and analyze how these emissions reductions from the City's lodging industry can help Los Angeles achieve the targets of its Sustainability pLAn.
2. Develop analytical tools for Green Seal to scale up the GS-33 hotel certification, including a user-friendly model for hotels that estimates greenhouse gas emissions and financial impacts associated with GS-33, as well as a marketing plan.

Chapter 2

Background

Policy Drivers

California Assembly Bill 32 & Senate Bill 32

In 2005, Governor Schwarzenegger signed Executive Order S-3-05, setting greenhouse gas reduction targets for California by 2010, 2020, and 2050.[13] To meet these goals, Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006, charges the California Air Resources Board (CARB) to adopt rules and regulations to reduce GHG emissions to 1990 levels by 2020.[14] As part of AB 32, CARB is required to develop a Scoping Plan that outlines a strategy for achieving the maximum technologically feasible and most cost-effective approach to reducing GHG emissions by the 2020 goal.[15] AB 32 was further amended in 2016 under Senate Bill 32 (SB 32), which requires California to reduce statewide GHG emissions to 40% below 1990 levels by 2030.[16] As part of this updated legislation, CARB is directed to develop a second Scoping Plan to reflect the new 2030 goal.[17]

The first update to the Climate Change Scoping Plan emphasizes the need for expanding climate actions across the state by encouraging local leadership to develop climate action plans.[18] These climate action plans (CAPs) enable local governments to monitor and track their GHG emissions to ensure they align with (or even exceed) statewide goals. Under its first CAP program, Green LA, the City of Los Angeles initially set a target of reducing citywide emissions 35% below 1990 by 2030, a standard more aggressive than the goals set out in AB 32.[19] Having already reached a 20% reduction by 2013, Lost Angeles is now focusing on more stringent greenhouse gas reduction targets.

Los Angeles Sustainability pLAn

The City of Los Angeles' updated Climate Action Plan, Sustainability pLAn, aims to reduce GHG emissions 45% below 1990 levels by 2025 (see Figure 1).[20] This target is not only more

[13] Office of Governor Edmund G. Brown Jr. (2008). Executive Order S-3-05. Retrieved from http://gov.ca.gov/news.php?id=1861.
[14] Nunez, F. (2008). Assembly Bill 32, The California Global Warming Solutions Act of 2006 (Statutes of 2006, Chapter 488). Retrieved from www.energy.ca.gov/2008publications/ARB-1000-2008-029/ARB-1000-2008-029-F-AP1.PDF.
[15] Ibid.
[16] Pavley, F. (2016). Senate Bill 32, The California Global Warming Solutions Act of 2006 (Statutes of 2016, Chapter 249). Retrieved from https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.
[17] California Air Resources Board. (2017). AB 32 scoping plan. *California Air Resources Board.* Retrieved from https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm.
[18] Brown, E. G., Rodriquez, M., Nichols, M. D., & Corey, R. W. (2014). Proposed first update to the climate change scoping plan: building on the framework. *AHRI Net.* Retrieved from www.ahrinet.org/App_Content/ahri/files/NEWSLETTER/2014/February/CA_Draft_Update_Climate_Change_Scoping_Plan_February_2014.pdf.
[19] Villaraigosa, M. A. R. (2007). Green LA. *LA Sanitation*. Retrieved from http://environmentla.org/pdf/GreenLA_CAP_2007.pdf.
[20] Garcetti, E. (2015). The Plan. *City of Los Angeles*.

stringent than the original target set out in Green LA, but it is also more ambitious than the updated goal in SB 32. The Sustainability pLAn builds on previous goals set out in Green LA, striving to keep the City current with emerging GHG emission data collection techniques.

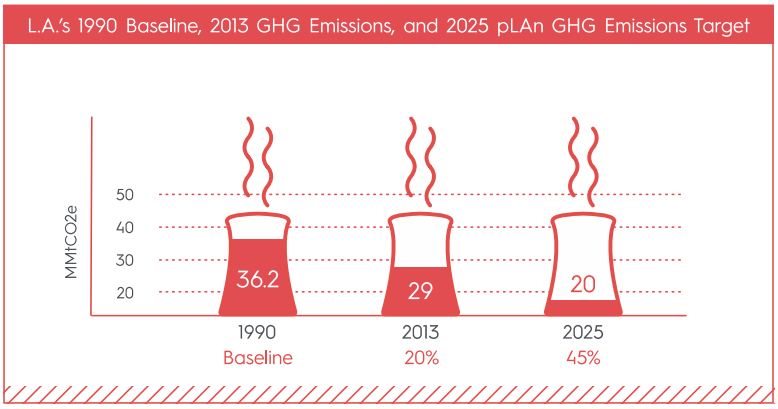

Figure 1. Los Angeles' 1990 Baseline, 2013 Greenhouse Gas Emissions, and 2025 Sustainability pLAn GHG Emissions Target[21]

The Sustainability pLAn not only helps LA track its community-wide GHG emissions and carbon footprint, it also catalyzes the City's green economy by promoting a business-friendly regulatory environment for green companies. This has led to the creation of the Los Angeles Green Business Program (LAGBP), which has two primary goals: (1) to help businesses become greener and more sustainable; and, (2) to recognize these achievements with an official certification.[22] It is through this program that the Los Angeles Green Lodging Program is implemented.

Los Angeles Green Lodging Program

The Los Angeles Green Lodging Program recognizes and promotes green hotels in the City under LAGBP's Green Certification Program. Furthermore, the Sustainability pLAn highlights this initiative, calling for an increase in the number of green-certified hotels in the City.[23] Hotels that follow the Green Lodging Program not only receive green certification, but they are also listed as a Certified Green Business. This program thus encourages environmental initiatives within the hospitality industry and furthers Los Angeles towards its green business and greenhouse gas reduction goals. The Green Lodging Program uses the Green Seal Standard for Hotels and Lodging Properties, GS-33, to ensure hotels comply with environmental requirements as regulated by the City.[24]

[21] Garcetti, E. (2015). The Plan. *City of Los Angeles*.
[22] Los Angeles Green Business. (2016). The City of Los Angeles Green Business Program. Retrieved from http://www.greenbizla.org/.
[23] Garcetti, E. (2015). The Plan. *City of Los Angeles*.
[24] Los Angeles Green Lodging. (2014). About. *LA Green Lodging.* Retrieved from http://lagreenlodging.webs.com/about.htm.

Green Seal Standard for Hotels and Lodging Properties

Green Seal, a U.S.-based non-profit, third party certification organization that verifies environmental leadership in various private sector industries,[25] was named the official sustainable-certifier for Los Angeles hotels.[6] The Green Seal Standard for Hotels and Lodging Properties (GS-33) requires hotels to reduce their carbon footprint by transforming their energy system, enhancing the resilience of their buildings, and integrating sustainability practices into their day-to-day operations.

Areas of Green Certification

The Green Seal Standard for Hotels and Lodging Properties covers key environmental areas in its requirements. Specifically, the criteria of GS-33 include[26]:

- Waste Minimization, Reuse, and Recycling
- Energy Efficiency and Conservation
- Management of Fresh Water Resources and Waste Water
- Reduction and Handling of Hazardous Substances
- Purchasing Policy

For the purposes of this project, we will refer primarily to the Energy Efficiency and Conservation aspect of the certification. The specific guidelines for the Energy Efficiency and Conservation requirements can be found in Table 3.

Levels of GS-33

Green Seal's sustainable-certification has three levels of certification: Bronze, Silver, and Gold. Bronze is an "entry level" and recognizes hotels that have taken initial steps to build a foundation in sustainability; Silver is for hotels that have "substantially reduced their environmental impact" through their sustainability initiatives; and, Gold is for the lodging industry leaders that are "practicing the top levels of sustainability."[27]

For each level, hotels must replace specific equipment with energy efficiency upgrades. The following sections outline which equipment types fall under each level of GS-33, and the benefits of these upgrades are further discussed in Chapter 7.

Bronze

As the initial step in GS-33, the Bronze level does not require a set percentage of equipment be upgraded at the time of certification. Rather, hotels that receive Bronze certification must upgrade to energy-efficient models *only when* the equipment is replaced. Specifically, the Bronze certification includes the following energy efficiency upgrades[28]:

- **Office and Room Equipment:** fax machines; copiers; printers; computers; monitors; televisions; video players/recorders

[25] Green Seal. (2016). About Green Seal. *Green Seal.* Retrieved from http://www.greenseal.org/aboutgreenseal.aspx.
[26] Green Seal. (n.d.). GS-33: Green Seal environmental leadership standard for lodging properties, 5th edition. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Standards/GS-33/GS-33%20One%20pager.pdf.
[27] Ibid.
[28] Ibid.

- **Heating, Ventilation, and Air Conditioning (HVAC) Equipment:** chillers; packaged terminal air conditioners; central air conditions; central heat pumps; split ductless heat pumps; geothermal heat pumps; water heaters
- **Kitchen Equipment:** freezers; refrigerators; cooktops; ovens; dishwashers
- **Laundry Equipment:** boilers; washers; dryers; extractors

Moreover, hotels must use energy-efficient lighting or implement a schedule to replace the existing lighting with energy-efficient bulbs, and lastly, hotels must perform preventative maintenance on key equipment.

Silver
In addition to requiring the efficiency upgrades that fall under the Bronze level, Silver has two additional energy management criteria[29]:

- **Windows:** energy-efficient windows; window film
- **Programmable timers and sensors:** installed on lighting and HVAC in low-traffic areas

The Silver level must be achieved within three years of receiving Bronze certification.[30] Therefore, we assume that all Silver-certified hotels have energy-efficient lighting,[31] equipment (when upgraded), and windows as well as programmable timers and sensors.

Gold
Gold, the most stringent of the three levels, not only builds upon the Bronze and Silver requirements, but it also requires hotels to make significant strides in broad environmental categories. Specifically, the hotels must have three of the following requirements[32]:

- Set goals for energy reduction or be an ENERGY STAR Leader
- Pursue LEED Certification or be an ENERGY STAR Building
- Use 25% renewable energy or (be) a Green-e Member
- Achieve zero greenhouse gas emissions through partnerships or carbon offsets
- Reduce solid or water by-product waste disposal by 90%
- Meet the requirements for GS-42, Green Seal's standard for commercial cleaning services
- Monitor water use and use U.S. Environmental Protection Agency (EPA) WaterSense fixtures and procedures

Notably, hotels do not have to do anything expressly related to energy usage or emissions reductions. They can choose instead to focus on the three non-energy-related qualifications to achieve the Gold certification level.

[29] Green Seal. (n.d.). GS-33: Green Seal environmental leadership standard for lodging properties, 5th edition. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Standards/GS-33/GS-33%20One%20pager.pdf.
[30] Ibid.
[31] Note that GS-33 requires lighting upgrade to occur within a five-year window.
[32] Ibid.

Costs of Hotels and Lodging Standard

To become green-certified under GS-33, hotels must pay an evaluation fee as well as an annual monitoring fee. Both fees are determined by the number of rooms in the hotel and are divided as follows[33]:

- **Tier III:** Fewer than 75 rooms
- **Tier II:** 75-299 rooms
- **Tier I:** 300 rooms or more

Evaluation for Certification

The evaluation fee covers the cost of evaluating and certifying lodging properties under GS-33 to verify the property meets the standard.[34] Green Seal verifies environmental standards in the hotels to ensure the process is science-based and transparent, and evaluation fees are due any time a hotel applies to become green-certified at a new level. Initial evaluation fees are listed in Table 1, and these fees vary after the initial application depending on what level the hotel is applying for (i.e., Bronze to Silver, Bronze to Gold, or Silver to Gold).

Table 1. Initial Evaluation Fees for GS-33[35]

	Bronze	Silver	Gold
Tier III	$1,950	$2,400	$2,700
Tier II	$2,075	$2,800	$3,000
Tier I	$2,350	$3,200	$3,200

Compliance Monitoring

Once a property is green certified, it undergoes annual compliance monitoring to ensure that it is still meeting the requirements for the certification level.[36] This annual fee covers the compliance monitoring review as well as a yearlong license to use the Green Seal mark on hotel materials. Monitoring fees do not vary year-to-year unless the hotel advances its certification level or moves to a different tier by adding or removing rooms (Table 2).[37]

Table 2. Annual Monitoring Fees for GS-33[38]

	Bronze	Silver	Gold
Tier III	$1,950	$2,400	$2,700
Tier II	$2,075	$2,800	$3,000
Tier I	$2,350	$3,200	$3,200

If hotels do not meet the required standards during this compliance monitoring review, it is possible their certification will be revoked. Particularly, once a hotel is Bronze-certified, it has

[33] Green Seal. (2016). Fees for Green Seal certification under GS-33 standard for lodging properties. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Fees/2016/GS-33%20Fee%20Schedule.pdf.
[34] Green Seal. (2016). Fees for Green Seal certification under GS-33 standard for lodging properties. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Fees/2016/GS-33%20Fee%20Schedule.pdf.
[35] Ibid.
[36] Ibid.
[37] Ibid.
[38] Ibid.

three years to progress to Silver. If the hotel does not meet the requirements of the Silver level, it will lose its entire GS-33 certification status.[39]

Other Hotel Green Certification Programs

Hotels are increasingly adopting verified environmental certifications to demonstrate credibility in sustainability and to help attract and retain niche customers and business organizations. Green Seal's GS-33 standard is not the only green certification for the lodging industry in the U.S., though it does have some notable differences between other programs such as the Green Key Eco-Rating Program, Green Globe, and the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) certification.

Canada-based Green Key Global created the Green Key Eco-Rating Program to recognize lodging facilities for sustainability in their environmental and financial performance. The hotels perform self-assessments for sustainable practices and are awarded a rating of 1-5 Keys, with 5 Keys being the best rating. While this self-assessment process is notably different than GS-33 which includes an on-site audit for all properties, at least 20% of the Green Key properties are audited on-site annually to ensure the accuracy of the environmental self-assessments. The environmental assessment examines five operational areas (Corporate Environmental Management, Housekeeping, Food & Beverage Operations, Conference & Meeting Facilities, and Engineering) and nine sustainable practices areas.[40] This voluntary program costs U.S. properties $650 per year, and in return Green Key assists member hotels with promotional materials to highlight their environmental benefits. Currently, over 1,500 hotels participate in the Green Key Eco-Rating Program globally.[41]

Another similar certification program, Green Globe Certification for Hotels, charges annual rates of $750 to $5,000 for U.S. hotels depending on the number of rooms. Hotels achieve Green Globe Membership based on four key themes – Sustainable Management, Social/Economic, Cultural Heritage, and Environment – and on the completion of independent audits every other year. Additionally, the certification has three levels based on how long the hotel has been certified and how it meets the required criteria. Hotels must first meet 50% of the required criteria before becoming a Green Globe Certified Member, and they then must be Green Globe Members for five consecutive years and demonstrate continuous efforts in the key themes to achieve Green Globe Gold Membership. Hotels can achieve Platinum membership by being members for 10 consecutive years.[42]

One last notable program is the LEED certification program from USGBC. This program is available for new construction or existing buildings and it assigns the building a point value based on environmental performance in the following categories: Sustainable Sites; Water Efficiency; Energy & Atmosphere; Materials & Resources; Indoor Environmental Quality;

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[39] Ibid.

[40] The nine sustainable practice areas include: energy conservation, water conservation, solid waste management, hazardous waste management, indoor air quality, community outreach, building infrastructure, land use, and environmental management.

[41] Green Key Global. (2017). Green key eco-rating program. *Green Key Global.* Retrieved from http://greenkeyglobal.com/programs/eco-rating-program/.

[42] Green Globe. (2017). Certification. *Green Globe.* http://greenglobe.com/contact-in-your-region/.

Innovations in Operations; and, Regional Bonus Points. This total point value determines the level of LEED achieved (Certified, Silver, Gold, Platinum). The certification fees depend on the building type and size. According to one report on LEED in the hospitality industry, there are more than 400 LEED-certified hotels globally (31 of which are in California), with four times as many registered hotels currently going through the certification process.[43] The LEED certification program is notably different than GS-33 in that it has a component that focuses strongly on the construction of the building, whereas GS-33 focuses on operations. USGBC has calculated the environmental benefits of LEED, with LEED-certified buildings typically seeing 30-50% reductions in energy usage, 35% reductions in carbon emissions, 40% reductions in water emissions, and 70% reductions in solid waste.[44]

These programs all differ slightly in the price and content of environmental requirements. LEED tracks environmental performance and can report on significant reductions in areas like energy conservation. GS-33, on the other hand, uses a third-party verification process to ensure that hotels are making the requisite changes to achieve certification. These programs, as well as the myriad of green rating systems online, provide hotels with ways to differentiate themselves and highlight their environmental performance for consumers.

Current Hotel & Energy Trends

Global, National, and Local Hotel Trends

The tourism sector globally is responsible for 5% of carbon dioxide emissions and accounts for 5% of direct global gross domestic product.[45] In the United States, the hotel sector specifically accounts for an estimated 1% of emissions.[46] Hotels typically operate every hour of every day, and the buildings serve multiple functions. A hotel can have restaurants, bars, gyms, pools, saunas, open spaces, meeting rooms, and guest rooms all on its property. Energy is used for heating, cooling, ventilation, cooking, lighting, and cleaning, among other things.[47] Additionally, the occupants of guest rooms are directly responsible for a portion of the energy use in their room, which includes thermostats and lighting. These factors cause hotels to be one of the most energy-intensive building types with a high potential for massive environmental reductions.[48]

[43] U.S. Green Building Council. (2016). LEED in motion: hospitality. *Readymag.* Retrieved from https://readymag.com/usgbc/hospitality/hospitality/.
[44] Brown, Christine. What does LEED certification mean to the hotel industry? *Pinnacle Advisory Group.* Retrieved from http://pinnacle-advisory.com/press-room/what-does-leed-certification-mean-to-the-hotel-industry-presented-by-christine-brown/.
[45] Michailidou, A. V., Vlachokostas, C., & Moussipoulos, N. (2016). Interactions between climate change and the tourism sector: multiple-criteria decision analysis to assess mitigation and adaptation options in tourism areas. *Tourism Management*, 55, 1-12.
[46] International Tourism Partnership. (n.d.). Carbon emissions. *Internal Tourism Partnership.* Retrieved from http://tourismpartnership.org/carbon-emissions/.
[47] Gössling, S. (2002). Global environmental consequences of tourism. *Global Environmental Change*, 12(4), 283 302. doi:10.1016/s0959-3780(02)00044-4.
[48] Huang, K., Wang, J., & Wang, Y. (2015). Analysis and benchmarking of greenhouse gas emissions of luxury hotels. *International Journal of Hospitality Management*, 51, 56-66.

Demand for lodging generally depends on income and employment (for which demand is positively correlated) and room price (for which demand is negatively correlated).[49] In 2014, the lodging industry in the United States had over 53,000 properties and nearly 5 million guest rooms; the average occupancy rate was 64.4%. Additionally, the lodging industry was growing with the number of jobs, the number of properties, and the wage rates, all of which were increasing from the previous year. Industry projections show an anticipated continued rise in the future as the economy continues to thrive and the demand for lodging consequently increases.[50]

The leisure and hospitality sector accounts for about 11% of all jobs in California, where hotel occupancy rates averaged 75% in 2015 (which is higher than the national average). Specifically, the hotel occupancy rate in Los Angeles County was even higher at 81.6% in 2015 across 98,135 guest rooms in 997 different hotels.[51] Furthermore, the tourism markets in California have seen recent growth and are projected to continue growing at least through 2016 and 2017.

Energy Usage in Lodging Industry

Hotel end-use energy is highly variable and dependent upon factors like location and hotel rating. The U.S. Energy Information Administration (EIA) has conducted ten Commercial Buildings Energy Consumption Surveys (CBECS) since 1979, with the most recent one conducted in 2012. The microdata from this survey gives a snapshot of the current state of affairs in the U.S. Lodging Industry.[52] The average annual electricity consumption for lodging industry buildings in 2012 was 4,563,765 kilowatt-hours (kWh), with the average yearly expenditures equaling $437,542. Moreover, the average annual electricity consumption for lodging industry buildings in the Pacific region was 4,246,281 kWh, with the average yearly electricity expenditures equaling $646.666.[53] The breakdown of this electricity end-usage for the surveyed lodging establishments in the Pacific Region can be seen in Figure 2.

[49] PKF Consulting. (2015). VIOC - Southern California lodging forecast. *Cal Poly Pomona.* Retrieved from https://www.cpp.edu/~collins/partners/outlook conference/documents/PKFConsulting.pdf.
[50] American Hotel & Lodging Association. (2015). Lodging Industry Trends 2015. *AHLA.* Retrieved from https://www.ahla.com/uploadedFiles/_Common/pdf/Lodging_Industry_Trends_2015.pdf.
[51] LAEDC Kyser Center for Economic Research. (2016). 2016 - 2017 economic forecast industry outlook. *Los Angeles County Development Corporation.* Retrieved from http://laedc.org/wp-content/uploads/2016/02/LAEDC-2016-2017-February-Forecast.pdf.
[52] U.S. Energy Information Administration. (2016). Commercial Buildings Energy Consumption Survey: 2012 CBECS Survey Data. *EIA.* Retrieved from https://www.eia.gov/consumption/commercial/data/2012/.
[53] Ibid.

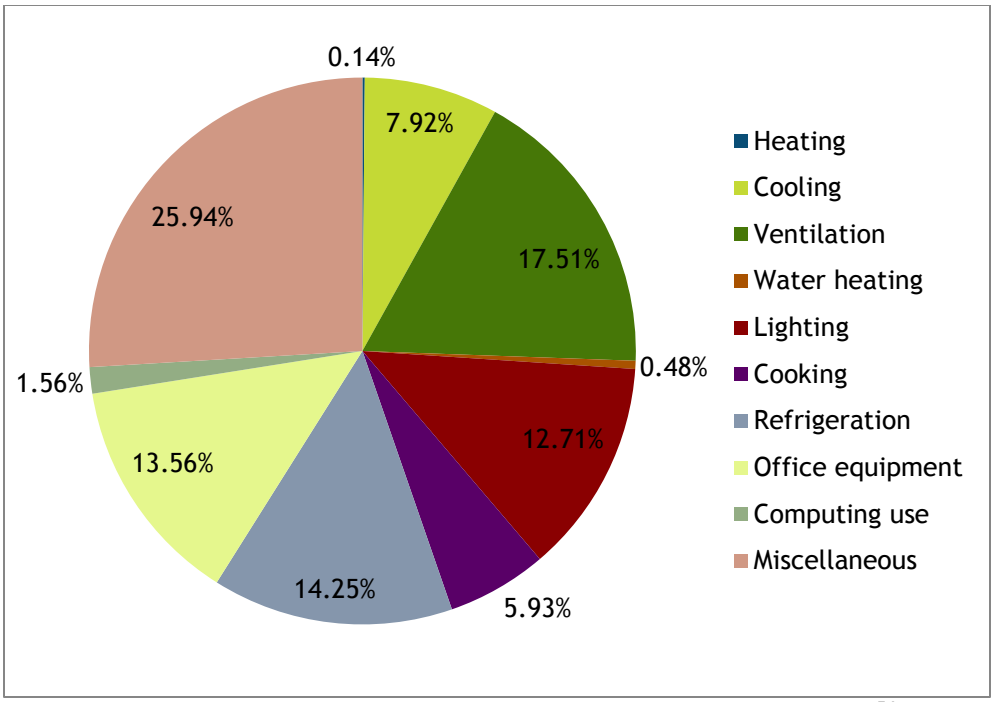

Figure 2. Pacific Region Lodging Building Electricity End Use[54]

Environmental Best Practices in the Hospitality Sector

Case Studies

Hotels around the world are adopting practices to reduce their environmental impact, especially their energy and water consumption. Major hotels have stated operational economic benefits, rebates, and political action strongly backed by scientific evidence as the drivers for this change.[55] For example, installation of a geothermal refrigeration system, variable speed hoods, sensor technologies, regenerative elevators, insulated precast envelope, and architectural design that allows for maximum use of daylight resulted in significant reductions at the Proximity Hotel in Greensboro, North Carolina.[56] Moreover, the Turnberry Isle Resort and Club in Aventura, Florida has saved approximately $65,000 annually after installing energy-efficient equipment; even more, it has benefitted from approximately $20,000 in utility company rebates. However, even though hotels are eager to pursue environmentally beneficial technologies, they are hesitant to compromise on the notion of luxury. For example, the Lenox in Boston refused to change its light bulbs because the energy-efficient fixtures were "less dramatic."[57]

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[54] U.S. Energy Information Administration. (2016). Commercial Buildings Energy Consumption Survey: 2012 CBECS Survey Data. *EIA.* Retrieved from https://www.eia.gov/consumption/commercial/data/2012/.
[55] Ricaurte, E. (2016). Hotel Sustainability Benchmarking Index 2016: Energy, Water, and Carbon. *Center for Hospitality Research Reports*. Retrieved from http://scholarship.sha.cornell.edu/chrreports/17/.
[56] Ahn, Y. H., & Pearce, A. R. (2013). Green luxury: a case study of two green hotels. *Journal of Green Building, 8*(1), 90-119. doi:10.3992/jgb.8.1.90.
[57] Albert, E. (n.d.) Sustainable hotels, how the industry is moving beyond green. *Occidental College.* Retrieved from https://www.oxy.edu/sites/default/files/assets/UEP/Comps/2011/Erika%20Albert_Sustainable%20Hotels%20How%20the%20Industry%20is%20Moving%20Beyond%20Green.pdf.

The clientele of most major and luxury hotels can be categorized into two groups: (1) travelers for personal leisure; and, (2) businesses and professional organizations using hotels as venues for conferences and meetings. By offering different environmental opportunities (e.g., carbon offset programs) to the range of clientele, hotels have managed to reduce their emissions through customer action. For example, in 2009, the Hilton was successful in reducing its GHG emissions 20.9% by allowing customers (in this case, businesses) to offset emissions by participating in the Clean Air Program. Ninety-two hotels in the Asia Pacific region now participate in this program, allowing the carbon offset credits to be applied toward projects in the sector of the customer's geographic or operational interest.[58]

To track energy, water, and material use efficiently, hotels have integrated monitoring software programs that monitor operations and have specifically designed emissions measurement platforms and dashboards such as LightStay. Brighter Planet CM1's Sustainability Analytics Platform can be integrated with travel planning systems and can calculate the direct and indirect emissions from lodging rooms.[59] By attributing carbon footprints to their routine activities, hotels have been able to identify emissions hotspots and target emissions reduction strategies without incurring additional costs.

[58] Hilton Worldwide. (n.d.). Preserving Environment. *Hilton Worldwide.* Retrieved from http://cr.hiltonworldwide.com/environments/.
[59] Eijgelaar, E., W. Miedema, W. Bongaerts, and P. Peeters. (2013). Overview of carbon calculators and the calculation of greenhouse gas emissions in tourism. *Carbon Management for Tour Operators.* Retrieved from http://www.cstt.nl/userdata/file/EijgelaarEtAl_OverviewCarbonCalculators_NHTV-CNG-2013.pdf.

Chapter 3

Scope of Analysis

The World Resources Institute's Greenhouse Gas Protocol for corporate accounting and reporting, which is the most common emissions reporting standard followed by hotels, categorizes greenhouse gas emissions into direct and indirect emissions.[60] Direct emissions are defined as GHG emissions from sources that are owned or controlled by the reporting entity. Indirect emissions are defined as those that are consequences of the activities of the reporting entity but occur at sources owned or controlled by another entity.[61]

Indirect and direct emissions are further categorized as:

- **Scope 1:** All direct GHG emissions
- **Scope 2:** Indirect GHG emissions from consumption of purchased electricity, heat, or steam
- **Scope 3:** Other indirect emissions associated with transport-related activities, purchased materials, outsourced activities, waste, etc.

While the GS-33 certification requires hotels to implement several plans related to material use, water conservation, and energy consumption,[62] previous studies indicate that measures to reduce energy consumption provide a large potential for reducing Scope 2 GHG emissions.[63] Furthermore, metrics of Scope 2 emissions are provided in energy usage (kWh), which is standardized throughout all hotels in Los Angeles, making energy consumption data easily comparable. Additionally, this data is readily accessible as most hotels use energy management systems to track energy consumption, or they have this information available on their monthly utility bills.

Based on the contribution of electricity to GHG emissions as well as the availability of data, our analysis focuses on Scope 2 emissions, or indirect greenhouse gas emissions from consumption of purchased electricity for the hotel buildings. Specifically, we focus on electricity consumed in the rooms, common areas and restaurants, and we exclude electricity required for outdoor events and outdoor seating areas as well as purchased heat and steam.

[60] World Resources Institute and World Business Council for Sustainable Development. (n.d.). A Corporate Accounting and Reporting Standard (Revised Edition). *Greenhouse Gas Protocol.* Retrieved from http://www.ghgprotocol.org/standards/corporate-standard.
[61] Ibid.
[62] Green Seal. (2016). About Green Seal. *Green Seal.* Retrieved from http://www.greenseal.org/aboutgreenseal.aspx.
[63] Ricaurte, E. (2016). Hotel Sustainability Benchmarking Index 2016: Energy, Water, and Carbon. *Center for Hospitality Research Reports*. Retrieved from http://scholarship.sha.cornell.edu/chrreports/17/.

Chapter 4

Data summary

Electricity Consumption Data from Certified Hotels

To study the greenhouse gas emissions associated with certified hotels' energy consumption, we requested monthly electricity data from six Green Seal-certified hotels in the Los Angeles area. In addition, we compiled information on hotel characteristics such as the area of the building, occupancy rate,[64] date of certification, and measures implemented to achieve GS-33 certification (Chapter 5).

Commercial Buildings Energy Consumption Survey

The U.S. Energy Information Administration has conducted ten Commercial Buildings Energy Consumption Surveys since 1979, with the most recent one conducted in 2012 (see Chapter 2 for more information).[65] We used annual electricity data from this dataset to benchmark the average energy consumption for an uncertified hotel in Los Angeles (Chapter 6).

Survey Data on Consumer Willingness to Pay

To analyze consumers' willingness to pay for green-certified hotels, we issued two surveys (gaining over 1,500 responses cumulatively) using Amazon Mechanical Turk (MTurk). Results from these surveys served as the primary data source in determining whether hotels can increase their nightly rates once they achieve GS-33 certification (Chapter 8).

[64] Occupancy rate refers to the ratio of rented or used space compared to the total amount of available space.
[65] U.S. Energy Information Administration. (2016). Commercial Buildings Energy Consumption Survey: 2012 CBECS Survey Data. *EIA.* Retrieved from https://www.eia.gov/consumption/commercial/data/2012/.

Chapter 5

Green Seal Certification & Greenhouse Gases: Actual Emissions Reductions for Certified Hotels

Objectives

The goal of this analysis is to provide Green Seal with a flexible statistical framework to evaluate the changes in energy consumption observed with the implementation of different levels of Green Seal's GS-33 certification.

Methodology

Description

The GS-33 certification requires hotels to implement different energy-related measures to reach Bronze, Silver and Gold levels. As seen in Table 3, the intensity of measures increases as a hotel progresses in GS-33 from Bronze to Silver to Gold. The GS-33 Gold level requires hotels to be much more stringent in their energy management plans as compared to the Silver and Bronze certification levels.

A hotel can enter the GS-33 certification by either initially obtaining the Bronze level certification and subsequently upgrading to the Silver and Gold levels, or it can directly obtain the Silver level certification. Requirements for Bronze completely overlap with that of Silver and Gold. Therefore, we assume that if a hotel has achieved Silver certification, it has by default also met Bronze certification requirements.

Table 3. Energy Efficiency-Related Requirements of GS-33 Certification[66]

	Bronze	Silver	Gold
Energy consuming devices	The property shall maintain a list of energy-consuming devices, including guest-room equipment, office electronics, HVAC systems, and kitchen and laundry equipment		
Indoor Lighting	All indoor lighting shall be energy-efficient[67] OR The property shall implement a replacement schedule for indoor lighting: All indoor lighting shall be on a schedule for replacement with energy-efficient lighting, to be completed within five years from the		

[66] Green Seal. (2016). Green Seal GS-33 Guide Book. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Standards/GS-33/GS-33%20Guidebook%202016.pdf.

[67] Green Seal states that energy-efficient is "requiring the consumption of a minimum amount of energy to provide a maximum amount of work or functionality. In the United States, products shall be identified as being in the lowest quarter (1/4) of energy used according to the FTC's yellow EnergyGuide labels (http://www.consumer.ftc.gov/articles/0072-shopping-home-appliances-use-energyguide-label), verified as environmentally-preferable, or otherwise demonstrate that they consume significantly less energy when compared with similar equipment using established, industry-standard testing methods."

	Bronze	Silver	Gold
	first date of certification to this standard. Priority shall be given to the replacement of lights that are typically on for 24 hours/day, followed by lights typically on for 8+ hours/day. The property shall maintain records of all indoor lights that are not energy-efficient and their schedule for replacement.		
Appliances and Heating, Ventilation, and Air Conditioning (HVAC) Systems	The property shall implement a regular preventative maintenance schedule for HVAC systems, in-room air conditioning units, and appliances for kitchen and laundry (for both the facility and the guests). This schedule shall be appropriate for each type of equipment and intended to ensure its proper operation		
Washing capacity	The property shall ensure that washing machines, dryers, and dishwashers are filled to the recommended capacity for each cycle, and that the coolest effective water temperature is used.		
Climate and Lighting Control		On/off timers and/or sensors shall be used for lighting and HVAC in low traffic and low occupancy areas.	
Purchasing & Energy-efficient windows	Energy-efficient models of energy-consuming devices shall be specified and purchased	Energy-efficient windows shall be specified and purchased.	
Energy Reduction			The property shall • set substantive, meaningful goals for energy reduction OR • be an ENERGY STAR Leader, or equivalent
			2.7.2.1 The property shall track its energy consumption (electricity, natural gas, fuel, etc.), potable water consumption, and the amounts of waste collected for disposal/incineration and for recycling. 2.7.2.2 Monthly bills shall be tracked with the ENERGY STAR Portfolio Manager, or an equivalent resource management OR documentation system (e.g., utility software or Excel spreadsheet) that: 1. tracks costs, total consumption, and Resource Use Intensity; 2. benchmarks these factors relative to past performance (normalized for sales

	Bronze	Silver	Gold
			volume); 3. determines percent improvement or savings in energy, water, and generation of waste. 2.7.2.3 These impacts shall be reviewed at least annually, with appropriate goals set for continuous improvement
Sustainable Building			The property shall • be certified by a nationally-recognized green building certification program. OR • register for and actively be in the process of achieving a nationally-recognized green building certification program (LEED certification, ENERGY STAR for Buildings, Green Globes).
Renewable Energy			The property shall • use renewable energy for at least 25% of its needs, either via onsite production or certified Renewable Energy Certificates. OR • be certified through the Center for Resource Solutions' Green-e Marketplace program or is a Partner in the EPA's Green Power Leadership Club.

Green Seal allows for flexibility with each hotel in how it fulfills the requirements of the GS-33 certification, resulting in variation in the energy-related reductions. For example, GS-33 allows for flexibility within its definition of energy efficiency upgrades. Hotels may therefore choose different models and have different replacement schedules for the windows. As a result, even though the hotels must make the same changes for each level of certification, differences in the actual enforcement practices lead to a vast range of electricity consumed for certified hotels.

Our discussions with the energy managers of several hotels in Los Angeles revealed that certain factors disproportionately influence the hotel's energy efficiency policies, which leads to different drivers for energy-efficient measures. For example, one hotel manager in Los Angeles stated that corporate policies and chain-wide sustainability goals were the main drivers for their energy efficiency initiatives, whereas another hotel stated that continued financial losses were forcing them to cut costs of energy consumption and consequently implement energy efficiency measures. Therefore, the heterogeneity of hotel characteristics such as size, occupancy rate, location, financial performance, policies (e.g., energy efficiency, Corporate Social Responsibility, and adoption of government rebates), variation in size, consumer demographics

(e.g., income, reason of stay, education), clientele demand, and grid mix has led to a huge variation in energy consumption per square foot (Figure 3).[68]

Because it is difficult to control for all the variables that could have a potential impact on a hotel's energy consumption, we addressed the problem of omitted variable bias (i.e., not accounting for all the observed and unobserved variables) by comparing a hotel to itself over time using a within-differences panel regression model. By obtaining multiple observations of each hotel and observing the energy consumption across all hotels, we controlled for time-constant features that make hotels different from each other our sample period. Therefore, we compared a hotel against itself before and after it received the GS-33 certification at different certification levels. We requested monthly electricity bills from seven GS-33-certified hotels in Los Angeles from 2009 to 2016 and received information for different time periods from six hotels, which is summarized in Figure 3. Discrepancies in the data were resolved with energy managers, property managers, and engineering teams of hotels and Green Seal executives. These discrepancies and the methods for resolving them are discussed further in Appendix A.

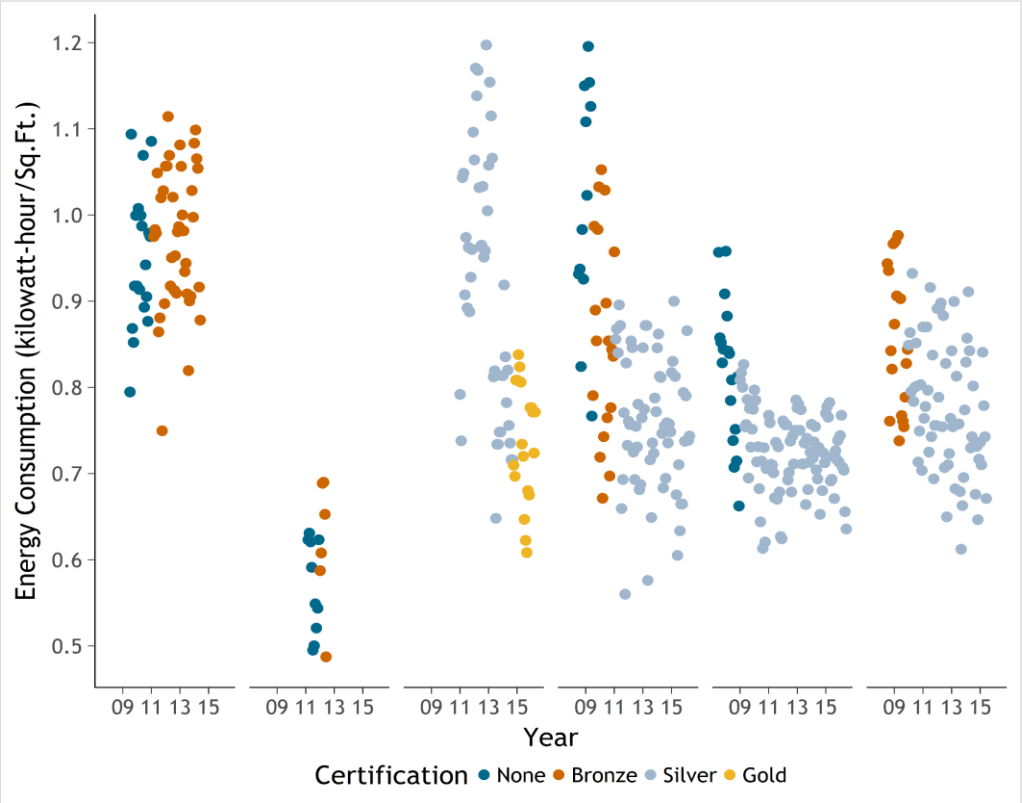

Figure 3. Electricity Consumption of Six GS-33-Certified Hotels in Los Angeles

Figure 4 (left) shows that the average electricity consumption of these six hotels has generally decreased from 2008 to 2016. Figure 4 (right) shows the average electricity consumption increases in summer (June, July, August, September) and decreases in winter and spring. To

[68] Electricity consumed per square foot (kWh/sq. ft.) is a unit commonly used in the hospitality industry. We used this unit to compare electricity consumption across all hotels.

address this seasonality in the data, we controlled for the monthly variation in temperature since it affects the demand for heating and cooling.

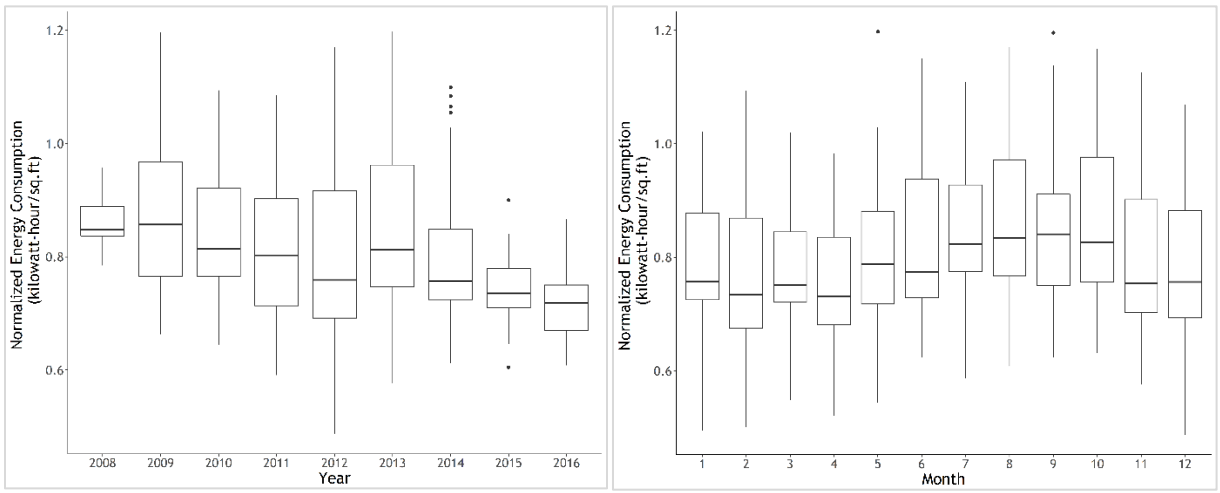

Figure 4. Annual (left) and Seasonal (right) Trends in Hotel Energy Consumption

It is important to note that this observed variability in energy consumption is reported by only six out of the 997 hotels in Los Angeles. Moreover, it must be noted that these six hotels are all luxury hotels and our sample is consequently not representative of a vast range of hotel types. Lastly, these six hotels are all located in Los Angeles, and in places where there are more extreme weather conditions (e.g., the U.S. Midwest), the monthly weather variation could play a bigger role due to seasonal changes in energy consumption.

Methodology of Fixed Effects Regression

Because we studied the differences in energy consumption by comparing a hotel to its average performance, electricity consumption data was de-meaned. The adjusted monthly electricity consumption (or the de-meaned electricity consumption) was calculated as follows:

$$Adjusted\ monthly\ electricity\ consumption\ (kWh) = Observed\ monthly\ electricity\ consumption\ (kWh) - Average\ kWh\ over\ all\ months\ (kWh)$$

A regression analysis was run on panel data consisting of monthly electricity usage per square foot (dependent variable), certification owned by the hotel in a given month (independent variable), and month, year, and hotel (control variables). The resulting panel regression equation is as follows:

$$ln\left(\frac{Energy\ (kWh)}{Area\ (sq.ft.)} = Month + Year + Hotel + Bronze + Silver + Gold\right)$$

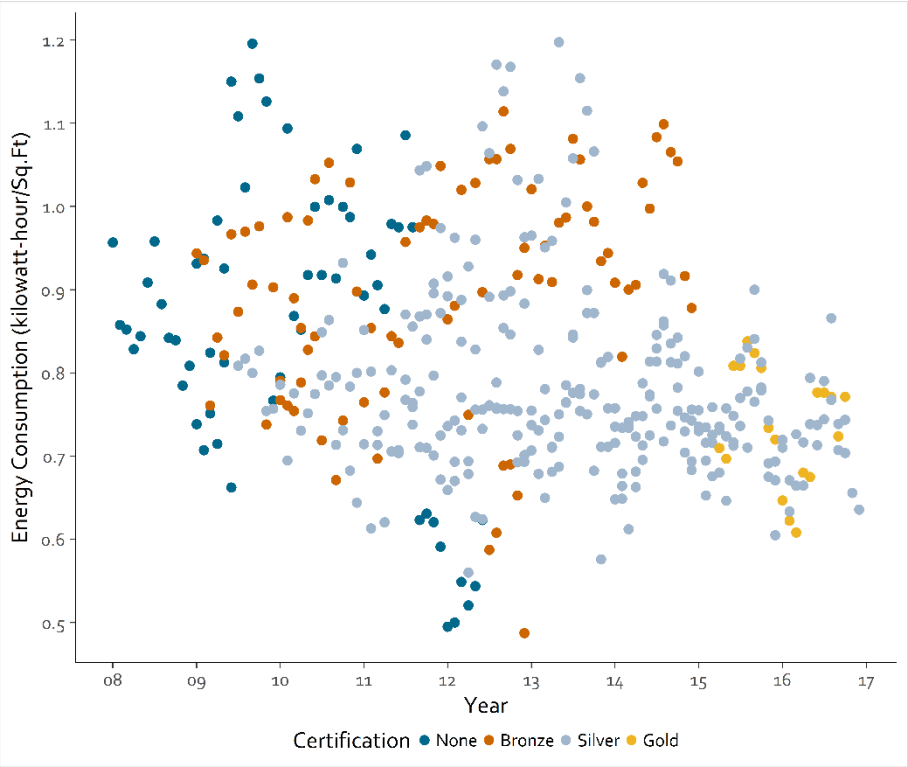

Figure 5. Monthly Electricity Consumption Across 6 Certified Hotels

Results

After controlling for year and month, we noticed that a hotel observes a statistically insignificant 2.8% reduction in energy consumption when it enters the GS-33 system (i.e., the hotel achieves Bronze level certification). When a hotel achieves Silver certification (after it achieved Bronze certification), it observes a statistically significant reduction of 8.8%. This means that if a hotel enters the GS-33 system by fulfilling the requirements of the Silver level, it would observe a reduction of (2.8 + 8.8 =) 11.6%. Similarly, going from Silver to Gold, a hotel would see a reduction of 18.2%. Therefore, if the hotel directly enters the GS-33 system by fulfilling all the requirements of Gold level, it would see a reduction of (2.8 + 8.8 + 18.2 =) 29.8% (Table 4 and Figure 6).

Table 4. Results from Fixed Effects Regression[69]

	Estimate	Std. Error	*t*-value	*p*-value
Bronze	-0.028	0.034	-0.835	0.404
Silver	-0.088	0.027	-3.293	0.001
Gold	-0.182	0.018	-10.023	< 2.2e-16

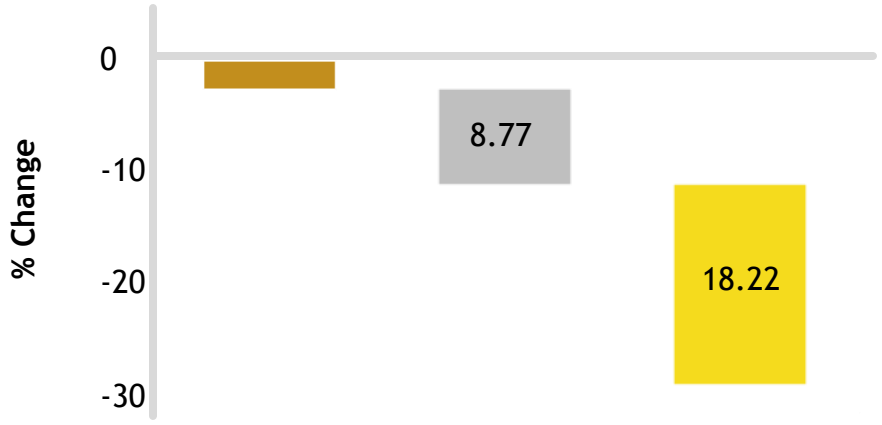

Figure 6. Results from Fixed Effects Regression
Results of the panel regression were significant for the Silver and Gold levels. However, the reductions for the Bronze level were not statistically significant.

Limitations

Fixed effect models are a useful standard framework to study the variation of individual responses to a treatment over time. However, like any statistical technique, the results are highly sensitive to the inputs. This analysis is based on the data provided by Green Seal from six hotels. As seen from Figure 3, the effect of the Gold certification level is currently seen based on the performance of one hotel. This analysis is based off the following number of data points (hotel-by-month observations) for each certification level:

- **None:** 60
- **Bronze:** 83
- **Silver:** 263
- **Gold:** 19

Next Steps

Results from the panel regression analysis were used to calculate potential emissions reductions for the City of Los Angeles (Chapter 6), and they were also used to inform the survey design for consumer willingness to pay (Chapter 8). Additionally, these results informed recommendations for improving Green Seal's GS-33 certification and developing a marketing strategy that will help Green Seal reach more consumers.

[69] The full results from the Fixed Effects Regression are in Appendix B.

Chapter 6

Green Seal Certification & Greenhouse Gases: Potential Emissions Reductions for Los Angeles

Objectives

The goals of this analysis are to (1) benchmark the average energy consumption of an uncertified hotel in LA, (2) perform an analysis of potential GHG emissions reduction scenarios for Silver and Gold levels, and (3) illustrate how Green Seal can help mitigate GHG emissions for the LA lodging sector and contribute to reaching the City's environmental goals set forth by LA's Climate Action Plan for the 2025 target.[70]

Methodology

Average Energy Consumption of an LA Hotel

To benchmark the average energy consumption for an uncertified hotel in LA, we used data from the 2012 U.S. EIA's Commercial Buildings Energy Consumption Survey,[71] which collects information on U.S. commercial buildings and their energy-related building characteristics and energy usage data (e.g., consumption and expenditures). This survey had, to our knowledge and accessibility, the most complete and detailed information regarding the GHG-related practices for buildings in the commercial sector. Although the CBECS data contains information for a variety of principal commercial building activities nationwide, we focused our analysis specifically on the 26 hotels surveyed in the Pacific Region as these characteristics best reflect a typical LA hotel and thus the potential energy savings for the LA lodging industry.

Using this subset of data, we then separated the buildings into uncertified hotels and potentially certified hotels. Because this was not a pre-defined variable in the survey, we used the binary factor "Does the building have an energy management plan?" to define a hotel as "uncertified." That is, we assumed that not having an energy management plan was adequate information to determine if a hotel was not certified. We did not, however, use this as a valid indicator to assume certification. Furthermore, to ensure consistency across our analysis, we used the CBECS data on the Pacific Region's Annual Electricity Consumption (in kWh) to estimate the potential savings that relate to GS-33 certification standards.

Based on these defined certification and electricity consumption parameters, the average annual electricity consumption for a hotel in the Pacific Region (which we assume most closely represents a hotel in LA) with no green certification is 4,246,280.8 kWh.

[70] Garcetti, E. (2015). Los Angeles Climate Action Report. *City of Los Angeles.* Retrieved from www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/pLAn%20Climate%20Action-final-highres.pdf.
[71] U.S. Energy Information Administration. (2016). Commercial Buildings Energy Consumption Survey: 2012 CBECS Survey Data. *EIA.* Retrieved from https://www.eia.gov/consumption/commercial/data/2012/.

Maximum Potential GHG Reductions

According to *Discover Los Angeles,* LA has the sixth largest hotel market in the U.S. and offers over 997 hotels.[72] To quantify the potential GHG savings of GS-33 certification for the LA Lodging Industry, we applied the energy savings estimates from the panel regression analysis (Chapter 5) across all 997 hotels with the following procedure.

First, we quantified how much uncertified hotels make up LA's citywide emissions. This was a two-step process. The initial step was to convert the average annual LA hotel electricity consumption (gathered from the CBECS data, as described above) into greenhouse gas emissions (in metric tons of carbon dioxide, MT CO_2) using the CO_2 output emission rate specific to LA (Table 6).[73]

$$4{,}246{,}280.8\frac{kWh}{yr} * \frac{0.0005\ MT\ CO_2}{kWh} = 2{,}177.14\ \frac{\frac{MT\ CO_2}{yr}}{hotel}$$

We then extrapolated emissions per hotel out to all 997 hotels. Because the actual proportion of certified and uncertified hotels is unknown, and because the energy efficiency progress of individual hotels is unknown, we chose to create a maximum emissions reduction scenario. In this scenario we assumed 98% of the 997 LA hotels were uncertified and 2% of hotels were GS-33-certified (1% Silver, 1% Gold). These proportions support the statistic reported earlier in that "less than 4% of the lodging establishments in the United States are green certified," including Green Seal, LEED, and Energy Star Label Hotels.[74] Referring back to the panel regression results presented in Chapter 5, Bronze certification emissions reductions are not statistically significant and are therefore included in the percentage of uncertified hotels (Table 4).

Total GHG emissions from uncertified hotels in the LA Lodging Industry were thus calculated as follows:

$$2{,}177.14\ \frac{\frac{MT\ CO_2}{yr}}{hotel} * (0.98 * 997\ hotels) = 2{,}127{,}193.66\ \frac{MT\ CO_2}{yr} = 2.13\ \frac{MMT\ CO_2}{yr}$$

According to LA's most recent inventory in 2013, current emissions levels are at 29 million metric tons carbon dioxide equivalent (MMT CO_2e).[75] This means that with 98% of hotels being uncertified, the lodging industry accounts for approximately 10% of the total emissions in the City, or about 15% of the emissions for the energy sector. Figure 7 shows a breakdown of LA's GHG emissions by sector.

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[72] *Discover Los Angeles.* "Facts About Los Angeles." Retrieved February 22, 2017 from http://www.discoverlosangeles.com/press-releases/facts-about-los-angeles.

[73] United States Environmental Protection Agency. (2016). Greenhouse Gas Equivalencies Calculator. Retrieved February 20, 2017 from https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

[74] Baylor, J. (n.d.). The value of green certification [review]. *Hotel Business Review*. Retrieved from http://hotelexecutive.com/business_review/3093/the-value-of-green-certification.

[75] Garcetti, E. (2015). Los Angeles Climate Action Report. *City of Los Angeles.* Retrieved February 18, 2017 from https://www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/pLAn%20Climate%20Action-final-highres.pdf.

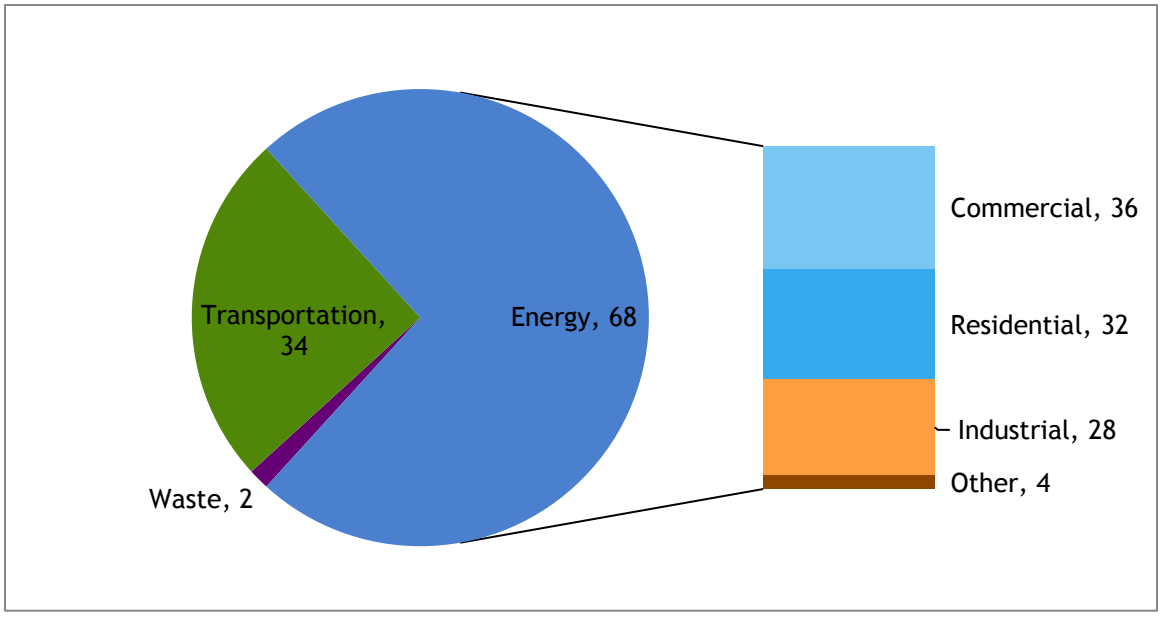

Figure 7. Los Angeles GHG Emissions by Sector
Percentage of GHG emissions for the energy (blue), transportation (green), and waste (purple) sectors in Los Angeles. Energy is further broken down into its components: commercial (light blue), residential (dark blue), industrial (orange), and other (brown). Lodging Industry is taken from the hypothetical hotel scenario described above.[76]

Next, we multiplied the average electricity consumption for an uncertified hotel by the energy savings that would be acquired if a hotel were to upgrade to a Silver and Gold level. The energy savings, which were obtained from the panel regression analysis, are 8.77% and 18.22%, respectively. This gave us the estimated average annual electricity consumption for a Silver and Gold GS-33-certified hotel in LA.

$$Silver\text{: } 4{,}246{,}280.8\ \frac{kWh}{yr} * (1 - 0.0877) = 3{,}752{,}964.85\frac{kWh}{yr}/hotel$$

$$Gold\text{: } 4{,}246{,}280.8\ \frac{kWh}{yr} * (1 - 0.0877 - 0.1822) = \ 2{,}979{,}254.28\frac{kWh}{yr}/hotel$$

Energy consumption comparisons for Uncertified/Bronze, Silver, and Gold-certified hotels are illustrated in Figure 8.

[76] Garcetti, E. (2015). Los Angeles Climate Action Report. *City of Los Angeles.* Retrieved from www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/pLAn%20Climate%20Action-final-highres.pdf.

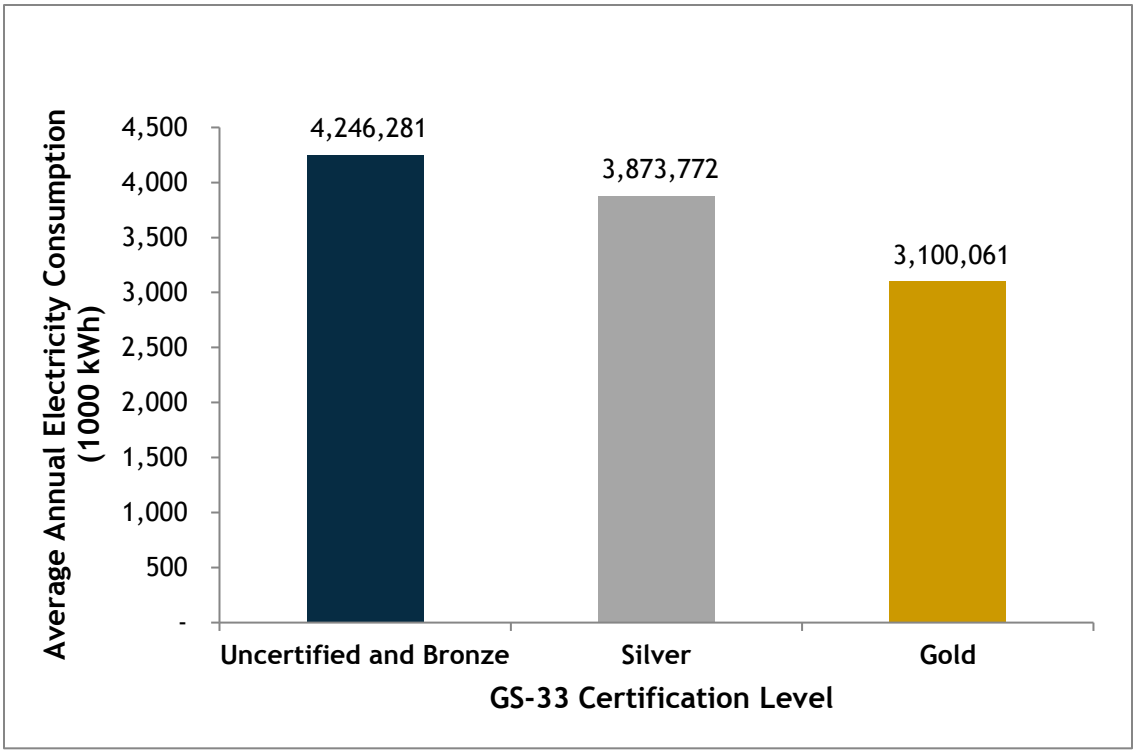

Figure 8. Average Annual Electricity Consumption for Uncertified, Silver, and Gold GS-33-Certified Hotels in Los Angeles

Finally, to determine GHG reduction potential in terms of 2025 City goals, we made the following assumptions about the timing of certification upgrades:

- It takes uncertified hotels three years to achieve GS-33 Silver certification.

This assumption is based off the GS-33 Compliance Guidelines,[77] which state that "Properties receiving Bronze certification will have three years from the date of certification to progress to Silver. Failure to progress to Silver in the timeframe specified will result in loss of certification." Once again, we assume that Bronze hotels hold the same status as uncertified hotels.

- It takes GS-33 Silver-certified hotels three years to achieve Gold certification.

Although Green Seal does not currently require Silver-certified hotels to achieve Gold certification, we assumed that if this were a requirement, Green Seal would enforce a similar deadline as the Bronze to Silver advancement.

- Certification upgrades begin in January 2018.

- All certification achievements receive a one-time occurrence emissions reduction.

[77] Green Seal. (2016). Fees for Green Seal certification under GS-33 standard for lodging properties. *Green Seal.* Retrieved from http://www.greenseal.org/Portals/0/Documents/Fees/2016/GS-33%20Fee%20Schedule.pdf.

Timing assumptions are necessary because emissions savings will accumulate on a year-by-year basis, which will ultimately affect how the lodging sector can contribute to LA's 2025 goals. The timeline of certification upgrades adheres to the sequence of events illustrated in Figure 9. Following the above assumptions, we proceeded to calculate energy and emissions savings for the City of LA.

Figure 9. Timeline of GS-33 Certification Upgrades

Energy Savings from Electricity Usage Reductions

To obtain the energy savings from all uncertified hotels, we found the difference between the annual electricity usage for Uncertified/Bronze and Silver levels and then for Silver and Gold levels (Figure 8).

$$Uncertified/Bronze\ to\ Silver: 4{,}246{,}280.77\ \frac{kWh}{yr} - 3{,}873{,}771.54\ \frac{kWh}{yr} = 372{,}509.23\ \frac{kWh}{yr}/hotel$$

$$Silver\ to\ Gold: 3{,}873{,}771.54\ \frac{kWh}{yr} - 3{,}100{,}060.97\ \frac{kWh}{yr} = 773{,}710.57\ \frac{kWh}{yr}/hotel$$

Total Emissions Savings from Electricity Usage Reductions

After calculating the electricity usage reductions by moving to the Silver and Gold levels, we then converted total electricity savings (kWh) into emissions savings (MT CO_2) and extrapolated these out to the City, assuming that 98% of the 997 hotels became Silver-certified by December 2020 and 3 years later, 99% of the hotels became Gold-certified (by December 2023).

$$Uncertified/Bronze\ to\ Silver: 372{,}509.23\frac{\frac{kWh}{yr}}{hotel} * \frac{0.0005\ MT\ CO_2}{kWh} * (0.98 * 997\ hotels) = 186{,}610.19\ \frac{MT\ CO_2}{yr} = 0.19\ \frac{MMT\ CO_2}{yr}$$

$$Silver\ to\ Gold: 773{,}710.57 \frac{\frac{kWh}{yr}}{hotel} * \frac{0.0005\ MT\ CO_2}{kWh} * (0.99 * 997\ hotels)$$
$$= 391{,}548.87\ \frac{MT\ CO_2}{yr} = 0.39 \frac{MMT\ CO_2}{yr}$$

Results

To meet LA's GHG emissions target of 20 MMT CO_2e by 2025, the City must decrease its baseline emission by 9 MMT CO_2e. Figure 10 shows the potential emissions reductions from the scenario described above. If 98% of uncertified hotels were to become Silver-certified, Los Angeles would decrease its emissions by 0.19 MMT CO_2. Next, if all 99% of Silver-certified hotels (including the 1% that was already Silver-certified) were to become Gold-certified, LA would reduce an additional 0.39 MMT CO_2. In total, this accounts for 6.4% of the total emissions reduction goal for 2025.

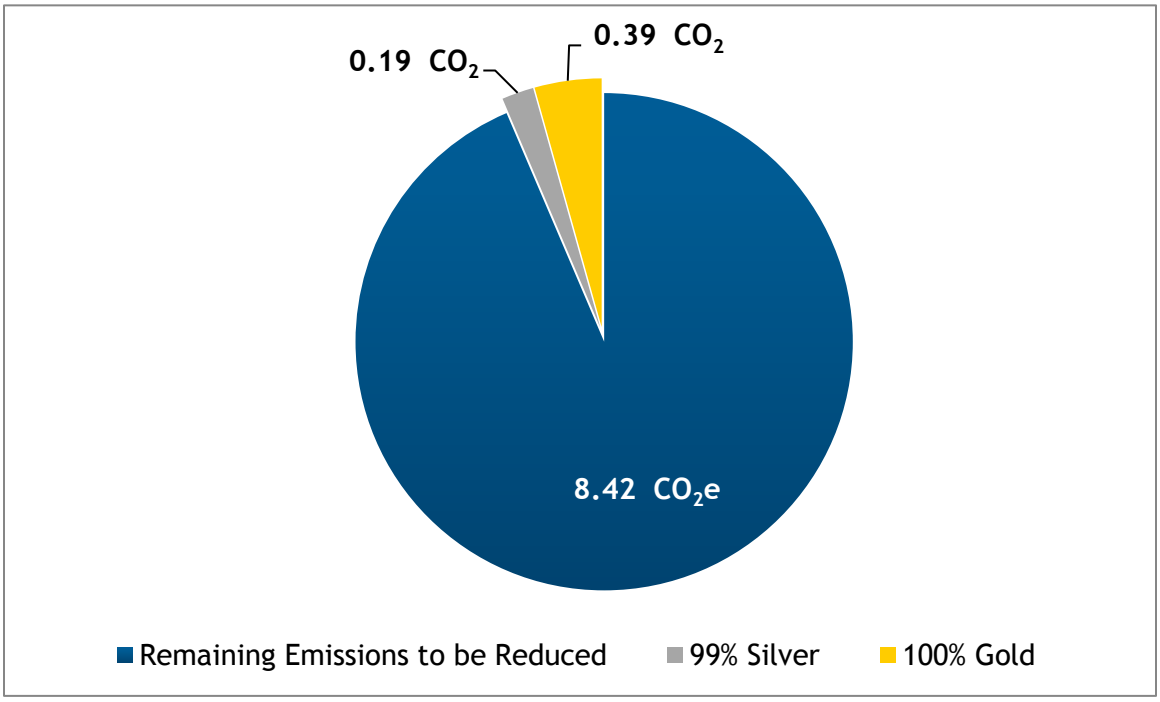

Figure 10. Potential Emissions Reductions from GS-33 Hotels for 2025 Goal
GHG reductions from LA's baseline emissions level (29 MMT CO_2e) if 99% of hotels in LA were to become Silver-certified and then if 100% of hotels were to become Gold-certified.

Figure 10 describes how many emissions will be reduced from the baseline level; it does not factor in the accumulation of year-to-year savings. To account for these extra savings, we added yearly GHG emissions from 2017 to 2025 (for the maximum reductions scenario) and then compared the sum to the total number of GHG emissions that would have been produced under business-as-usual conditions. Therefore, following the assumption that all hotels achieve their expected upgrades within the defined timeline, total emissions reductions add up to 1.72 MMT

saved now until 2025. According to the emissions factor specific to Los Angeles, this is equivalent to over 362,000 passenger vehicles off the road for one year.[78] A summary of yearly emissions savings is provided in Table 5.

Table 5. Total Emissions Savings for the City of LA up to 2025

Year	Business as Usual (MMT CO_2)	GHG Emissions (MMT CO_2)
2017	29	29
2018	29	29
2019	29	29
2020	29	29
2021	29	28.81
2022	29	28.81
2023	29	28.81
2024	29	28.42
2025	29	28.42
Total	**261**	**259.28**
Emissions Savings		**1.72**

Figure 11 is a graphical representation of the yearly emissions described in Table 5. In 2021, there is a noticeable drop in total emissions from GS-33 Silver certification upgrades, and there is another drop in 2024 from Gold certification upgrades.

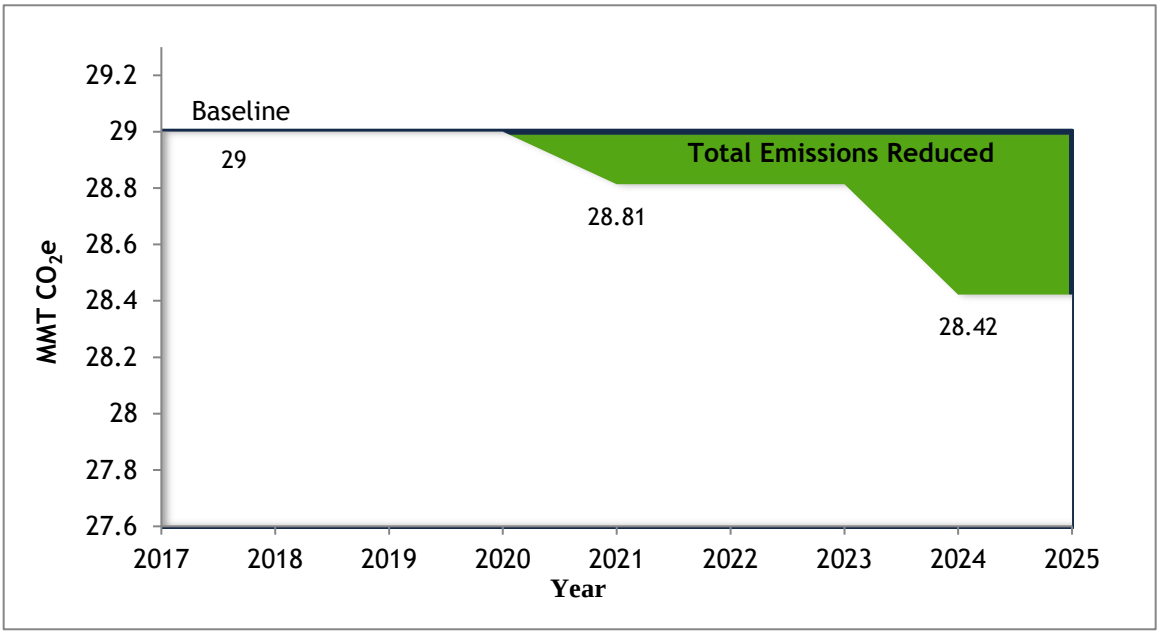

Figure 11. Maximum Emissions Savings from GS-33-Certified Hotels
Total emissions reduced from the maximum emissions reduction scenario from 2020 to 2025.

[78] United States Environmental Protection Agency. (2016). Greenhouse Gas Equivalencies Calculator. Retrieved February 20, 2017 from https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

For the maximum potential emissions reduction scenario, we assumed the current number of uncertified hotels to be 98%. To understand the range of potential emissions that could be reduced, we created a scenario analysis that calculated potential emissions savings for uncertified hotels. For the remaining certified hotels, we assumed a 5:1 ratio for Silver and Gold hotels. That is, out of 6 certified hotels, 5 hotels would be Silver-certified and 1 hotel would be Gold-certified. This assumption is based directly off the current ratio of GS-33-certified hotels in LA. If all hotels were uncertified, total emissions would be equivalent to the sum of 29 MMT CO_2 (LA's current emissions level) for every year from 2017 to 2025, assuming all else remains constant. This sum is equivalent 261 MMT CO_2. Total emissions for each scenario are then subtracted from this number to obtain total potential emissions savings from the LA lodging sector. A higher percentage of uncertified hotels reveals a higher potential for emissions savings (Figure 12).

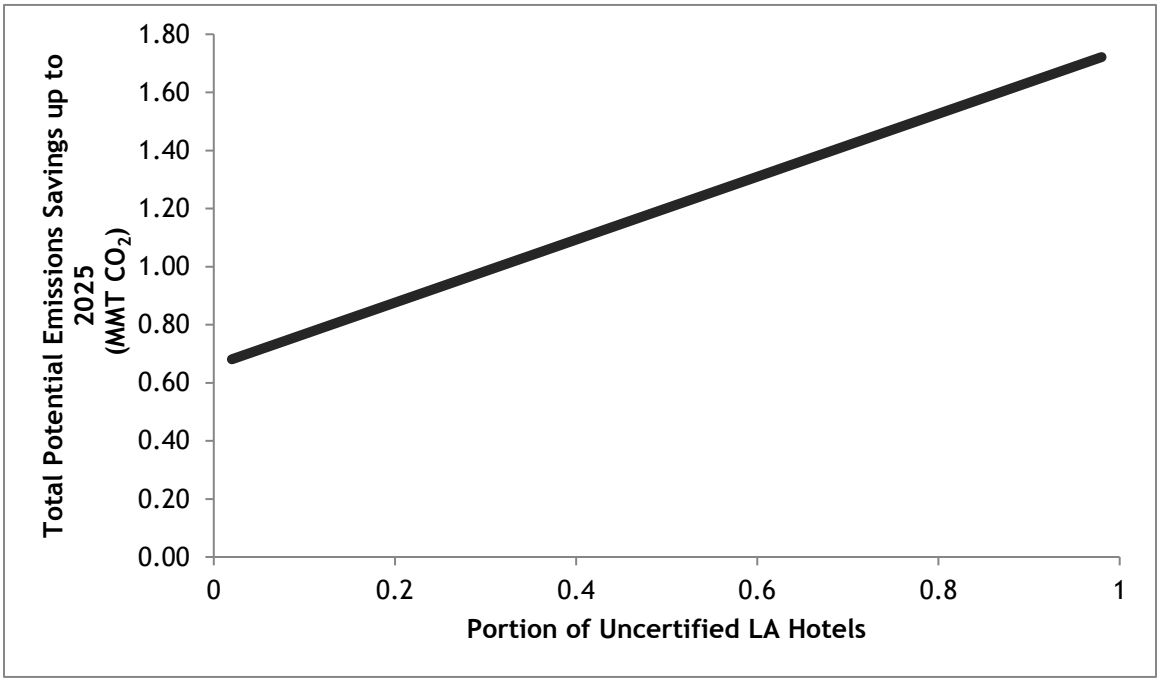

Figure 12. GS-33 Scenario Analysis of Potential Emissions Reductions for the City of Los Angeles with Unknown Number of Uncertified Hotels

Limitations

Estimating emissions reduction potential for the City of LA requires several assumptions to be made, including the average annual electricity consumption (i.e. Pacific Region vs. the City of LA), the current number of uncertified hotels in LA, the ratio of Silver to Gold-certified hotels, and the time it takes hotels to advance to higher certification levels. This analysis creates a maximum emissions reduction scenario in which all hotels will be certified by 2025. Although this is a highly unlikely scenario, it is a useful exercise to determine the magnitude in which GS-33 certification can contribute to LA's Climate Action goals. The scenario analysis then provides a range of potential emissions savings for different proportions of uncertified hotels.

Chapter 7

Green Seal Certification & Financial Impacts: Cost-Savings Analysis for Certified Hotels

Objectives

As discussed in Chapter 6, the Green Seal Standard for Hotels and Lodging Properties generates environmental benefits. Even more, there is potential for certified hotels to see financial impacts from GS-33. To meet the requirements for the Bronze and Silver levels of GS-33, hotels must replace their existing equipment with those that are more energy efficient (for a complete list of upgrade requirements, see Table 3). These energy-efficient upgrades, which include light-emitting diode (LED) lights and ENERGY STAR products, may help hotels save money over time. For example, with lighting, efficient light bulbs reduce the amount of energy needed to emit the same amount of light as more intensive bulbs, hence reducing how much electricity a consumer uses.[79] This results in less electricity being purchased from the utility, yielding dramatic savings through avoided costs of electricity. These savings from avoided costs can be applied to GS-33 requirements, quantifying the potential financial impacts from energy efficiency upgrades in hotels.

While it is known that energy-efficient equipment has the potential to lead to economic savings, it remains unknown exactly how much the GS-33 certification impacts individual hotels financially. To do this, we created an Excel-based model that determines the overall financial cost-savings from energy efficiency upgrades required in GS-33.[80]

This user-friendly Excel-based tool is targeted towards hotel General Managers who are trying to quantify the environmental and financial impacts of pursuing GS-33-related upgrades. The goal is to help hotels that are pursuing certification fully understand the environmental costs and benefits (in terms of energy and greenhouse gas emissions savings) and financial costs and benefits from equipment upgrades related to GS-33 certification.

Methodology

The model calculates energy, greenhouse gas emissions, and financial savings for each level of certification, following the guidelines of GS-33 for required upgrades. Every category of equipment that must be replaced has its own project tab, and the different tabs are colored according to which certification level the upgrade falls under. Specifically, the colored tabs represent required upgrades for the following levels:

- **Bronze:** Lighting; Exit Signs; Heating, Ventilation, and Air Conditioning (HVAC); Office & Room Equipment; Kitchen Equipment; Laundry Equipment

[79] U.S. Environmental Protection Agency. (n.d.). The business case for energy efficiency. ENERGY STAR Program. *EPA.* Retrieved from https://www.energystar.gov/buildings/about-us/how-can-we-help-you/build-energy-program/business-case.
[80] To see the full model, go to https://ucsb.box.com/v/StayGreenModel.

- **Silver:** Sensors; Windows
- **Gold:** Renewable Energy Credits (RECs) & Carbon Offsets

The methodology for energy savings differs for each equipment category, and greenhouse gas savings calculations differ for electric- and gas-based energy. Financial savings are consistent for all equipment types and include Net Present Value (NPV), Internal Rate of Return (IRR), and Payback calculations.

Energy Savings

Lighting & Exit Signs
Because power consumption for bulbs are often known, the tabs for Lighting and Exit Signs ask the user to input the power consumption for existing bulbs as well as for the upgraded, energy-efficient bulbs. Taking into account the annual usage of the bulb (in hours) and how many are replaced, energy savings are calculated as follows:

$$\begin{aligned} &Annual\ Reduction\ in\ Energy\ (kWh) \\ &\quad = [Power\ Consumption\ \boldsymbol{before}\ Certification\ (W) \\ &\quad - \ Power\ Consumption\ \boldsymbol{after}\ Certification\ (W)] * \frac{1\ kW}{1000\ W} \\ &\quad * Annual\ Usage\ (hours) * Quantity\ Replaced \end{aligned}$$

HVAC, Office, Room, Kitchen, and Laundry Equipment
The Green Seal Standard for Hotels and Lodging Properties requires that energy-consuming equipment be upgraded to more energy-efficient alternatives, and it suggests specifically replacing existing equipment with ENERGY STAR appliances. Consequently, this model assumes that all HVAC, Office, Room, Kitchen, and Laundry equipment before certification is not energy efficient and all upgrades follow ENERGY STAR efficiency standards (see Appendix C for specific ENERGY STAR equipment ratings). Using these efficiency values, the model automatically calculates the energy or gas consumption after certification for every type of upgraded equipment:

$$\begin{aligned} &Gas\ \left(Btu/_{hr}\right) or\ Power\ (W)\ Consumption\ \boldsymbol{after}\ Certification \\ &\quad = \ Gas\ or\ Power\ Consumption\ \boldsymbol{before}\ Certification * [1 \\ &\quad - Equipment\ ENERGY\ STAR\ Savings\ Rating\ (\%)] \end{aligned}$$

The annual reduction in gas/power is calculated the same as above (as described under Lighting & Exit Signs) by calculating the difference between the gas/power consumption for the equipment used before and after certification and extrapolating those values out for the whole year.

Sensors
To calculate the annual reduction in energy from sensors, the model assumes that sensors ensure lighting is only used when the space is occupied. Therefore, the key input in the Sensor tab is the percentage of time the area impacted by the sensor (before the device was installed) is unoccupied but lit. Taking this value into consideration along with the average power

consumption per bulb in the area, the total number of bulbs, and the annual usage (in hours) of the bulbs, the annual reduction in energy from sensors is calculated as follows:

$$\begin{aligned} &Annual\ Reduction\ in\ Energy\ from\ Sensors\ (kWh) \\ &\quad = [Average\ Power\ Consumption\ (W) * \#\ Bulbs * Annual\ Usage\ (hours) \\ &\quad * \%\ Unoccupied] * \frac{1\ kW}{1000\ W} \end{aligned}$$

Windows

Similar to the methodology for general ENERGY STAR equipment (as described under the HVAC section above), the Windows tab uses ENERGY STAR ratings for window replacements and window film to calculate how much these upgrades can reduce the overall annual energy consumption of a building. These calculations assume the ENERGY STAR rating for windows will reduce overall building energy usage, regardless of building type or window location.

Because window replacements impact the annual energy usage of the building, the new annual energy consumption value considers what percentage of windows are being replaced, the ENERGY STAR rating of those replaced windows, and how much electricity the building was consuming before certification:

$$\begin{aligned} &New\ Annual\ Energy\ Consumption\ \boldsymbol{after}\ window\ replacement\ (kWh) \\ &\quad = Current\ Annual\ Electricity\ Use\ \boldsymbol{before}\ replacement\ (kWh) \\ &\quad - \left[Current\ Electricity\ Use(kWh) * Window\ ENERGY\ STAR\ Savings\ Rating\ (\%)\right. \\ &\quad \left. * \frac{Total\ \#\ of\ Windows\ in\ Building}{\#\ Windows\ being\ replaced}\right] \end{aligned}$$

The annual reduction in energy (kWh) is then calculated as the difference between the current annual electricity use before window replacement and the new annual electricity consumption after window replacement.

Renewable Energy Credits (RECs)

The RECs & Carbon Offsets tab provides two values for the users: the annual reduction in energy (in kWh) from purchasing RECs as well as the remaining annual energy consumption (in kWh) hotels need to offset to meet the 100% emissions reduction goal that falls under the Gold level.

The annual reduction in energy from purchasing RECs is a simple calculation. Because 1 REC is equal to 1 MWh of electricity, the annual reduction in kWh is 1000 times greater than the number of RECs purchased. For example, if a hotel purchases 4 RECs, the annual reduction in energy is 4000 kWh.

The calculations for the remaining annual energy consumption hotels need to offset to meet the Gold 100% emissions reduction goal are twofold. First, the current annual energy consumption to be offset is calculated as the difference between the annual energy consumption before certification and the energy savings from upgrades made to meet the Bronze and Silver levels. This is called the Annual Energy (in kWh) needed to offset before RECs:

$$\begin{aligned} &Annual\ Energy\ Need\ to\ Offset\ \boldsymbol{before}\ RECs\ (kWh) \\ &\quad = Current\ Annual\ Electricity\ Use\ \boldsymbol{before}\ Certification\ (kWh) \\ &\quad - [Energy\ Savings\ from\ Bronze\ Upgrades\ (kWh) \\ &\quad + Energy\ Savings\ from\ Silver\ Upgrades\ (kWh)] \end{aligned}$$

Next, the remaining annual energy consumption to be offset after RECs is calculated as the difference between the annual energy needed to be offset before RECs and the annual reduction in energy from RECs:

$$\begin{aligned} &Annual\ Energy\ Need\ to\ Offset\ \boldsymbol{after}\ RECs\ (kWh) \\ &\quad = Annual\ Energy\ Need\ to\ Offset\ \boldsymbol{before}\ RECs\ (kWh) \\ &\quad - Annual\ Reduction\ in\ Energy\ from\ RECs\ (kWh) \end{aligned}$$

The purpose of this value is to inform the user exactly how many RECs are needed to ensure the annual energy usage is offset 100% by RECs or other similar means. The goal is to have this value eventually be 0 kWh, thus showing the hotel has met the Gold level energy requirements.

Greenhouse Gas Savings

Users can select if the equipment they are upgrading uses natural gas or electricity. Because the greenhouse gas emissions for these two sources differ, calculating the resulting greenhouse gas savings from energy savings has separate methodologies depending on the source.

Electric Energy (kWh/year)

Energy savings in kilowatt-hours per year (kWh/year) are from reduced electricity consumption and consequently electricity purchasing. For the purposes of this project, all hotels are assumed to purchase electricity from the Los Angeles Department of Water and Power (LADWP). Therefore, this reduction in electric energy utilizes the LADWP grid mix to calculate resulting greenhouse gas savings.

Table 6. Fuel Emissions Factors and Power Plant Efficiencies

Fuel Source	LADWP Grid Mix[81] (%)	Emissions Factor[82] (kg CO_2/MMBtu)	Efficiency[83] (%)
Coal, Electric Power Sector	42	94.70	0.34
HHV 1025-1050 Btu/sq. ft.	17	53.06	0.35

[81] Los Angeles Department of Water and Power. (2015). 2015 Briefing Book. *LADWP News.* Retrieved from http://www.ladwpnews.com/external/content/document/1475/2606574/1/2015%20Briefing%20Book%2002-26-2015LR.pdf.

[82] U.S. Energy Information Administration. (2013). Voluntary reporting of greenhouse gases. Form EIA-1605; Appendix H. *EIA.* Retrieved from https://www.eia.gov/oiaf/1605/.

[83] U.S. Energy Information Administration. (2016). Annual Electric Generator Report. Form EIA-860; Table 8.2. *EIA.* Retrieved from http://www.eia.gov/electricity/annual/html/epa_08_02.html.

Using carbon accounting methodology, the electricity savings from efficiency upgrades are divided between coal and natural gas emissions. This divide is based on the LADWP grid mix, with 42% of electricity usage being attributed to coal emissions and 17% being attributed to natural gas.[84] These split kWh values for coal and natural gas are then converted into greenhouse gas emissions using the U.S. Energy Information Administration's emissions factors and power plant efficiencies, as well as the losses from transmission and distribution (which is about 5%)[85]:

$$Greenhouse\ Gas\ Emissions\ (MT\ CO_2) = Energy\ Savings\ (kWh) * \frac{0.00341\ MMBtu}{kWh} * \frac{1\ MT}{1000\ kg} * \Sigma_i [LADWP\ Grid\ Mix\ _i(\%) * \frac{Emissions\ Factor_i\ (kg\ CO_2)}{1\ MMBtu} * \frac{1}{Efficiency_i\ (\%)} * \frac{1}{1 - T\&D\ Losses\ (\%)}]$$

Gas Energy (Btu/year)

Energy savings in British Thermal Units per year (Btu/year) are from reduced natural gas consumption and consequently natural gas purchasing. For the purposes of this project, all hotels are assumed to purchase natural gas from the Southern California Gas Company (SoCalGas). Therefore, this reduction in electric energy utilizes SoCalGas' presumed pipeline high heating value of 1025-1050 Btu per square-foot to calculate resulting greenhouse gas savings (Los Angeles Basin has a monthly average heating value of 1000-1060 Btu, which falls within the 1025-1050 Btu per square-foot range).[86]

Because natural gas is burned onsite, power plant efficiency and transmission and distribution losses are not considered in this carbon accounting. Therefore, using the same emissions factor found in
Table 6, greenhouse gas emissions from natural gas consumption are calculated as follows:

$$Natural\ Gas\ Emissions\ (MT\ CO_2) = Energy\ Savings\ \left({Btu}/{year}\right) * \frac{0.00341\ MMBtu}{kWh} * \frac{53.06\ kg\ CO_2}{1\ MMBtu} * \frac{1\ MT}{1000\ kg}$$

Carbon Offsets

The RECs & Carbon Offsets tab provides two values for the users: the annual reduction in emissions (in metric tons of carbon dioxide) from purchasing carbon offsets as well as the remaining annual emissions (in metric tons (MT) CO_2) hotels need to offset to meet the 100% greenhouse gas reduction goal that falls under the Gold level.

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[84] Los Angeles Department of Water and Power. (2015). 2015 Briefing Book. *LADWP News.* Retrieved from http://www.ladwpnews.com/external/content/document/1475/2606574/1/2015%20Briefing%20Book%2002-26-2015LR.pdf.

[85] U.S. Energy Information Administration. (2017). Frequently Asked Questions: How much electricity is lost in transmission and distribution in the United States? *EIA.* Retrieved from https://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3.

[86] Southern California Gas Company. (2010). Rule No. 02 Description of Service: Filing to the California Public Utilities Commission. *SoCalGas.* Retrieved from https://www.socalgas.com/regulatory/tariffs/tm2/pdf/02.pdf.

The annual reduction in emissions from purchasing carbon offsets is a simple calculation. Because 1 carbon offset is equal to 1 metric ton of CO_2, the annual reduction in emissions is equal to the number of carbon offsets purchased.

The calculations for the remaining annual emissions (in MT CO_2) hotels need to offset to meet the Gold level 100% emissions reduction goal are twofold. First, the current annual emissions that need to be offset is calculated as the difference between the annual greenhouse gas emissions before certification and the emissions reductions from upgrades made to meet the Bronze and Silver levels. This is called the Annual Emissions (in Metric Tons CO_2) needed to offset before carbon offsets:

$$\begin{aligned} &Annual\ Emissions\ Need\ to\ Offset\ \boldsymbol{before}\ carbon\ offsets\ (MT\ CO_2) \\ &\quad = [Current\ Annual\ Electricity\ Use\ \boldsymbol{before}\ Certification\ (kWh) \\ &\quad * Electric\ Energy\ Conversions\ (\frac{MT\ CO_2}{kWh})] \\ &\quad - [Emissions\ Reductions\ from\ Bronze\ Upgrades\ (MT\ CO_2) \\ &\quad + Emissions\ Reductions\ from\ Silver\ Upgrades\ (MT\ CO_2)] \end{aligned}$$

Next, the remaining emissions to be offset after carbon offsets is calculated as the difference between the annual emissions needed to be offset before RECs and the annual reduction in emissions from carbon offsets:

$$\begin{aligned} &Annual\ Emissions\ Need\ to\ Offset\boldsymbol{after}\ RECs\ (kWh) \\ &\quad = \ Annual\ Emissions\ Need\ to\ Offset\ \boldsymbol{before}\ carbon\ offsets\ (MT\ CO_2) \\ &\quad - Annual\ Reduction\ in\ Emissions\ from\ carbon\ offsets\ (MT\ CO_2) \end{aligned}$$

The purpose of this value is to inform the user exactly how many carbon offsets they need to purchase to ensure their annual emissions are offset 100% by carbon offsets or other similar means. The goal is to have this value eventually be 0 MT CO_2, thus demonstrating that the hotel has met the Gold level requirements.

Financial Savings

To calculate the financial savings from efficiency upgrades, this model projected a 20-year cash flow for costs and savings of each replacement project using the cost of electricity, cost of gas, and discount rate provided by the user.

Costs

The only costs for each efficiency upgrade were the costs of installation. The installation costs are calculated as follows:

$$Installation\ Costs\ (\$) = Price\ per\ Equipment\ (\$) * Quantity\ Replaced$$

The user also inputs the lifetime of the piece of equipment, and the model assumes that installations occur at the end of the equipment's lifetime. For example, if light bulbs only have a lifetime of three years, then the installation costs occur every three years on the 20-year cash flow projection.

Savings

The savings values include avoided utility costs as well as possible rebates for the efficiency projects. For avoided utility costs, the model pulls the automatically calculated annual energy savings (either in kWh or Btu, as described above) and applies the user's electricity or natural gas rate, which is inputted on the first Instructions tab of the model:

$$\begin{aligned} &Avoided\ Utility\ Costs\ (\$) \\ &\quad = \ Annual\ Reduction\ in\ Electricity\ (kWh) * \ Electric\ Rate\ \left(\$/_{kWh}\right) \boldsymbol{OR} \\ &\quad = Annual\ Reduction\ in\ Gas\ (Btu) * \frac{1 \cdot \ 10^{-5}\ therm}{1\ Btu} * Gas\ Rate\ \left(\$/_{therm}\right) \end{aligned}$$

The model assumes that a reduction in annual electric or gas usage is equivalent to the same amount of reduced purchasing from the local utility. The avoided utility costs therefore assume that with energy-efficient equipment, utility bills will decrease due to the reduced energy usage.

In addition to avoided costs, the savings tab calculates possible rebates for energy efficiency upgrades. LADWP has existing rebates for lighting, sensors, and HVAC equipment, and these rebates are calculated with a dollar per kWh value.[87] Specifically, the rebates pull the annual reduction in energy from the upgrade, assuming this value is the savings from the replacement project, and applies the rebate value:

$$Rebates\ (\$) = \ Annual\ Reduction\ in\ Energy\ (kWh) * \ Rebate\ Savings\ Value\ \left(\$/_{kWh}\right)$$

These rebates are only applicable to initial upgrades and therefore do not account for multiple replacements (for example, from lifetimes shorter than 20 years).

The model tab Available Rebates contains the full list of existing relevant rebates from LADWP. Because this list changes often, there are instructions to Green Seal explaining how to update important information on rebates. The model automatically incorporates any changes or additions the client would like to make to this tab.

Net Present Value (NPV)

The model calculates the annual cash flow from the project by finding the difference between costs and savings for each of the 20 years. These values can then be applied in the net present value calculation, which is the present value of the annual savings for the 20-year cash flow. The discount rate for the individual hotel is inputted under the Instructions tab and is used in the NPV function in Excel:

$$\begin{aligned} &NPV\ (\$) \\ &= \ NPV(Discount\ Rate, Range\ of\ Annual\ Savings\ for\ each\ of\ the\ 20\ years\ in\ the\ Cash\ Flow) \end{aligned}$$

[87] Los Angeles Department of Water and Power. (2013). Rebates and Programs. *LADWP*. Retrieved from https://www.ladwp.com/ladwp/faces/ladwp/commercial/c-savemoney/c-sm-rebatesandprograms?_adf.ctrl-state=1dore2cbai_4&_afrLoop=341625037812246&_afrWindowMode=0&_afrWindowId=mkjq47sou_18#%40%3F_afrWindowId%3Dmkjq47sou_18%26_afrLoop%3D341625037812246%26_afrWindowMode%3D0%26_adf.ctrl-state%3Dmkjq47sou_34.

The goal of the NPV is to show users if the planned project yields benefits over time. A positive NPV suggests that the efficiency project is worth pursuing whereas a negative NPV implies that the project may not be worth the upfront investment.

Internal Rate of Return (IRR)
The internal rate of return calculates the necessary discount rate to ensure net present value for a project is zero. Internal rate of return can also be compared to a user's hurdle rate to see if the initial investment for a project is offset within the required rate of return. The IRR calculation in Excel applies a simple function to the annual cash flow:

$$IRR\ (\$) = IRR(Range\ of\ Annual\ Savings\ for\ each\ of\ the\ 20\ years\ in\ the\ Cash\ Flow)$$

The goal of the IRR value is to see if the percentage is higher or lower than the company's discount rate. If higher, IRR suggests that the efficiency project is worth pursuing; if lower, the project may not be worth the upfront investment

Simple Payback
The model only calculates payback for the initial upgrade; this model does not account for multiple upgrades that may be required due to limited equipment lifetime. Therefore, simple payback is calculated as the amount of time it takes for annual savings to cover, or pay back, the initial investment for the equipment upgrade.

To calculate simple payback, the model incorporates a secondary 20-year project cash flow with only the initial installation under costs. This initial installation project cash flow calculates annual savings for each year as well as cumulative savings over the course of the 20-year cash flow, summing annual savings over time. Payback incorporates two calculations: the amount of years the cumulative savings are negative (i.e. when cumulative annual savings have yet to surpass the initial investment); and, the "fraction" of payback, or when an investment is paid back partway through a year. In Excel, this fraction is calculated as follows:

$$Fraction\ Calculations = IF(Cumulative\ Savings\ for\ current\ year < 0, "", ABS(Cumulative\ Savings\ for\ current\ year) \Big/ Annual\ Savings\ for\ previous\ year)$$

Put in simple terms, the fraction calculations occur only when the cumulative savings surpass 0 (i.e., the year the initial investment is paid back). These calculations then take the fraction of that year in which the investment remains negative. Following this logic, the fraction calculation informs the user exactly how long it takes for an investment to fully be covered by savings into the final year of payback.

The final step of calculating simple payback is a complicated statement in Excel that can be easily broken down:

$$Payback(years) = COUNTIF(Range\ of\ Cumulative\ Savings\ for\ the\ 20 - year\ Cash\ Flow,"< 0") + INDEX(Range\ of\ Fraction\ Calculations\ for\ the\ 20 - year\ Cash\ Flow,,COUNTIF(Range\ of\ Cumulative\ Savings\ for\ the\ 20 - year\ Cash\ Flow,"< 0") + 1)$$

This function counts the number of years the cumulative savings are negative and adds the fraction calculation to this number, including a value of one for the year in which the fraction occurs. For example, if there are 3 years that have negative cumulative savings and in year 4 the fraction calculation was 0.78, the payback period would be calculated as:

$$Payback\ (years) = Neg.Cumulative\ Savings + Fraction + 1 = 3 + 0.78 + 1 = 4.78\ years$$

This value potentially has the greatest significance for the users because it allows them to understand how long it will take an individual project to see the financial benefits in the forms of savings.

Gold Level

Because RECs and carbon offsets are simply an initial upfront investment and do not yield any financial savings over time, this tab does not calculate the 20-year cash flow of the projects. Consequently, the RECs & Carbon Offsets tab does not include NPV, IRR, or payback.

Potential Cumulative Environmental & Financial Savings

The final tab, Potential Savings, takes the environmental and financial results from all individual projects and aggregates them into a comprehensive table that divides benefits by level. These tables separate overall greenhouse gas reductions (in metric tons CO_2) and cumulative cash flows (in $) for each equipment type as well as for each level (Bronze, Silver, and Gold). Moreover, the cumulative cash flows are also presented in present value, incorporating the discount rate provided by the user. For the Gold level, the present value is equivalent to the cumulative upfront investments because REC and carbon offset purchases are assumed to be done in Year 1, which is already a present value.

The purpose of this tab is to show the user potential overall environmental and financial savings from upgrades needed to meet GS-33 requirements for Bronze, Silver, and Gold levels. It simplifies the information provided by each project into a comprehensible format for the overall certification benefits, separated by level.

Results

This model is most beneficial to individual hotels that are debating whether to pursue certification. It not only informs them of what steps need to be taken to meet the GS-33 environmental requirements, but it also shows them how much they are impacted financially from energy efficiency upgrades. The goal of this model is to provide Green Seal with a tool to share with certified hotels or with hotels it is targeting for certification, enabling them to emphasize the environmental and financial costs and benefits of the green lodging certification.

For our research, we were interested in running a case study through the model to understand how much a lighting upgrade project could impact a hotel seeking certification. Using lighting replacement information from a high-end LA hotel that is currently pursuing certification, we calculated how much upgrading existing bulbs with energy-efficient bulbs would cost and benefit a hotel, both environmentally and financially. Additionally, we proposed installing sensors for a portion of these lights to help the case-study hotel meet Silver-level requirements

Case Study Assumptions

Lighting
For this case study, we used data from a proposed lighting upgrade from one of the GS-33-certified hotels. There were 8,771 lighting replacements in total, and each upgrade consisted of replacing a light bulb with one that consumed less power (in watts).

Sensors
We assumed that 1,276 sensors were added to individual lights in meetings rooms, the back rooms, ballroom, and boardroom. These sensors were added to the upgraded light bulbs, and the areas with the sensors were only occupied 50% of the time.

Case Study Results

Lighting
From the lighting upgrades, which fall under the Bronze level of the certification, we found that the case-study hotel has the potential to reduce its emissions a total of 1,066 MT CO_2 annually after the upgrades were completed. Furthermore, these replacements show financial benefits as well: over a 20-year project cash flow, the hotel saw $1,562,157 in cumulative savings from avoided utility costs, which equaled $232,204 in present value (with a 10% discount rate).

Sensors
For the Silver level of GS-33, which includes sensor installation, we found that the hotel could potentially reduce its emissions 98.34 MT CO_2 annually, with cumulative savings of $384,951 and present-value savings of $57,220 (with a 10% discount rate).

Discussion

Based on the case study results, hotels can see potential financial gains from lighting projects. These results can help hotels seeking certification target lighting upgrades as "low-hanging fruit," or efficiency upgrades that yield higher benefits than costs. This will not only incentivize the upfront costs, but it will also provide additional funds that can be used for more expensive upgrades in different levels in the future. Moreover, our case study highlights the benefits of the tool in quantifying a cost-effective approach to pursuing GS-33.

Chapter 8

Green Seal Certification & Financial Benefits: Consumer Response to Certified Hotels

Objectives

In addition to analyzing potential greenhouse gas emissions reductions and financial benefits of GS-33, this project sought to better understand how consumers react to green lodging certifications. Previous research indicates that consumers consider environmental impact when making travel plans, and two-thirds of travelers consider active protection of the environment to be part of a hotel's responsibility.[88] Additionally, less than 4% of the lodging establishments in the United States are green certified. This may give certified hotels the opportunity to stand out to their customers, travel websites, and bloggers.[89]

According to a 2013 survey by TripAdvisor, an online travel website, 79% of travelers think it is important that accommodation providers implement eco-friendly practices.[90] However, 56% of travelers are skeptical of hotels "greenwashing," or using misleading marketing messages to overemphasize their environmental impact reductions.[91]

Despite these studies pointing to consumer preferences moving towards green-certified hotels, there have been few studies investigating if and how much more consumers would be willing to pay for these hotels. Some studies indicate that consumers are generally willing to pay more for green products.[92] Other studies have found that while consumers value environmental steps taken by hotels, they are not willing to pay a premium for these environmental practices.[93] Still, others argue that consumers' reactions to corporate social responsibility initiatives differ across different consumer segments.[94]

One study by Kang et al. in 2012 sought to explore consumers' willingness to pay more directly.[95] Firstly, this study found that 30% of people said they would "pay more to stay at a

[88] Baylor, J. (n.d.). The value of green certification [review]. *Hotel Business Review*. Retrieved from http://hotelexecutive.com/business_review/3093/the-value-of-green-certification.
[89] Ibid.
[90] International Tourism Partnership. (n.d.). Carbon emissions. *Internal Tourism Partnership*. Retrieved from http://tourismpartnership.org/carbon-emissions.
[91] Baylor, J. (n.d.). The value of green certification [review]. *Hotel Business Review*. Retrieved from http://hotelexecutive.com/business_review/3093/the-value-of-green-certification.
[92] Creyer, E.H. (1997). The influence of firm behavior on purchase intention: do consumers really care about business ethics? *Journal of Consumer Marketing*, 14(6), 421-432. DOI: http://dx.doi.org/10.1108/07363769710185999.
[93] Manaktola, K. & Jauhari, V. (2007). Exploring consumer attitude and behaviour towards green practices in the lodging industry in India. *International Journal of Contemporary Hospitality Management*, 19(5), 364-377.
[94] Bhattacharya, C.B., Sen, S. (2004). Doing better at doing good: when, why, and how consumers respond to corporate social initiatives. *California Management Review*, 47(1), 9-24.
[95] Kang, K. H. et al. (2012). Consumer's willingness to pay for green initiatives of the hotel industry. *International Journal of Hospitality Management*, 31(2), 564-572.

hotel that is making efforts to be environmentally sustainable." They also found that levels of environmental concern were significantly and positively correlated with willingness to pay for environmental practices. Furthermore, they found that luxury and mid-priced hotel customers are generally more willing to pay a premium for environmental practices than customers staying in economy hotels. Interestingly, and perhaps at odds with this previous finding, they also found that willingness to pay a premium for a green hotel decreases amongst people with higher incomes. These results, along with the findings of earlier studies, suggest there is room for research in this field to explore consumers' willingness to pay.

In efforts to expand upon this research and apply it directly to our study, we conducted two surveys to analyze consumers' willingness to pay for green-certified hotels. The findings of these surveys would help us determine whether hotels can increase their nightly rates once they achieve GS-33 certification. It may be valuable for hotels to offset the costs of certification and initial investments by raising their nightly rates. If they know that consumers are willing to pay more for environmental attributes and third-party certification, then hotels may be more comfortable with raising rates.

We fielded two surveys to analyze the interactions between consumer willingness to pay and green hotel certification. The first survey tested if customers are willing to pay a premium for a green-certified hotel. The second survey, on the other hand, tested whether a green-certified hotel's description of the environmental benefits from green certification affect consumer's willingness to pay.

Methodology

To determine whether consumers are willing to pay more for a hotel with a green certification than one without, we conducted a survey experiment using Amazon Mechanical Turk (MTurk). This is an online platform where "requesters" can pay "workers" to perform electronic tasks. Researchers and social scientists use this service to conduct primary research by paying people to partake in surveys or experiments. While the workers tend to be younger than average, as well as overeducated, underemployed, less religious, and more liberal than the general U.S. population,[96] they are more representative and diverse than convenience sampling or samples of college students.[97] Given this, we decided that this platform was appropriate to use in fielding our surveys. Additionally, our surveys were only made available to a subset of Amazon MTurk users – those who live in the United States – since the GS-33 standard is primarily administered to hotels in the U.S.

Survey 1 Methodology

Our first survey was specifically designed to test the hypothesis that people are willing to pay more for a hotel with a green certification than a hotel without one.

[96] Paolacci, G., & Chandler, J. (2014). Inside the Turk: understanding mechanical turk as a participant pool. *Current Directions in Psychological Science*, 23(3) 184-188. DOI: 10.1177/0963721414531598.

[97] Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for experimental research: Amazon.com's Mechanical Turk. *Political Analysis,* 20(3): 351-368. DOI: 10.1093/pan/mpr057.

Null hypothesis: Consumers are **not** willing to pay more for a hotel with a green certification than a hotel without one.

Alternative hypothesis: Consumers **are** willing to pay more for a hotel with a green certification than a hotel without one.

The survey was designed using the online survey-building platform Qualtrics, and it contained ten questions. These questions were used to collect data on environmental attitudes, hotel preferences, and general demographic information from the respondents. One question sought to test the hypothesis through an experiment. The survey contained two versions of this question – a control version and a treatment. The control question described a generic hotel and then asked respondents how much they would be willing to pay to stay in this hotel. The control hotel description is as follows, and the full text of this question can be seen in Appendix D:

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites."

The treatment question contained the exact same description as the control version in addition to a description of a fictional green certification the hotel had received for taking steps to reduce its environmental footprint. The treatment hotel description follows, with emphasis added to show the differences between the control and the treatment (the full text of this question can be seen in Appendix D):

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. *The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts.*"

Half of the respondents were randomly administered the control, and the other half were administered the treatment. This survey experiment design allowed for two random sets of responses from different respondents of the same sample.

See Appendix D for full survey questionnaire.

<u>Survey 2 Methodology</u>

After seeing statistically insignificant results in the first survey, we revisited our hypothesis to test if consumers' willingness to pay changes based on the description of a green-certified hotel. For this survey, we developed a new hypothesis to test and used MTurk to administer a second version of the survey.

Null hypothesis: Consumers are **not** willing to pay more for a green-certified hotel that offers concrete descriptions of the environmental impact reductions than for a green-certified hotel with a vague description of the environmental impact reductions.

Alternative hypothesis: Consumers **are** willing to pay more for a green-certified hotel that offers concrete descriptions of the environmental impact reductions than a green-certified hotel with a vague description of the environmental impact reductions.

For this survey, we made minor refinements to some of the questions in the first survey, but the main changes came in the experimental question. Where we previously had one control version and one treatment version, we instead designed the survey to have four different versions of the treatment to determine if consumers' willingness to pay is higher when the green-certified hotel's environmental reductions are more clearly communicated.

The control version of the question was the exact same as the control used in our first survey. This text describes a generic hotel with no mention of sustainable practices or certifications. The four treatments all contained varying forms of the green certification descriptions. We added different text to include information about the greenhouse gas emissions reductions associated with the hypothetical green certification. These emissions reductions used the results from the panel regression (see Table 4), and the results for GS-33 Bronze, Silver, and Gold-certified hotels were used to calculate the descriptions in Treatments 1, 2, and 3 respectively. The emissions in Treatment 4 were calculated using a greater emissions reduction scenario, thus making this the strongest treatment. These percent reductions were multiplied by the average pre-certification emissions from the six GS-33-certified hotels in LA to calculate the numerical descriptions in the different treatments.

While the results of the panel regression are discussed more fully in Chapter 5 above, it would be valuable to revisit those findings to understand how they influenced our survey design. Using the fixed effects panel regression, we found that the GS-33 Bronze certification had a statistically insignificant reduction of 2.8% on hotel greenhouse gas emissions ($p = 0.404$). For the purposes of this survey we chose to consider this a non-effect due to the lack of statistical significance and high standard error. We found that the GS-33 Silver level certification had a statistically significant 8.8% greenhouse gas emissions reduction ($p = 0.001$) on average when compared to hotels with no certification (and when compared to hotels with Bronze certification, since there was a statistically insignificant effect as explained above). We also found that Gold certification had a statistically significant 18.2% greenhouse gas emissions reduction relative to Silver certification ($p < 0.001$), or a 27% reduction relative to no certification.

Lastly, we used the average reductions in carbon dioxide emissions found in LEED-certified buildings (34%) for the strongest treatment question (Treatment 4).[98] These percent changes in greenhouse gas emissions from GS-33 Bronze, Silver, and Gold as well as LEED-certified hotels informed the descriptions in Treatments 1, 2, 3 and 4, respectively.

We calculated the equivalent reductions of removing cars off the road and preventing coal burning using the EPA Greenhouse Gas Equivalency Calculator.[99] The different descriptive text

[98] U. S. Green Building Council. (2016). Benefits of green building. *USGBC.* Retrieved from http://www.usgbc.org/articles/green-building-facts.
[99] U.S. Environmental Protection Agency (2016). Greenhouse gas equivalencies calculator. *EIA.* Retrieved from https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

for the hypothetical hotels is outlined below, with emphasis added to show the differences between the treatments and the control question.

Control:

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites."

Treatment 1 (based on GS-33 Bronze certification emission reductions):

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. *The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts*."

Treatment 2 (based on GS-33 Silver certification emission reductions):

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. *The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 120 metric tons of carbon dioxide, which is equivalent to taking 25 cars off the road for one year or preventing 125,000 pounds of coal from being burned for energy*."

Treatment 3 (based on GS-33 Gold certification emissions reductions):

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. *The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 390 metric tons of carbon dioxide, which is equivalent to taking 82 cars off the road for one year or preventing 415,000 pounds of coal from being burned for energy*."

Treatment 4 (based on LEED-certified building emissions reductions):

> "The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel

is located in a popular destination and gets generally positive reviews on travel websites. *The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 510 metric tons of carbon dioxide, which is equivalent to taking 108 cars off the road for one year or preventing 540,000 pounds of coal from being burned for energy*."

Results

Survey 1 Results

The overall results of the first survey experiment were in the anticipated direction of the hypothesis, but they were not statistically significant ($125.00 ± $38.64 and $121.59 ± $37.47 for treatment and control responses respectively (M ± SD); n = 252 and n = 253 respectively); $t(503) = -1.007$, $p = 0.166$, $\alpha = 0.05$. This demonstrates that consumers are not willing to pay more for a green-certified hotel than a hotel without a green certification. Specifically, this tested the hypothesis with a vague description of the environmental benefits of the hotel certification that did not include any numerical values or equivalencies. The results of the second survey build upon these findings.

Survey 2 Results

The results from the second survey demonstrate that consumers are willing to pay more for a green-certified hotel if the hotel has concrete descriptions of the environmental impact reductions. To test this, we first compared the mean willingness to pay for the control version of the question to the mean willingness to pay for the treatments combined, because all of them contained some description of the green certification. This test demonstrated that consumers are willing to pay more for a green-certified hotel than a hotel without a green certification ($124.32 ± $35.35 and $116.34 ± $34.53, respectively (M ± SD); n = 835 and n = 210 respectively); $t(1043) = -2.936$, $p = 0.002$, $\alpha = 0.05$. Notably, this seems to contradict our findings from the first survey. But importantly, the descriptions of the green-certified hotels in this second survey are stronger and contain numerical evidence of impacts for the green hotel certifications. The mean values and standard deviations are detailed in Table 7, and the full distribution of responses for each group is shown in Figure 13.

Table 7. Mean Willingness to Pay, Standard Deviation, and Number of Respondents for Each Version of Survey Experiment Question

Question	*Mean ($)*	*Standard Deviation ($)*	*n*
Control	116.34	34.53	210
Treatment 1 (Bronze equivalent)	119.40	35.90	211
Treatment 2 (Silver equivalent)	125.34	35.25	207
Treatment 3 (Gold equivalent)	125.12	34.74	207
Treatment 4 (LEED equivalent)	127.45	35.23	210

We then tested our second hypothesis – that consumers are willing to pay more for a green-certified hotel that offers concrete descriptions of the hotel certification than a green-certified hotel that only has vague descriptions of the hotel certification. To test this, we compared the

mean willingness to pay of consumers for a hotel with a vague description of the hotel certification (Treatment 1) to the mean willingness to pay of consumers for a hotel with concrete descriptions of the environmental impacts of the certification (Treatments 2, 3, and 4). We found that the mean willingness to pay of consumers for a hotel with concrete descriptions is significantly higher than the mean willingness to pay of consumers for a hotel with a vague description of the environmental impacts of the certification ($125.98 ± $35.04 and $119.40 ± $35.90, respectively (M ± SD); n = 624 and n = 211 respectively); $t(833) = -2.342$, $p = 0.01$, $\alpha = 0.05$. This increase in willingness to pay per night spent in the hotel of over $6.50 could be used by green-certified hotels to offset the costs of certification.

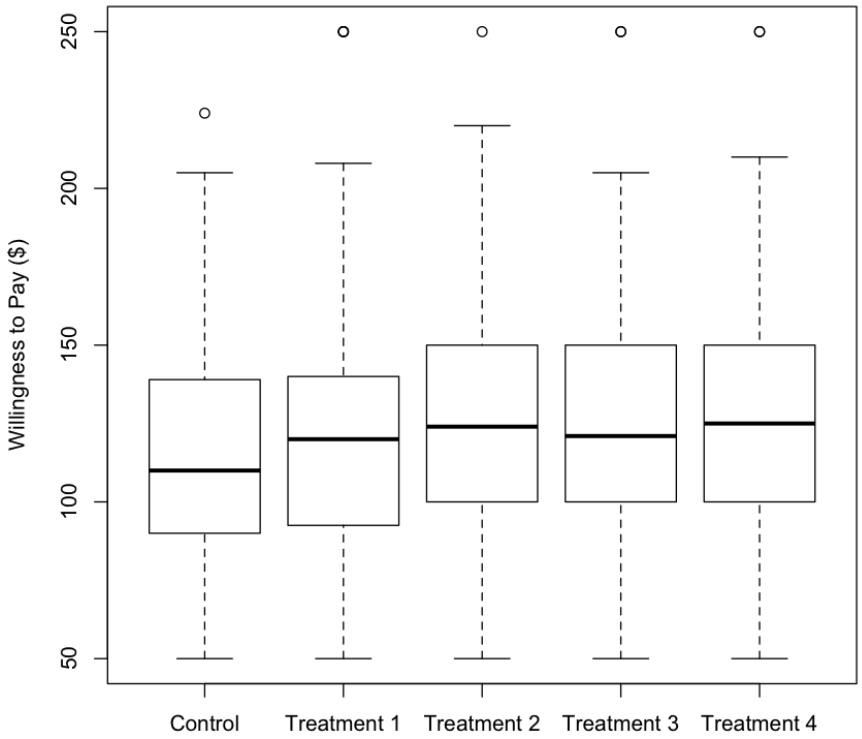

Figure 13. Consumer Willingness to Pay for Different Treatments
Boxplots showing the distribution of willingness to pay responses from consumers, depending on the question asked of them. The survey instrument gave respondents the option to choose any value along a sliding scale from $50 to $250.

Discussion

The results from our initial survey indicated that while consumers generally think it is important to take care of the environment, they are not necessarily willing to pay more for a hotel with a generic green certification. This seemed to corroborate the findings of Manaktola & Jauhari.[100] However, it was possible that this result was more a function of the certification description rather than a function of whether the hotel had a green certification.

[100] Manaktola, K. & Jauhari, V. (2007). Exploring consumer attitude and behaviour towards green practices in the lodging industry in India. *International Journal of Contemporary Hospitality Management*, 19(5), 364-377

The efficacy of how the green certification is described was tested in the second survey. We found results that seemed to contradict the findings of the initial survey by showing that consumers are willing to pay more for the green-certified hotel descriptions than the non-certified hotel description. Through further analysis we found that when the hotel certification descriptions included a numerical value of metric tons of carbon dioxide reduced, the equivalent number of cars taken off the road, and the equivalent reduction in pounds of coal burned for energy (Treatments 2, 3, and 4) there was a statistically significant higher willingness to pay compared to the vague description of the hotel certification's environmental benefits (Treatment 1). This confirmed our second hypothesis by showing that concrete, numerical descriptions of the hotel certification's environmental impacts can increase consumer willingness to pay.

This finding could be dramatic for hotels that have a green certification like GS-33. It implies that if the hotel sees actual emissions reductions and if the hotel communicates these reductions in an effective manner, they may see a higher willingness to pay from consumers. Hotel General Managers could potentially use this knowledge to increase nightly rates to offset certification fees or energy investment costs. Our survey showed that consumers are willing to pay on average about $6.50 more per night for the green-certified hotel that offered concrete, numerical descriptions of the environmental impacts of certification. This constitutes a 5% increase from the vague descriptions of green-certified hotels simply through more effective marketing.

The findings of this survey also emphasize the importance of tracking environmental benefits by Green Seal. As it stands, the GS-33 certification only requires that hotels take specific steps that should lead to energy reductions. However, the results of this survey directly support the idea that consumers care more about actual emissions reductions rather than knowing that a hotel has simply taken steps to reduce its energy reductions and carbon footprint.

Future Research

In an optional feedback section at the end of the survey, one respondent wrote the following: "I am a poor person, so I really can't afford to pay more for a green hotel. If a green hotel was the same price as a non-green one, I'd choose the green hotel, but I generally choose the hotel with the best star ratings for the lowest price." This makes for an interesting research question that we did not directly address in our study. Our findings indicate that people are willing to pay more for a green-certified hotel than a non-certified hotel (assuming the environmental benefits are clearly communicated). This seems to imply that generally, people would be more likely to stay in a green-certified hotel than a non-certified hotel as long as the environmental benefits are effectively communicated and all other factors remain equal. However, the research in this field would benefit from additional studies exploring whether consumers would prefer to stay at a green-certified hotel compared to a non-certified hotel based on the description of the environmental initiatives undertaken by the green-certified hotel.

These surveys have demonstrated that communication matters in presenting the benefits of green hotel certification. However, there remain questions about how strong the environmental descriptions need to be before people are willing to pay more for a green-certified hotel. Additionally, there may be equivalency descriptions that resonate more than others (e.g., people may be more interested in how many trees would be needed to sequester carbon emissions than

how many pounds of coal are not burned as a result of emissions reductions). Future research could further explore the efficacy of different messaging strategies in influencing consumers' opinions and willingness to pay for green-certified hotels.

The findings of the survey imply that willingness to pay does not change based on small changes in the amount of emissions reductions (as evidenced by the small changes in willingness to pay for treatments 2, 3, and 4). The fact that these hotel descriptions simply include the emissions reductions seems to play more of a factor. However, there remains a question about whether significantly different magnitudes of emissions reductions (and subsequent equivalency expressions) influence willingness to pay and at what point these numerical emission reduction descriptions are more effective.

Notably, our emission reductions for the different treatments were initially miscalculated for these surveys, leading to the impacts being underemphasized. We did not include power plant efficiencies or transmission and distribution losses in our initial calculations for converting kilowatt-hours of electricity from LADWP to metric tons of carbon dioxide. Including these considerations in the calculations, increases the emissions factor about threefold (e.g. Treatment 2 should have had 369 metric tons of emissions reduced, not the 120 metric tons that was in the survey). This would have resulted in stronger treatments for the Silver, Gold, and Platinum treatments, and it would not have affected the Bronze treatment.

Limitations

These findings are relevant to the U.S. hotel industry only as the survey respondents all live in the United States. Additionally, results may differ by hotel and by region, as other factors like location and quality are relevant in determining willingness to pay. Therefore, different communication methods may have different results depending on hotel location. Additionally, these findings are only relevant when communicating greenhouse gas emissions reductions and may not apply to other environmental initiatives taken by hotels, such as water conservation or waste reduction measures.

Chapter 9

Summary & Recommendations

Summary

The Green Seal Standard for Hotels and Lodging Properties (GS-33) encourages hotels to reduce their carbon footprint by transforming their energy system, enhancing the resilience of their buildings, and integrating sustainability practices into their day-to-day activities. While it is known that the energy efficiency upgrades that fall under GS-33 requirements have the potential to reduce greenhouse gas emissions, Green Seal had yet to quantify the environmental savings directly associated with its hotel certification. This report sought to fill that knowledge gap by addressing the following objectives:

1. Quantify the impacts of GS-33 on greenhouse gas emissions and analyze how these emissions reductions in the City's lodging industry can help Los Angeles achieve the targets of its Sustainability pLAn.
2. Develop analytical tools for Green Seal to scale up the GS-33 hotel certification, including a user-friendly model for hotels that estimates greenhouse gas emissions and financial impacts associated with GS-33, as well as a marketing plan.

Actual Emissions Reductions for Certified Hotels

Both Silver and Gold levels of the GS-33 certification reduce GHGs for the average green-certified hotel in Los Angeles. Specifically, the Silver certification reduces emissions in certified hotels 8.77% (as compared to Bronze hotels) and the Gold certification reduces GHGs 18.22% (as compared to Silver hotels). Both reductions are statistically significant; however, the results for reductions from the Bronze certification are not. Appendix B contains a complete results table of the panel regression analysis performed to address this objective.

Potential Emissions Reductions for Los Angeles

Los Angeles' Sustainability pLAn sets the target of reducing Citywide greenhouse gas emissions 45% from a 1990 baseline level by 2025. To determine how much GS-33 could contribute towards this goal, we calculated the total possible reduction in emissions if 99% of the 997 hotels in LA became Gold-certified by 2023. This resulted in a step-wise decrease (due to the assumed required three-year timeline to go from Silver to Gold certification), with a 0.19 million MT CO_2 drop in emissions in 2021 and an additional 0.39 million MT CO_2 decrease in 2024. The total emissions savings between now and 2025 were 0.58 million MT CO_2, which is equivalent to taking over 122,000 passenger vehicles off the road for one year. Although this value could have substantial impacts in Los Angeles, when compared to current Citywide GHGs, we observe the maximum reduction in emissions from GS-33 is 2%.

Potential Cost-Savings for Certified Hotels

To understand how the environmental benefits of the Green Seal Standard for Hotels and Lodging Properties affect hotels financially, this report described a user-friendly Excel-based tool that is targeted towards hotel general managers. This financial tool enables hotels to quantify the environmental and financial impacts of pursing GS-33-related energy efficiency upgrades. The flexibility of this tool allows hotels to examine various types of efficiency investments on which they may have detailed information. To show the utility of the model, this report highlighted a case study that inputted lighting upgrade information from a "typical" high-end LA hotel into the model. Results from the case study found that replacing existing lighting with energy-efficient fixtures has the potential to generate environmental and financial benefits for hotels.

Consumer Response to Certified Hotels

After releasing and analyzing data from two separate surveys on how consumers respond to green-certified hotels, we found that, on average, consumers are willing to pay more for a green-certified hotel than for one that is not certified. However, this is dependent on the description of the hotel. Consumers were not willing to pay more for a green-certified hotel that only offered vague descriptions of its environmental impacts than for a generic hotel with no sustainability initiatives. On the other hand, we found that consumers would be willing to pay on average 5% more per night for a green-certified hotel with concrete descriptions of its environmental impacts than for a green-certified hotel that only offered vague descriptions of its certification program. This supports the idea that hotel managers could potentially increase nightly rates to offset certification fees or energy efficiency investments if they demonstrate the environmental benefits of certification in an effective manner.

Recommendations

Based on the results and limitations of our analysis, we recommend Green Seal modify its GS-33 certification in three main areas:

- Certification Requirements
- Data Tracking
- Marketing Materials and Targeting Approach

The purpose of these recommendations is to help Green Seal make their certification more robust, refine its compliance monitoring procedures, and best target hotels that have the largest potential for greenhouse gas reductions.

Certification Requirements

When hotels are initially applying to receive GS-33, they are required to fill out a certification checklist (as discussed in Chapter 5). This checklist is qualitative, merely asking hotels to respond yes or no to the requirement. We recommend Green Seal update this to a quantitative checklist, specially using clear language with clear deliverables. For example, instead of "hotels should have energy-efficient windows," the checklist should be reframed to "exactly what percentage of windows is energy efficient." Furthermore, GS-33 could have a threshold limit that hotels must meet to become certified (e.g., 35% of windows must be replaced with energy-efficient technology).

In addition to replacing its checklist with one that is more quantitative, Green Seal should require hotels to eventually become Gold-certified. As of now, Bronze hotels must become Silver-certified within 3 years of achieving initial certification. However, there are no set timelines for which hotels must achieve Gold certification. Because of the potentially strong environmental benefits of the Gold level, this recommendation could help GS-33 more substantially contribute to LA's greenhouse gas emissions reduction target.

Data Tracking

As discussed above, Green Seal's green certification currently has many qualitative requirements, and it could greatly benefit from enabling a more quantitative approach to GS-33. First, we recommend Green Seal perform an annual request of monthly energy consumption data from certified hotels. With more hotels moving towards the use of energy management systems and software to track their energy usage, this would be an easy requirement for hotels to fulfill. Use of standardized metrics (energy consumed for the entire building compared to energy consumed in guest rooms) is also recommended.

Documentation on hotel monthly energy usage would also benefit additional studies on the certification's impact moving forward. Because this type of data feeds directly into the panel regression analysis approach discussed in Chapter 5, having monthly energy consumption data would allow easy replication of this methodology. This information would then enable Green Seal to more accurately quantify its impact on LA's GHG goals as more hotels become GS-33-certified. An alternative to this approach is to capture information directly from energy management systems already used by hotels that report and manage energy data.

Next, Green Seal should more accurately track energy efficiency upgrades hotels make once green-certified. This particularly applies to the Bronze and Silver levels, which require hotels to switch to energy-efficient equipment only when replacement is needed. By maintaining detailed information about the upgrades that occurred, Green Seal will be able to better associate the direct causes of the decreases in onsite greenhouse gas emissions of certified hotels. Moreover, this data can also be inputted into the financial model (discussed in Chapter 7) to precisely calculate the assumed environmental and financial benefits of the upgrades.

Last, we recommend Green Seal more diligently enforce its protocol stated in the Compliance Monitoring Guidelines that requires all Bronze-certified hotels to become Silver-certified within three years. We saw evidence that some hotels did not progress from Bronze to Silver certification within the required time frame. Because the Silver level requires all lighting be replaced with energy-efficient technology, this upgrade is key in helping LA meet its greenhouse gas emissions goal. Therefore, Green Seal should track the GS-33 hotels' certification timelines to confirm they are meeting the deadlines for level upgrades.

Marketing Materials and Targeting Approach

Analyzing the results from the consumer surveys (Chapter 8), we recommend both Green Seal and green-certified hotels use numerical values and comparisons in their marketing materials. For example, survey analysis indicated that hotels may find more support for green initiatives if they demonstrate the impacts of green certification through numbers (i.e. we reduced greenhouse

gas emissions by 10,000 MT CO_2 last year) or comparisons (i.e. our energy reductions are roughly equivalent to taking 300 cars off the road for one year). Furthermore, seeing as consumers care more about actual emissions reductions than steps taken to reduce a hotel's carbon footprint, this emphasizes the importance of tracking environmental benefits by Green Seal, as discussed above.

To maximize the number of hotels in its program, Green Seal should research similar certifications with requirements that overlap with GS-33. Using this knowledge, Green Seal can target hotels with these other certifications, thus enabling hotels to receive credit for what they are already doing. This not only helps hotels become certified more quickly, but it also catalyzes GS-33's growth throughout the Los Angeles area. Additionally, Green Seal should target hotel chains for certification rather than individual, "boutique" hotels. Because hotel chains are more widespread, they typically have a blanket policy of energy efficiency (i.e., their policies are more standardized than others), making it easy to implement GS-33 certification in multiple hotels simultaneously.

Not only should Green Seal focus on "easy target" hotels to expand the reach of their program, but we also recommend establishing criteria for working with hotels that have the greatest potential to maximize greenhouse gas reductions. While it is easy to certify a hotel that may already have LEED certification and ENERGY STAR appliances, hotels that have no experience with energy efficiency could dramatically reduce their emissions once they become GS-33-certified. Therefore, Green Seal should research which hotels have little to no existing sustainability initiatives and find ways to assist them and nudge them towards achieving GS-33 certification. This will allow GS-33 to make greater strides towards helping the City of Los Angeles achieve its greenhouse gas emissions reduction goals.

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Acronyms

AB 32	California Assembly Bill 32, the Global Warming Solutions Act of 2006
Btu	British Thermal Unit
CAP	Climate Action Plan
CARB	California Air Resources Board
CBECS	Commercial Buildings Energy Consumption Survey
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
EIA	United States Energy Information Administration
EPA	United States Environmental Protection Agency
GHG	Greenhouse Gas
GS-33	Green Seal Hotels and Lodging Standard
HVAC	Heating, Ventilation, and Air Conditioning
IRR	Internal Rate of Return
kWh	kilowatt-hour
LA	Los Angeles
LADWP	Los Angeles Department of Water and Power
LAGBP	Los Angeles Green Business Program
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
MT	metric ton
MTurk	Amazon Mechanical Turk
NPV	Net Present Value
REC	Renewable Energy Credit
SB 32	California Senate Bill 32
SoCalGas	Southern California Gas Company

Appendix A

Panel Data Discrepancies

Electricity consumption data for the hotel building was requested in the form of utility bills from at least one year before and after each level of certification. Based on the data provided, one hotel was earliest to get certified in 2009. Thus, our ideal data requirement would have data from 104 total months (July 2008 to December 2016) from 6 hotels for a balanced panel (i.e., 624 entries). However, this data was difficult to get from all hotel managers. The actual range of data obtained from hotels is shown in Figure 3. We successfully obtained data for 425 entries.

Note the Panel 3 data in Figure 3 – this discrepancy leads to an unbalanced panel model and imperfect comparison. Our analytical model is flexible to incorporate any number of hotels for any time period.

$$Number\ of\ entries = Number\ of\ hotels * Number\ of\ years * 12$$

Utility bills were provided by hotels in the form of Excel files and PDF documents. In the case of illegible print (i.e. PDF files), human judgment was used to interpret the numbers. The month of certification was decided based on the date of certification: if the certification was awarded before the 15th of a month, it was assumed the "certification" level was achieved that month. If the certification was awarded after the 15th of a month, it was assumed the "certification" level was achieved the next month.

Data from one hotel (called Hotel A) were obtained for 2009 to 2016 in the form of Excel file. Data for years 2009 to 2012 were provided from LADWP, explicitly categorized as "energy bills". However, data from 2013 to 2016 were not distinctly marked as "energy bills" (Figure 14). Interviews with hotel managers indicated this data could be a combination of energy, water, and gas. However, to avoid extrapolation and uncertainty in our analysis, this data was excluded.

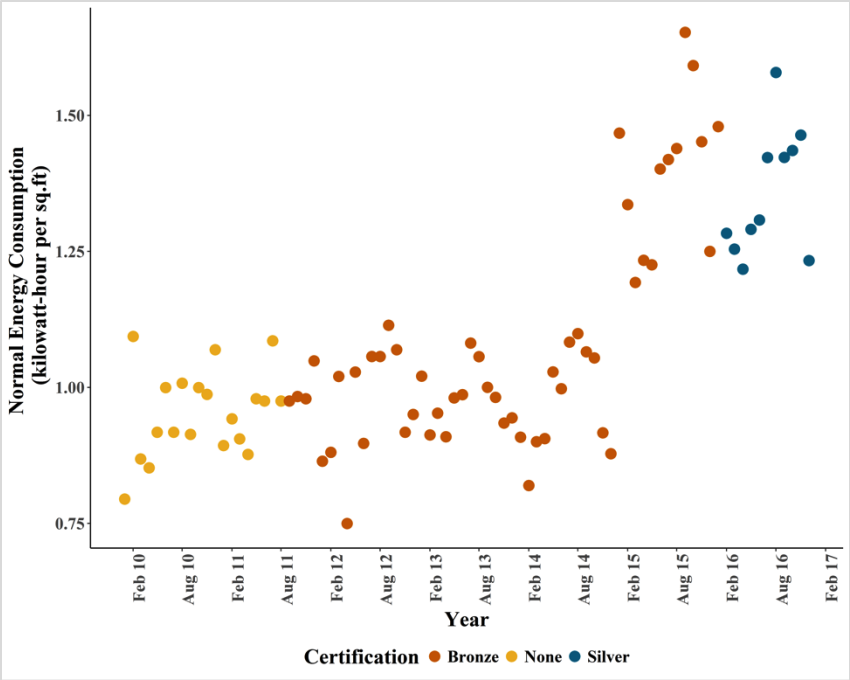

Figure 14. Energy Consumption Data from Hotel A

Similarly, data from a different hotel (called Hotel B) obtained from 2009 to 2012 showed dramatic fluctuations between 300,000 kWh and 900,000 kWh in one month (Figure 15). Interviews with the hotel manager indicated this data was likely not reflective of actual electricity usage during this time frame as construction projects were occurring near the meters. Based on the manager's recommendation, this data was excluded from the analysis.

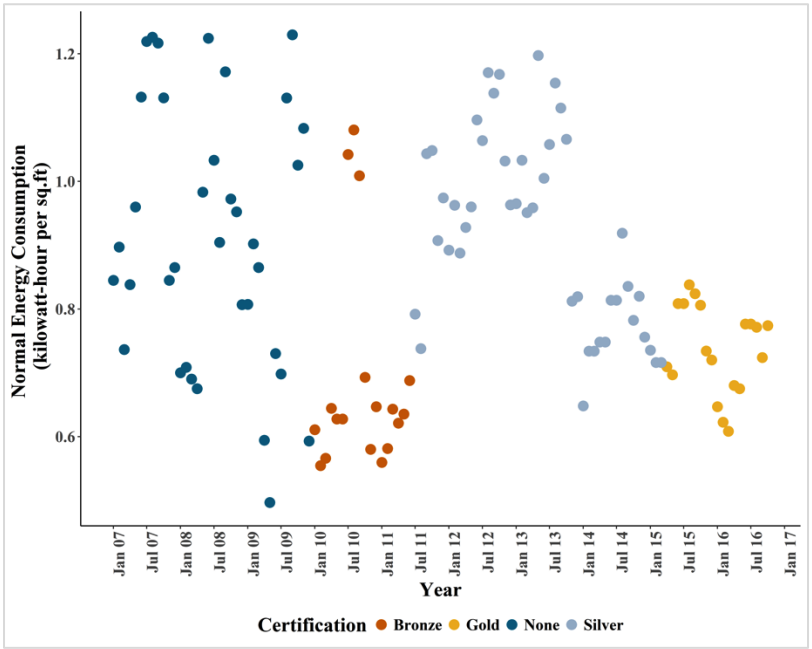

Figure 15. Normalized Energy Data for Hotel B

Appendix B

Full Results of Panel Regression Fixed Effects Model

	Estimate	Std. Error	*t*-value	*p*-value
Year2009	-0.026	0.036	-0.719	0.473
Year2010	-0.081	0.019	-4.270	0.000
Year2011	-0.091	0.027	-3.328	0.001
Year2012	-0.074	0.033	-2.246	0.025
Year2013	-0.069	0.036	-1.906	0.057
Year2014	-0.130	0.036	-3.619	0.000
Year2015	-0.122	0.033	-3.732	0.000
Year2016	-0.144	0.028	-5.156	0.000
Month2	-0.022	0.025	-0.885	0.377
Month3	-0.019	0.026	-0.732	0.465
Month4	-0.039	0.023	-1.724	0.085
Month5	0.029	0.034	0.856	0.393
Month6	0.053	0.037	1.455	0.146
Month7	0.097	0.021	4.543	0.000
Month8	0.104	0.034	3.054	0.002
Month9	0.104	0.035	3.000	0.003
Month10	0.103	0.032	3.218	0.001
Month11	0.022	0.032	0.671	0.502
Month12	0.000	0.027	0.010	0.992
Bronze	**-0.028**	**0.034**	**-0.835**	**0.404**
Silver	**-0.088**	**0.027**	**-3.293**	**0.001**
Gold	**-0.182**	**0.018**	**-10.023**	**< 2.2e-16**

Appendix C

ENERGY STAR Equipment Rated Efficiency

ENERGY STAR-rated equipment follows specific efficiency standards and is projected to save a certain percentage of energy when compared to traditional, non-efficient technology. The table below shows the projected potential savings from purchasing ENERGY STAR equipment, following the required upgrades to meet GS-33.

Equipment	Projected ENERGY STAR Savings[101]
HVAC Equipment	
Central Air Conditioners	8%
Central Heat Pumps	5%
Chillers	*
Geothermal Heat Pumps	45%
Packaged Terminal Air Conditioners	10%
Split Ductless Heat Pumps	60%
Water Heaters	*
Office & Room Equipment	
Computer	30%
Copier	40%
Fax Machine	30%
Monitor	25%
Printer	30%
Television	25%
Video player/Recorder	44%
Kitchen Equipment	
Dishwasher	40%
Commercial Deep-Fat Fryer	17%
Single-Sided Commercial Griddle	10%
Double-Sided Commercial Griddle	10%
Fry-Top Range	0%
Commercial Hot Food Holding Cabinet	70%
Ice Machine	15%
Commercial Refrigerator	40%
Commercial Freezer	40%
Commercial Refrigerator-Freezer	40%
Commercial Ice Cream Freezer	40%
Self-Contained Refrigeration Cabinet	40%
Steam Cooker	50%

[101] U.S. Environmental Protection Agency. (n.d.). ENERGY STAR Program. *EPA.* Retrieved from https://www.energystar.gov.

Commercial Oven	20%
<u>Laundry Equipment</u>	
Boiler	12%
Dryer	20%
Extractor	33%
Washer	25%
<u>Windows</u>	
Energy Star Windows	12%
Window Film	5%

* Actual rated efficiency is machine-specific

Appendix D

Consumer Surveys

SURVEY 1

You are being asked to take part in a short survey on your opinions of lodging accommodations. Please read the questions carefully and respond thoughtfully.

The survey should take approximately 1-2 minutes to complete. Taking part in this survey is completely voluntary. You do not have to participate if you do not want to. You will not be penalized for not participating. Your responses will be completely anonymous. We will not collect any identifying information connected to your responses. Please note that you must be at least 18 years old to participate in this study. By clicking the NEXT button below and answering the following questions, you are indicating that you are at least 18 years of age and that you agree to participate. In exchange for completing the survey, you will receive a payment of $0.15 through Amazon Mechanical Turk.

1) What is your gender?
Female
Male
Other
Prefer not to say

2) How old are you?

3) How much money did your household make last year in taxable income?
$0 – 20,000
$20,001 – 40,000
$40,001 – 60,000
$60,001 – 80,000
$80,001 - 100,000
$100,001 - 120,000
Greater than $120,000

(Treatment and control administered to 250 people each, for 500 total respondents)

Control:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

Treatment:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

4) On average, how often do you stay in a hotel? If you are not sure, provide your best guess.
I never stay in hotels
Once or twice per year
Once every few months
Once a month
Once a week
More than once a week.

5) When it comes to choosing a hotel, please rank the following from 1-5 in terms of importance, with 1 being "most important" and 5 being "least important": *(Note these five options will appear in a random order)*
___ Convenience
___ Reputation
___ Sustainable Practices
___ Amenities
___ Price

6) In general, how important do you think it is to take care of the environment?
Extremely important
Very important
Moderately important
Slightly important
Not at all important

7) What is the highest level of education you have completed?
Some high school
High school graduate
Some college
College graduate
Masters/Professional Degree

8) Which of the following best describes your race or ethnicity?
African American (Black)
Caucasian (White)
East Asian / Pacific Islander
Latino(a) / Hispanic
Middle Eastern
Native American
Multi-racial
Other (please specify)

9) Which state do you reside in?

10) Thank you for participating! This was a survey experiment by a group of Master's students at University of California, Santa Barbara to test our hypothesis that consumers are willing to pay more for a hotel that has a green certification than one that does not.

Please give any feedback about this survey, if desired.
Otherwise, click the NEXT button to receive your unique MTurk code.

SURVEY 2

You are being asked to take part in a short survey on your opinions of lodging accommodations. Please read the questions carefully and respond thoughtfully.

The survey should take approximately 1-2 minutes to complete. Taking part in this survey is completely voluntary. You do not have to participate if you do not want to. You will not be penalized for not participating. Your responses will be completely anonymous. We will not collect any identifying information connected to your responses. Please note that you must be at least 18 years old to participate in this study. By clicking the NEXT button below and answering the following questions, you are indicating that you are at least 18 years of age and that you agree to participate. In exchange for completing the survey, you will receive a payment of $0.20 through Amazon Mechanical Turk.

1) What is your gender?
Female
Male
Other
Prefer not to say

2) What is your age in years?

3) How much money did your household make last year in taxable income?
$0 – 20,000
$20,001 – 40,000
$40,001 – 60,000
$60,001 – 80,000
$80,001 - 100,000
$100,001 - 120,000
Greater than $120,000

(Control and 4 treatments administered to 250 people each, for 1250 total respondents)

Control:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

Treatment 1:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

Treatment 2:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 120 metric tons of carbon dioxide, which is equivalent to taking 25 cars off the road for one year or preventing 125,000 pounds of coal from being burned for energy."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

Treatment 3:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is located in a popular destination and gets generally positive reviews on travel websites. The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 390 metric tons of carbon dioxide, which is equivalent to taking 82 cars off the road for one year or preventing 415,000 pounds of coal from being burned for energy."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

Treatment 4:
We are interested in understanding people's preferences regarding different hotel options. Before continuing, please carefully read the following hotel description:

"The Cedarwood, a three-star hotel, offers amenities like free Wi-Fi, a Jacuzzi and pool, a complimentary continental breakfast, a shuttle to the airport, and free parking. The hotel is

located in a popular destination and gets generally positive reviews on travel websites. The Cedarwood also has a certification from the Green Lodging Alliance, indicating that the hotel has taken significant steps (e.g. recycling programs, energy efficiency, water management, and more) to reduce its environmental impacts. The Cedarwood has reduced its greenhouse gas emissions by 510 metric tons of carbon dioxide, which is equivalent to taking 108 cars off the road for one year or preventing 540,000 pounds of coal from being burned for energy."

What is the maximum amount you would be willing to pay per-night for this hotel in US dollars?

4) On average, how often do you stay in a hotel? If you are not sure, provide your best guess.
I never stay in hotels
Once or twice per year
Once every few months
Once a month
Once a week
More than once a week.

5) When it comes to choosing a hotel, please rank the following from 1-5 in terms of importance by dragging and dropping the following options, with 1 being "most important" and 5 being "least important": *(Note these five options will appear in a random order)*
___ Convenience
___ Reputation
___ Sustainable Practices
___ Amenities
___ Price

6) In general, how important do you think it is to take care of the environment?
Extremely important
Very important
Moderately important
Slightly important
Not at all important

7) What is the highest level of education you have completed?
Some high school
High school graduate
Some college
College graduate
Masters/Professional Degree

8) Which of the following best describes your race or ethnicity?
African American (Black)
Caucasian (White)
East Asian / Pacific Islander

Latino(a) / Hispanic
Middle Eastern
Native American
Multi-racial
Other (please specify)

9) Which state do you reside in?

10) Thank you for participating! This was a survey experiment by a group of Master's students at University of California, Santa Barbara to test our hypothesis that consumers are willing to pay more for a hotel that has a green certification than one that does not.

Please give any feedback about this survey, if desired.
Otherwise, click the NEXT button to receive your unique MTurk code.