HOTEL ENERGY & CARBON EFFICIENCY

CHAIN RANKINGS
INDUSTRY TRENDS
EFFICIENCY DRIVERS
MARKET PATTERNS

BRIGHTER PLANET

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About Brighter Planet

Brighter Planet is a sustainability technology company that helps organizations make revenue, efficiency, and brand advancements by integrating carbon and energy analytics into custom applications for managers, employees, and customers. Since getting its start in a college classroom in 2005, Brighter Planet has partnered with dozens of leading organizations, attracted hundreds of thousands of customers, performed tens of millions of cloud-based carbon calculations, and prevented hundreds of millions of pounds of carbon dioxide emissions. This work has been recognized with a Financial Times Social Innovation Award, a TreeHugger Small Business of the Year award, and an EPA Best Overall Green Apps award, among others.

Brighter Planet's CM1 web service powers sustainability analytics inside client applications, helping developers and organizations efficiently build green programs that harness hard scientific data to inform decision making. Used by hobbyist programmers and Fortune 500 companies, the CM1 API provides real-time, standards-certified impact calculations for activities ranging from travel to facilities to product life cycles.

Executive Summary

Using a proprietary hotel energy and emissions model, Brighter Planet analyzed details on more than 46,000 hotel properties nationwide—80% of all US hotels with 15 or more rooms—to shed light on energy efficiency dynamics in the lodging industry. This report presents our findings, including hotel chain rankings, key efficiency drivers, patterns of variability, and best practices for business travel managers.

At a time when the impacts of the travel and tourism are receiving unprecedented attention from lodging providers and customers alike, this new analysis offers timely perspective to travel management, sustainability, and lodging industry professionals. Business travel carbon reporting has become mainstream, with 4 in 10 Global 500 companies now publicly reporting employee travel footprints. The hotel industry is also beginning to address the issue head on, with the number of LEED-certified hotels more than doubling from 2010 to 2011 and with industry groups preparing to release an official hotel carbon accounting protocol.

Key findings:

- **Energy and carbon per room-night varies more than tenfold among US hotels.** The dirtiest quarter of hotels are responsible for more than half of the lodging industry's energy and carbon impact, while the cleanest quarter represent just 7%.

- **Hotel chains differ markedly in efficiency.** Red Carpet Inns, Travelodge, and Scottish Inns took top rankings for budget establishments, while Four Points Sheraton, Disney Parks and Resorts, and Marriott Residence Inn lead the efficiency rankings for upscale hotels. Among midrange properties, Vagabond Inns, Red Lion Hotels, and Howard Johnson were efficiency leaders.

- **Hotels within the same chain also differ markedly in efficiency.** For example in Nashville, Tennessee estimated energy and carbon per room-night varied by a factor of two between the most and least efficient Holiday Inn Express.

- **Budget hotels are generally more efficient, but footprint reduction opportunities exist at every price point.** The average upscale hotel uses 25% more energy per room-night than the average budget hotel, but efficiency varies enormously within service segments, and the majority of upscale hotels are cleaner than the dirtiest budget establishments.

- **Hotel sustainability shows dramatic geographic variation.** On energy efficiency, Arkansas, Tennessee, and Alabama scored top ranks while Minnesota and Wisconsin were least efficient; for carbon emissions, California polluted the least per room-night while the Upper Midwest was dirtiest.

- **Travel and sustainability managers can reduce footprints without cutting travel**—and can dramatically improve the accuracy of sustainability reporting—by accounting for efficiency variability instead of assuming all hotel rooms are equal.

- **Five key drivers can be use to predict hotel efficiency.** Square footage per room, local climate, hotel amenities, energy sources, and electric grid cleanliness account for enormous variation in impact per room-night. These drivers differ in their relative influence on efficiency.

- **Hotels are growing less and less efficient.** Modern hotels use significantly more energy per room-night than their older-vintage counterparts, and the energy they use is dirtier. A recent surge in interest in programs like LEED and Energy Star has the potential to reverse the trend.

- **LEED and Energy Star metrics fall short for lodging industry sustainability accounting** because they fail to take into account the number of rooms that are fit into a hotel. Measuring hotel energy use and emissions per room-night rather than per square foot is more relevant and actionable for business travel managers.

Hotel chain rankings

These rankings compare the 25 largest hotel chains in three service segments based on their modeled impact per room per night. These 75 chains represent more than 3 million hotel rooms —two thirds of hotel rooms in our database, or about 60% of all hotel rooms in the US. Energy efficiency and carbon efficiency are correlated but vary independently; our ranking rubric weights the two variables equally in determing chain efficiency standings. See page 26 for further discussion of variation in efficiency among chains.

Carbon and energy efficiency can vary significantly within a single chain, so these figures should not be taken to represent any single property. Rankings are modeled estimates based on best available data; as hotel chains continue to increase transparency surrounding energy use, sustainability rankings will grow even more accurate.

Rank	Chain	Energy efficiency (MJ/room-night)	Carbon efficiency (Kg CO2e/ room-night)	Service segment	Rank within segment
1	Vagabond Inns	191	14	Midrange	1
2	Red Lion Hotels & Inns	205	18	Midrange	2
3	Red Carpet Inns	188	22	Budget	1
4	Travelodge	191	22	Budget	2
5	Scottish Inns	184	23	Budget	3
6	America's Best Inns & Suites	188	24	Budget	4
7	Shilo Inns & Resorts	224	19	Midrange	3
8	Knights Inn	189	24	Budget	5
9	Howard Johnson	198	23	Midrange	4
10	Rodeway Inn	203	23	Budget	6
11	Americas Best Value Inn	193	24	Budget	7
12	Motel 6	199	23	Budget	8
13	Econo Lodge	200	24	Budget	9
14	Days Inns of America	196	25	Budget	10
15	Ramada Worldwide	203	24	Midrange	5
16	Budget Host Inns	190	26	Budget	11
17	Red Roof Inns	194	26	Budget	12
18	Clarion	208	24	Midrange	6
19	Country Hearth Inns	187	27	Budget	13
20	Quality	206	25	Midrange	7
21	Best Western International	210	24	Midrange	8
22	Studio 6	199	26	Budget	14
23	GuestHouse International	207	25	Budget	15
24	Jameson Inns	188	28	Budget	16
25	Suburban Extended Stay Hotel	196	28	Budget	17

Rank (cont.)	Chain	MJ/room-night	KG CO2e/ room-night	Service segment	Rank within segment
26	Super 8 Motel	201	27	Budget	18
27	La Quinta Inns & Suites	211	26	Midrange	9
28	Homestead Studio Suites Hotels	211	27	Budget	19
29	Microtel Inns & Suites	201	28	Budget	20
30	Extended Stay Deluxe	210	27	Budget	21
31	Extended Stay America	216	26	Budget	22
32	InTown Suites	209	28	Budget	23
33	Four Points Hotels by Sheraton	229	26	Upscale	1
34	MainStay Suites	209	29	Midrange	10
35	Candlewood Suites	208	29	Midrange	11
36	Hawthorn Suites	216	28	Midrange	12
37	TownePlace Suites by Marriott	219	28	Midrange	13
38	Walt Disney Parks & Resorts	228	28	Upscale	2
39	Holiday Inn Express Hotels	226	28	Midrange	14
40	Sleep Inn	221	29	Midrange	15
41	Value Place	209	31	Budget	24
42	Residence Inn by Marriott	231	28	Upscale	3
43	Wingate by Wyndham	222	29	Midrange	16
44	Holiday Inn Hotels & Resorts	231	28	Midrange	17
45	Comfort Inns & Suites	230	28	Midrange	18
46	Hampton Inns & Suites	228	29	Midrange	19
47	Courtyard by Marriott	236	28	Upscale	4
48	Wyndham Hotels and Resorts	238	28	Upscale	5
49	Radisson Hotels	241	28	Upscale	6
50	Staybridge Suites	230	29	Upscale	7
51	Baymont Inns & Suites	221	30	Midrange	20
52	Homewood Suites by Hilton	235	29	Upscale	8
53	Fairfield Inn & Suites by Marriott	233	29	Midrange	21
54	Marriott Vacation Club Intl	243	29	Upscale	9
55	Budget Suites of America	245	29	Budget	25
56	SpringHill Suites by Marriott	242	30	Upscale	10
57	Crowne Plaza Hotels & Resorts	252	29	Upscale	11
58	Doubletree Hotels	250	30	Upscale	12
59	Hilton Garden Inn	252	31	Upscale	13
60	Hyatt Place	242	32	Upscale	14
61	Holiday Inn Select Hotels	244	32	Midrange	22
62	Country Inns & Suites By Carlson	245	32	Midrange	23
63	Hilton Worldwide	267	31	Upscale	15
64	Sheraton Hotels & Resorts	267	31	Upscale	16
65	Hyatt Hotels Worldwide	273	31	Upscale	17
66	InterContinental Hotels Group	276	32	Upscale	18
67	Drury Inns	249	37	Midrange	24
68	Marriott International	280	33	Upscale	19
69	Omni Hotels	288	32	Upscale	20
70	The Ritz-Carlton Hotels	287	33	Upscale	21
71	Westin Hotels & Resorts	286	34	Upscale	22
72	Embassy Suites Hotels	283	35	Upscale	23
73	Renaissance Hotels & Resorts	291	34	Upscale	24
74	AmericInn International	287	38	Midrange	25
75	JW Marriott Hotels & Resorts	309	38	Upscale	25

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Introduction

Hotel sustainability in the spotlight

Business travel increasingly is recognized as a major contributor to the energy and environmental footprints of many organizations. Moreover, as a category where stakeholders may be able to move relatively nimbly to reduce environmental impacts (compared to other core areas of their operations), travel also is gaining attention for the potential it holds as a cost-effective area for organizations to implement efficiencies. Our analysis of Carbon Disclosure Project reporting data shows that 40% of Global 500 companies calculated and reported employee travel footprints in 2011, making business travel the most prominent category of indirect corporate emissions, and demonstrating widespread interest in travel sustainability among major companies.

This paper focuses on lodging, a key component of the travel industry.[1] The hotel industry has seen numerous recent developments on the sustainability front, signaling a growing focus on hotel impacts by business travel managers, lodging industry stakeholders, and sustainability professionals.

The travel industry associations International Tourism Partnership and World Travel & Tourism Council have announced the imminent release of a new Hotel Carbon Accounting standard aimed specifically at the lodging industry. Developed through a collaboration of leading hotel chains, the effort promises to standardize footprint accounting practices across the industry.

Last year, the Greenhouse Gas Protocol Initiative, the de facto authority on corporate greenhouse gas accounting standards, also released a major new protocol detailing guidelines for measuring and reporting "Scope 3" carbon impacts—footprints from activities like business travel that occur in the supply chain outside the responsible organization's direct ownership.

The growing interest in hotel footprints among sustainability professionals and travel-intensive businesses is also shared by the hospitality industry. As of 2011 the number of hotels certified under the LEED sustainability standard more than doubled in one year, and more than a thousand more had registered for LEED and were working toward certification.[2] This groundswell indicates that industry leaders are beginning to commit real money to hotel efficiency measures. The US EPA also offers a hotel energy benchmarking program as part of its Energy Star initiative, through which hundreds of hotels have recently been awarded Energy Star designation by demonstrating they are in the top 25% of hotels for energy efficiency.[3]

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[1] Brighter Planet's companion paper, Air Travel Carbon and Energy Efficiency, focuses on efficiency in the aviation industry.
[2] http://www.usgbc.org/ShowFile.aspx?DocumentID=5301
[3] http://www.energystar.gov/index.cfm?c=hospitality.bus_hospitality

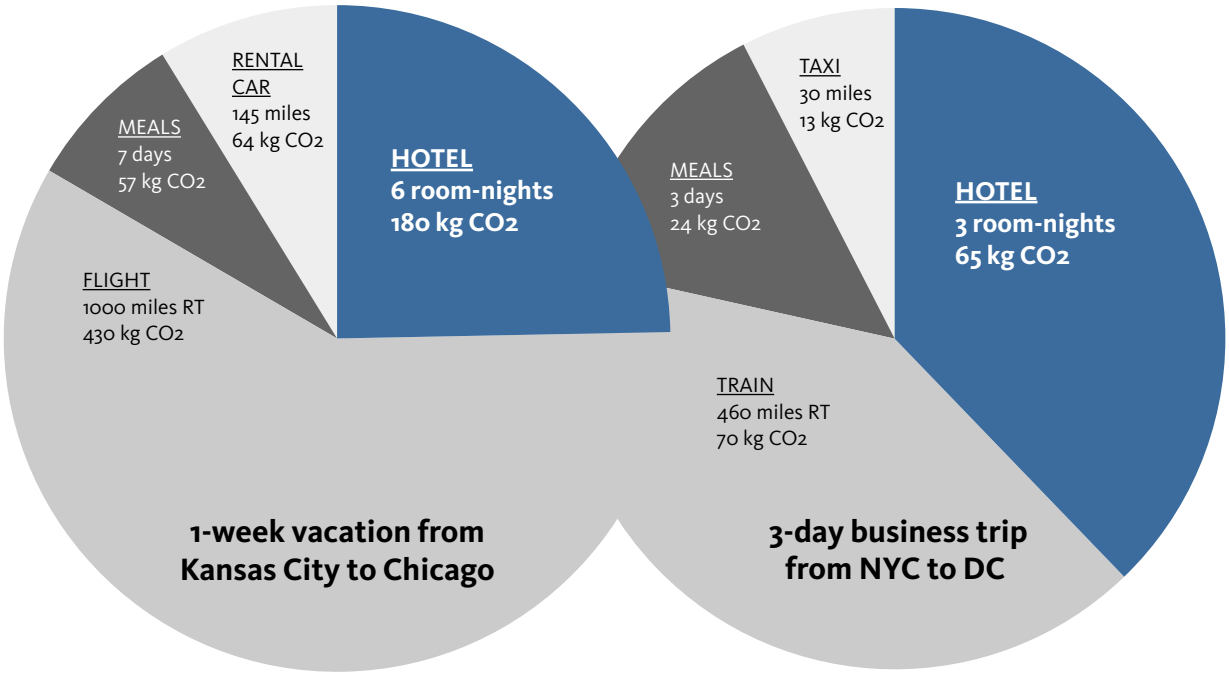
Lodging impacts

The lodging market is large and diverse. In the US alone, an estimated 5 million[4] guest rooms represented by 51,000 hotels, motels and inns nationwide[5] house travelers for a billion room-nights[6] each year. The industry generates $127 billion in revenue each year[7], 5% of which is spent on energy (or 6% of operating costs[8]).

US hotels consume 44.4 billion kWh of electricity, 32.5 billion kWh of natural gas, and 2.3 billion kWh of fuel oil each year. This represents 4% of all commercial building energy consumption in the country, and generates 34.7 million metric tons CO2e of greenhouse gas emissions annually.

From the traveler perspective, lodging represents a major slice of many trips' impacts, typically coming in second only to air travel. For travel-intensive businesses, the environmental impacts of employee lodging can be quite significant, in some cases even approaching the levels of emissions from primary office space.

HOTEL IMPACTS IN CONTEXT:
TWO SAMPLE TRIPS

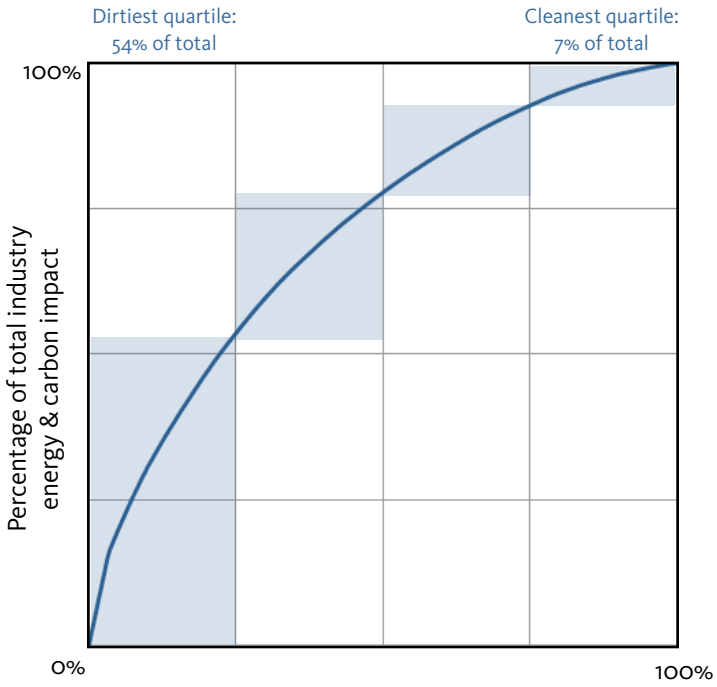


[4] http://www.ahla.com/content.aspx?id=32567
[5] Ibid; count includes only hotels with 15 or more rooms
[6] Calculated using occupancy rate from http://www.pwc.com/us/en/press-releases/2012/pwc-us-lodging-industry-forecast.jhtml
[7] http://www.ahla.com/content.aspx?id=32567
[8] http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH12_HotelsMotels

Accounting for efficiency

As hotel carbon and energy accounting becomes mainstream, professionals in the sustainability, lodging, and travel management fields can find themselves on a steep learning curve. An overly simplistic understanding of hotel impacts can leave a travel manager's hands tied, preventing effective measurement, management, and reporting of business travel footprints.

Travel sustainability managers have traditionally treated lodging impacts as relatively uniform, assigning average emissions factors to a hotel room-night regardless of the establishment in question. But the data show that hotel impacts are in fact far from uniform: efficiency varies tenfold across the industry, with the 90th percentile hotel emitting seven times as much per room-night as the 10th percentile hotel.



Cumulative percentage of lodging industry room-nights rank-ordered by energy intensity (high to low)

Treating all hotels as uniform incorrectly suggests that the only way to reduce lodging impacts is to reduce business travel, obscuring opportunities for significant sustainability gains that would be possible through travel procurement choices. It also introduces major inaccuracies into sustainability reports, and hides footprint trends that are independent of travel volumes.

The chart above illustrates the striking footprint variation in in the US lodging market: the dirtiest quarter of hotel rooms are responsible for more than half of the entire industry's energy use and carbon footprint, while the most efficient quarter are responsible for just 7%. Choosing a hotel from the latter category over the former clearly represents a major footprint reduction opportunity for travelers. Recognizing this variation during sustainability reporting also drastically improves the accuracy of sustainability reports issued by the swelling ranks of companies who now do so.

Given the striking variation in hotel energy and carbon intensity, treating hotels as uniform should be no more than a last resort or a crude ballparking measure. To effectively measure and manage hotel efficiency, travel and sustainability managers should understand and account for the key factors that cause this enormous variation.

The two main sections of this report examine the causes and consequences of hotel efficiency variation. We discuss the key underlying drivers of hotel efficiency, and investigate the patterns of efficiency variation across the industry.

MODELING EFFICIENCY

Brighter Planet's analysis

In this study we use the lodging model hosted on our CM1 sustainability analytics platform to examine the dynamics of hotel efficiency variation. The model uses detailed building energy data from the US Energy Information Administration to calculate energy use and emissions for the 46,000 US hotels in a lodging properties database from leading travel intelligence provider Northstar Travel Media.

The model predicts natural gas, fuel oil, district heat, and electricity use based on local climate, number of rooms, number of floors, construction year, and air conditioning coverage, and adjusts for the presence of various amenities. It then calculates greenhouse gas emissions using appropriate emission factors.

Energy efficiency is also influenced by factors that can't be accounted for in this analysis due to data unavailability. Variables like occupancy rate, building envelope, thermostat settings, and appliance efficiency play important roles in hotel energy use per room-night but aren't to our knowledge included in any major lodging industry data set. Still, the results lend significant insight into the dynamics of efficiency variation across the lodging market.

SNAPSHOT: DATA SOURCES

SNAPSHOT: ANALYSIS

- Based on modeled footprints of 46,000+ US hotels representing 4.6 million+ hotel rooms.
- Performed using Brighter Planet CM1 lodging impact model.
- Core hotel model certified by Det Norske Veritas in 2011 for compliance with GHG Protocol and ISO 14064-1.

The findings we present likely understate the magnitude of variation in hotel energy use and emissions, because our model tends to overestimate for the most efficient properties and underestimate for the least efficient, erring on the side of average versus extreme estimates.

A lodging-specific efficiency metric

The LEED and Energy Star standards both measure building energy use per square foot. While this generic metric allows for comparison across different building types, it does not account for the room-night service model unique to the lodging industry; as a result, it fails to recognize the critical effect of floorspace per room on hotel sustainability.

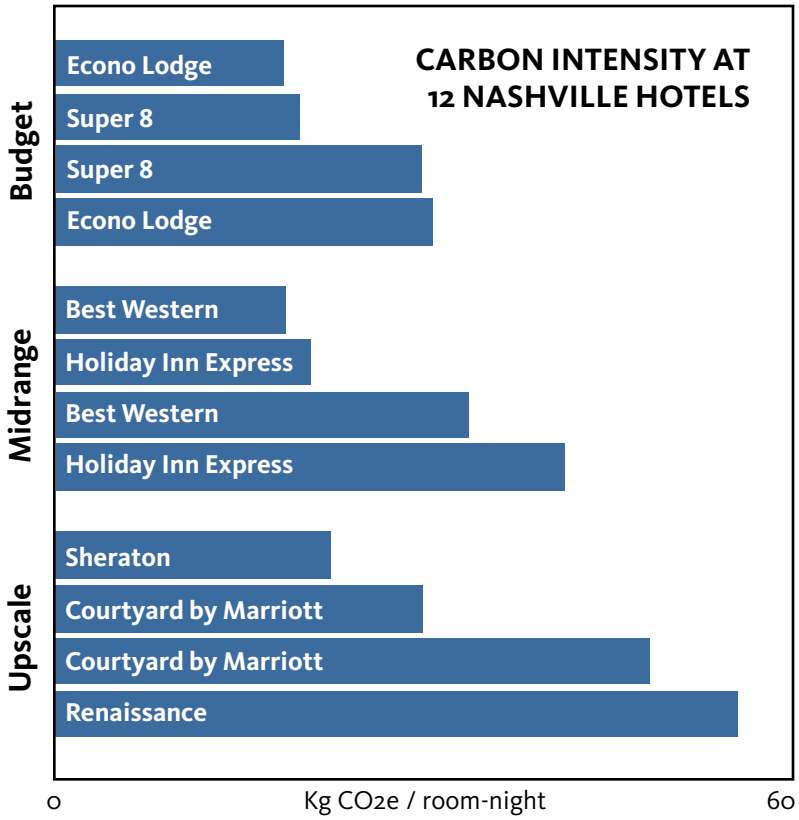
In this study we instead normalize energy use by room-night—so a top-scoring LEED property could turn out to have mediocre energy performance if it has unusually large rooms. Architects and facility managers may think in square feet, but travelers consume lodging services by the room-night, and should view hotel efficiency accordingly.

CASE STUDY: LODGING IN NASHVILLE, TN

Since it's often what matters most to the traveler, variation within a single city serves as a good introduction to hotel energy and carbon efficiency. In this example, 12 Nashville hotels illustrate the range in estimated carbon emissions per room-night, not just within a city but also within a service segment (budget, midrange, and upscale) and within a hotel chain.

Carbon efficiency varied significantly between properties. The cleanest hotel we compared, an Econo Lodge, emitted just a third as much per room-night as the least efficient, a Renaissance.

Efficiency also varied significantly within a service segment, and even within a hotel chain. The least efficient upscale hotel, a Renaissance, emitted 2.5 times as much carbon per room-night as the cleanest upscale hotel, a Sheraton. The cleanest Holiday Inn Express emitted half as much as the dirtiest Holiday Inn Express.

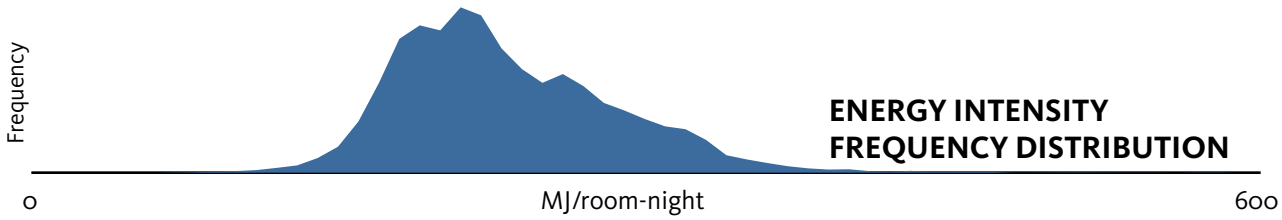


As a result of this variation, footprint reduction opportunities exist for travelers at every price point. While the average upscale hotel was dirtier than the average budget hotel, the cleanest upscale hotels were comparable to the cleanest budget hotels. The cleanest upscale hotel in Nashville, a Sheraton, emitted just 20% more than the cleanest budget hotel, an Econo Lodge, making it cleaner than 75% of budget hotels and 90% of midrange hotels.

With little variation in emission factor, energy efficiency exhibited the same pattern as carbon efficiency.

Efficiency drivers

ENERGY EFFICIENCY DRIVERS



Energy intensity varies by more than an order of magnitude among US hotels, with common values ranging from 150 to more than 300 megajoules per room-night. Area per room, local climate, and the number of amenities like mini-fridges and pools are the main drivers of energy efficiency accounted for in our model. Each of these drivers is examined individually on the following pages.

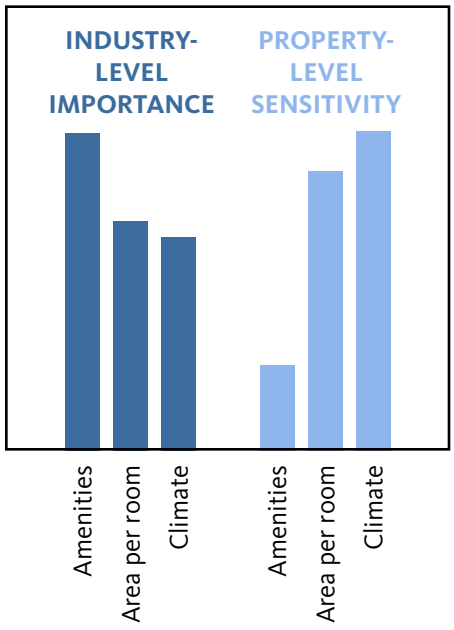
Comparing the relative importance of efficiency drivers can be useful for the understanding it offers both to travel and facility managers seeking to assess hotel impacts when footprint data is unavailable, and to lodging and sustainability professionals seeking insight about what drives efficiency variation across the market. These are separate questions that result in distinct rankings of relative driver importance.

At the property level, a driver's predictive strength can be judged using a sensitivity analysis that measures the percent change observed in efficiency for every percent change in the driver. Using this metric, climate has the greatest impact, followed by room area, while amenities plays a lesser role.

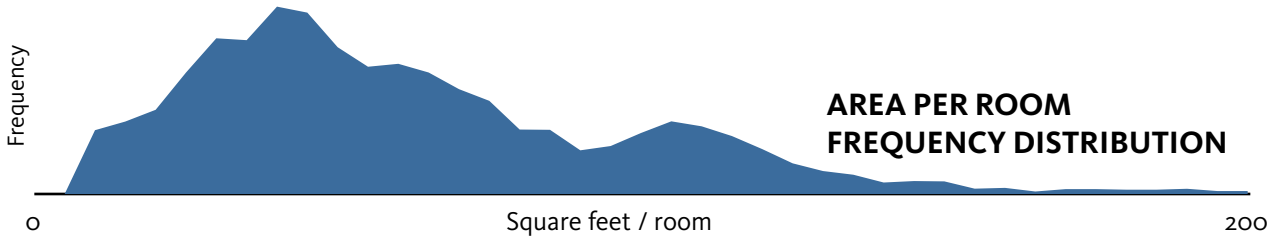
Within the entire lodging industry, by contrast, amenities variation accounts for the greatest variation in energy efficiency, with room area and climate accounting for less. This is measured by calculating the percent change in efficiency across the actual spread of driver values observed among US hotels.

The property-level sensitivity analysis tells us, for instance, that a doubling in amenities energy use will have less of an impact on a hotel's efficiency than a doubling in room area or climate control needs. But the industry-level analysis shows that amenities actually cause the most efficiency variation among US hotels (because amenities vary much more widely than the other drivers).

DRIVERS COMPARED: RELATIVE IMPACT ON ENERGY EFFICIENCY



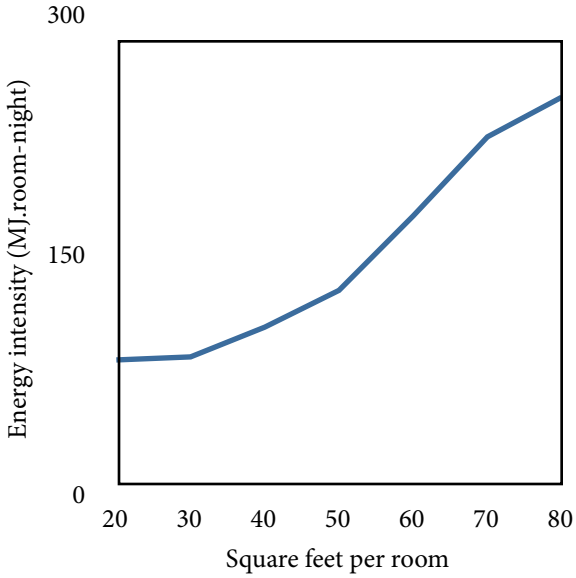
Area per room



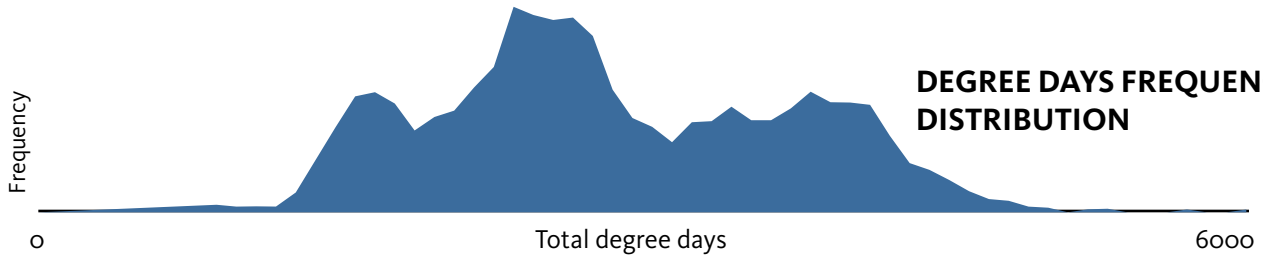
The more rooms that are fit into a building of a given size, the less energy each room uses. Area per room is a hotel's total square footage divided by its number of lodging rooms. As such, it encompasses two separate factors: the average floor space of a lodging room in the hotel, and the amount of floor space devoted to other uses, including corridors, lobbies, dining areas, and fitness centers.

There's significant variation in room area within the US lodging market, with values spanning more than an order of magnitude. The vast majority of hotels have between 20 and 80 square feet per room, with an average of 54.

As would be expected, energy use per room-night is highly proportional to floor space per room. A hotel with 80 square feet of floor space per room consumes more than three times as much energy per room-night as a hotel with 20 square feet per room.

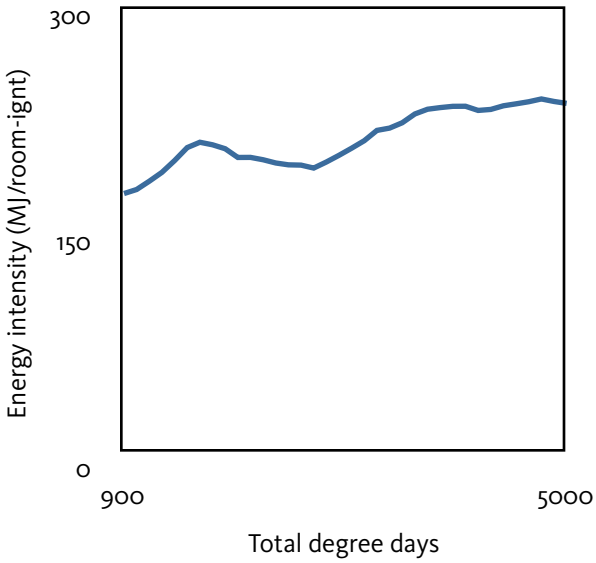


Climate



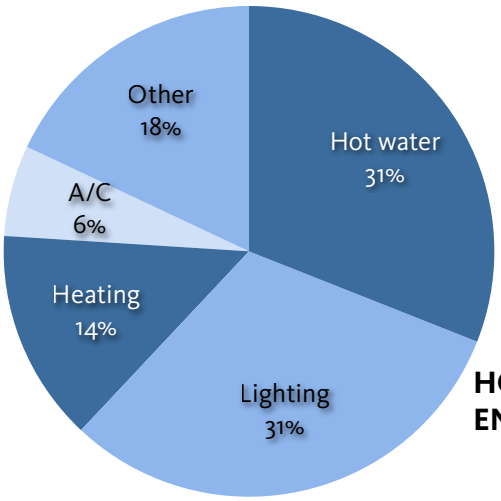
DEGREE DAYS FREQUENCY DISTRIBUTION

The standard for measuring a locality's climate-driven heating and cooling demands is the "degree day". Heating degree days quantify the need for heating, and cooling degree days the need for air conditioning; they can be added together to estimate total climate control needs. The annual degree days faced by hotels across the US varies by more than a factor of six, with most hotels facing between 2000 and 4200 degree days each year.



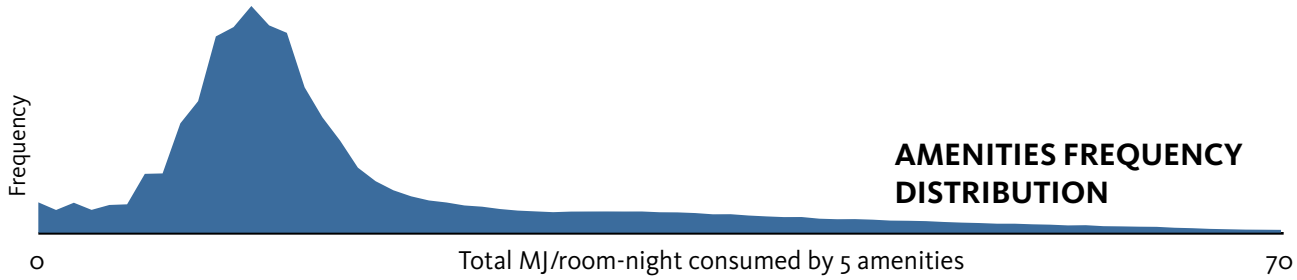
As the data demonstrate, total degree days does indeed influence a hotel's energy efficiency. Hotels in regions with high climate control needs use 30% more energy per room-night than hotels in moderate climates.

Given the substantial variation in climate, we might expect it to have a greater influence on energy efficiency; the reason it doesn't is that climate control accounts for just 20% of total hotel energy use. Meanwhile almost two thirds of hotel energy goes towards lighting and water heating, end uses that are largely unaffected by the local climate. Although this end use breakdown differs significantly among hotels, at the national level, climate control is dwarfed by other energy end uses.

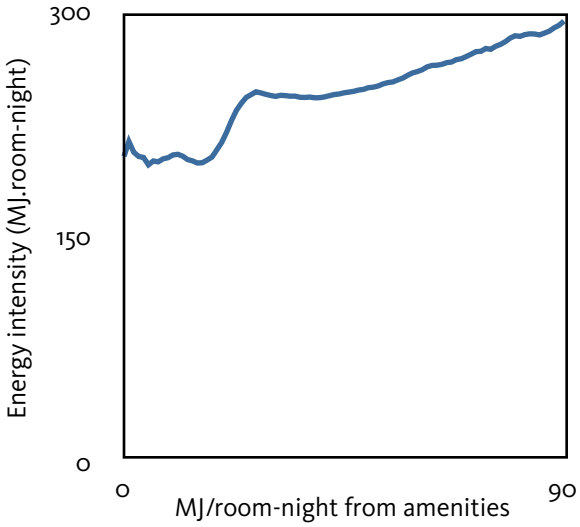


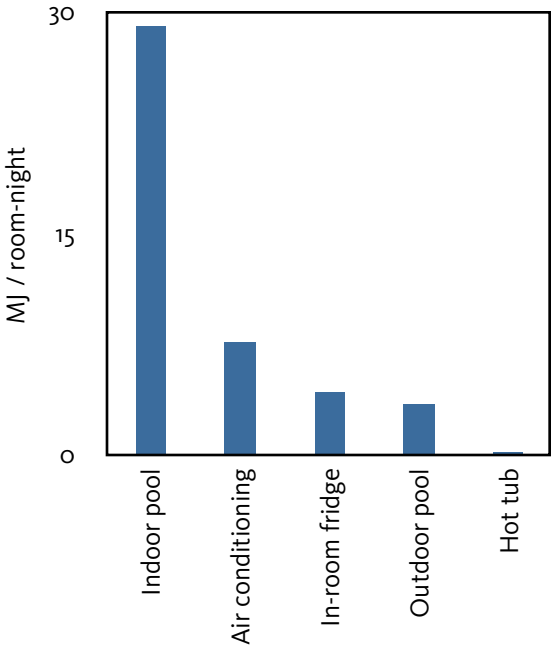
HOTEL ENERGY END USES

Amenities



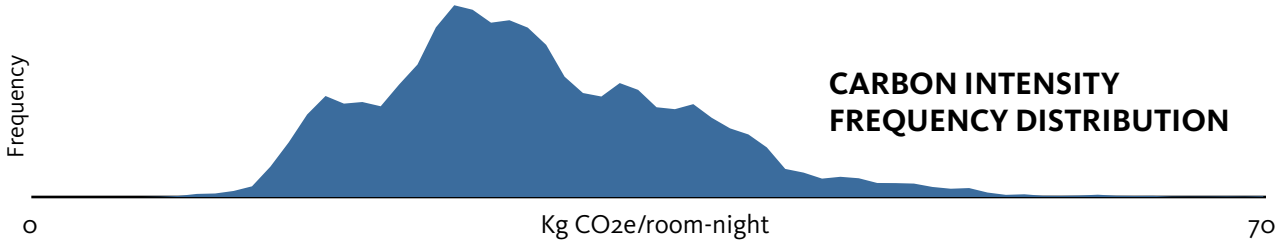
Hotels' offerings often extend far beyond the basic guest room with heat, light, and hot water. The typical room consumes 13 megajoules of energy per night from air conditioning, in-room fridges, hot tubs, and indoor and outdoor pools combined. This represents less than 10% of total energy use at the typical hotel, but for some hotels this figure can be more than 25%. Amenities energy use varies more than tenfold across the industry depending on the features offered by a particular establishment, playing an important role in overall energy efficiency.





Amenities differ markedly in their relative impacts. The average indoor pool consumes nearly 30 megajoules of energy per room per night, or roughly 15% of the average hotel room's total energy use. By contrast the average outdoor pool consumes about a tenth as much.

CARBON EFFICIENCY DRIVERS

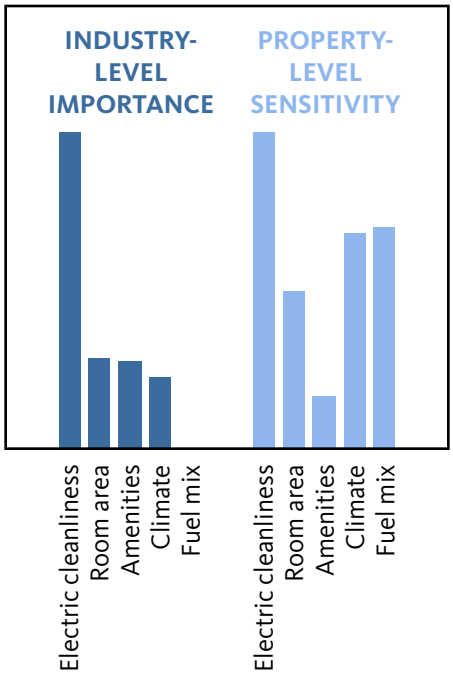


Carbon efficiency varies even more widely than energy efficiency. Because emissions are a function of energy use, the variability in carbon intensity includes all the variability in energy intensity—but it also includes the variability in the cleanliness of different hotel energy sources, most importantly the dirtiness of the local electricity grid. Common carbon intensity values range from 15 to 40 kilograms CO2e per room-night.

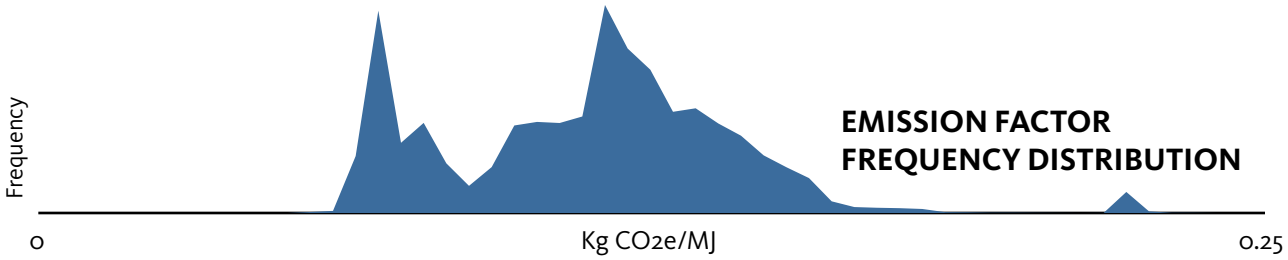
As with energy efficiency drivers, the relative importance of the five carbon efficiency drivers can be compared using two separate approaches aimed at answering distinct questions. Across the US lodging industry, electricity cleanliness accounts for more variation in carbon efficiency than does any other driver, followed by room area and amenities. At the property level, a change in electricity cleanliness results in the greatest change in carbon efficiency, with fuel mix and climate the next most powerful drivers.

The greatest disparity between the two ranking schemes exists for fuel mix, which is the second strongest carbon efficiency driver at the property level but registers no connection with carbon efficiency in the industry as a whole. The phenomenon behind this counterintuitive finding is explained on the following page, where we focus on fuel mix and electricity cleanliness, the two drivers that make carbon efficiency vary independently from energy efficiency.

DRIVERS COMPARED: RELATIVE IMPACT ON CARBON EFFICIENCY

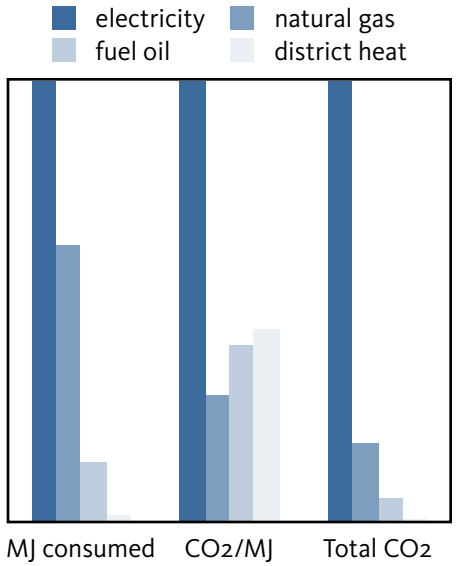


Energy sources



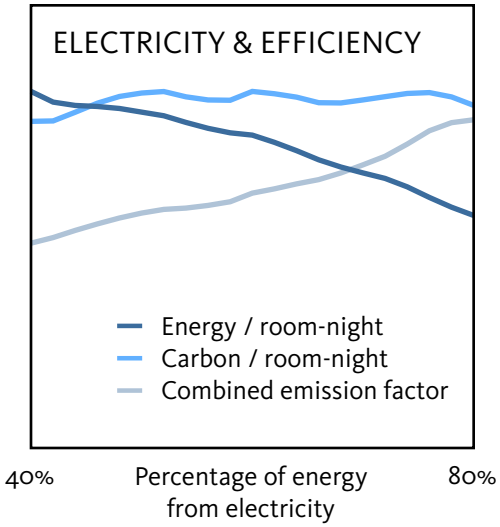
Energy source is an important driver of hotel carbon efficiency—properties that use cleaner fuels are more carbon efficient. Electricity, natural gas, fuel oil, and district heat are the four main hotel fuels. Electricity is generally the dirtiest per unit energy (this varies geographically), and it also happens to be the fuel hotels use most. The next most common fuel, natural gas, is also the cleanest. Electricity and natural gas combined supply over 90% of all hotel energy.

Because it is both the dirtiest and the most common hotel energy source, electricity represents 88% of all lodging emissions, despite accounting for just 55% of energy used.



Given that electricity is so much more carbon-intensive than other energy sources (making energy mix the second strongest carbon efficiency driver at the property level, as we saw on the previous page), one could reasonably expect that hotels relying more heavily on electricity would have higher carbon intensities on average. But surprisingly, this is not the case—electric proportion and carbon intensity have no measurable correlation across the industry. This is because hotels that derive more of their energy from electricity also tend to be more energy efficient.

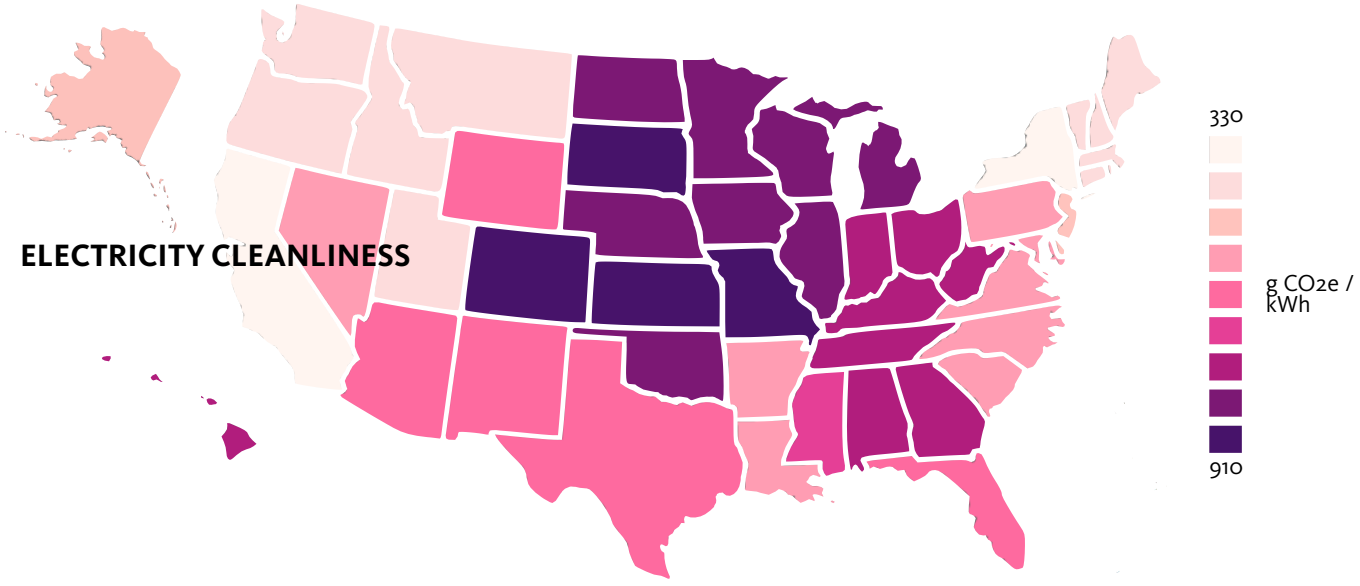
Energy prices are one likely reason for this—electricity is the most expensive fuel, so properties that depend heavily on electricity have a stronger incentive to implement efficiency programs, and energy-intensive properties have an incentive to use other fuels rather than electricity.



Another explanation may be that electricity is simply a more efficient fuel. Space and water heating systems that run on fuel oil or natural gas can indeed be less than 70% as efficient as electric heaters, which waste less energy heating unoccupied spaces and exhaust gas.

Electricity Cleanliness

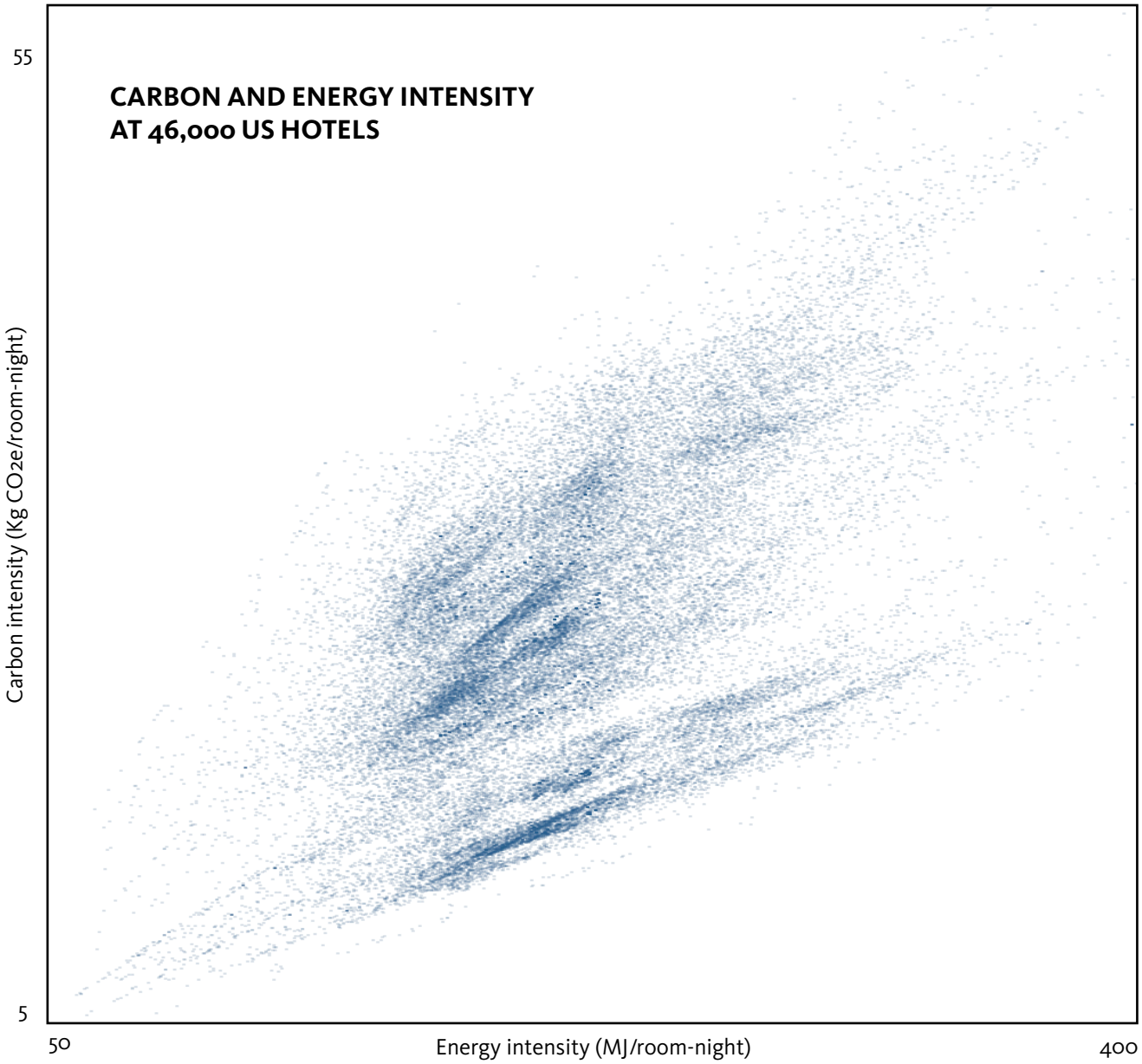
Unlike the other hotel fuels, electricity differs in carbon intensity depending on where a hotel is located. While some regions derive their electricity predominantly from hydroelectric or nuclear sources, others do so with high-emissions coal-fired power plants. The US state with the cleanest electricity (California) emits just a third as much per kilowatt-hour as the dirtiest (Colorado).



Since electricity comprises such a major portion of hotel energy consumption, this variability is a major driver of emissions efficiency differences among regions and hotel chains. For instance, the number one most efficient hotel chain in our industry rankings on page 5—Vagabond Inns—ultimately outperforms the competition not through energy efficiency (on which it ranks a respectable but not medal-winning 9th out of 75 chains), but primarily through exceptional greenhouse gas efficiency due to its properties being located almost exclusively in California.

While a hotel's carbon impact is strongly tied to its geographic location, this relationship can be mitigated through alternative energy strategies. Installation of on-site solar or wind power, or the purchase of renewable energy credits or carbon offsets, can help hotels in any region to take action on the efficiency driver that would otherwise be least within their control. Numerous US hotels have already taken these steps, and as energy prices and sustainability continue to grow in importance, we're likely to see a continuation of this trend.

THE ENERGY-CARBON CONNECTION



This chart, where each point represents a hotel, illustrates the wide variability in both energy and carbon efficiency across US hotels. The points cluster roughly around a diagonal line from bottom left to top right, indicating that more energy-intensive properties are usually more carbon-intensive as well. But the wide two-dimensional spread shows that despite this general trend there is still significant variation in carbon intensity among properties with the same energy intensity, and vice versa. This means energy efficiency is only a very rough indicator of carbon efficiency. Travelers trying to minimize their carbon footprint should be aware that an energy-efficient hotel can still have a significant carbon impact.

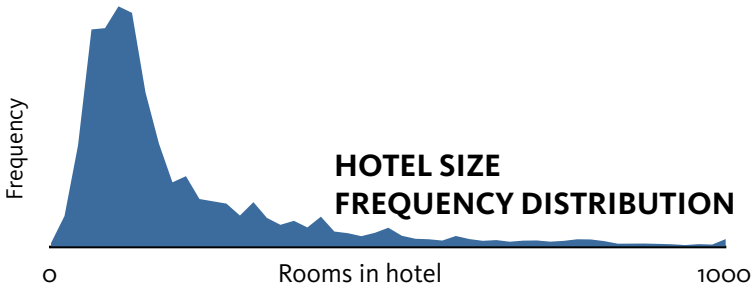
Efficiency indicators

As we know, lodging energy and carbon efficiency varies dramatically, and this variation is driven by numerous underlying factors. But while these efficiency drivers are insightful, and important to the lodging industry, the dynamics of how efficiency plays out in the hotel market are more relevant to the average traveler or business sustainability manager.

The following sections investigate these market patterns, showing how energy and carbon efficiency vary according to five industry variables: hotel size, geographic location, building age, chain, and service segment. These characteristics help to explain why particular trip itineraries or corporate travel programs are more efficient than others.

They can also serve as indicators of hotel sustainability when information about underling drivers is unavailable. These industry variables are simply indicators reflecting averages of the five drivers from the previous section that actually influence a hotel's efficiency. As such, while using these factors to predict hotel footprints has a lower margin of error than the predominant method of simply using an overall average, it has a higher margin of error than can be achieved through the use of information about the underlying drivers.

HOTEL SIZE

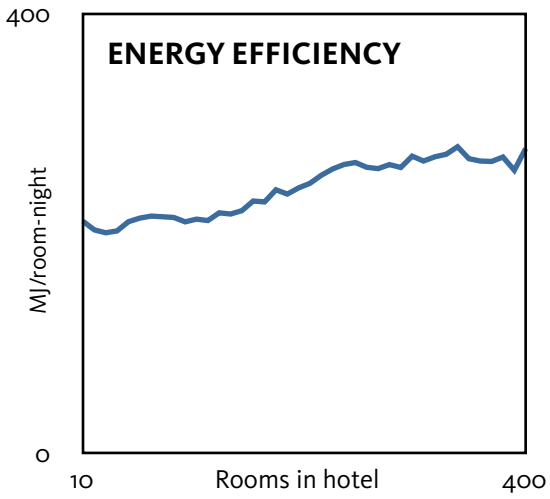


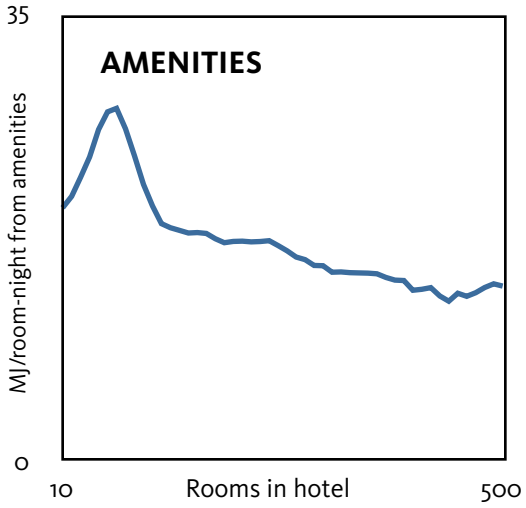
It almost goes without saying that larger hotels consume more energy. But they also consume it more intensively—a hotel with 400 rooms consumes and emits a third to a half more energy and carbon, respectively, per room-night than a hotel with 20 rooms. This is true not just of energy use per room-night, but also of energy use per square foot.

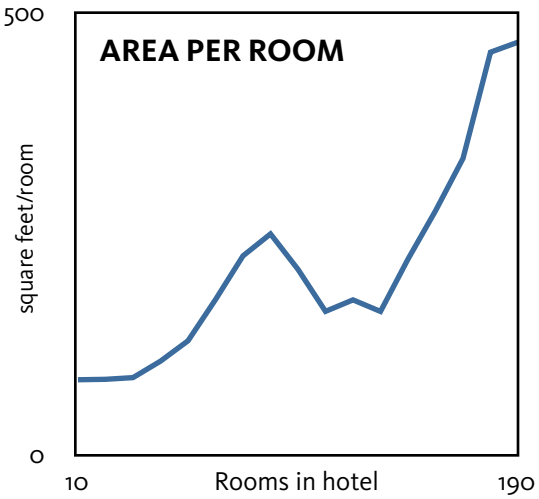
Interestingly, this is opposite the pattern observed in many other building types where energy intensity is inversely proportional to building size—typically, as floor space increases, the ratio of surface area to volume decreases, reducing heating and cooling needs per square foot. So what makes hotels different?

Amenities appear not to be the answer. While larger hotels do have more amenities, they're shared among more rooms, resulting in lower amenities energy use per room-night than in smaller hotels.

Instead, the main reason is that larger hotels have more total floor space per room. As we know, area per room is highly proportional to energy per room-night, so the fact that larger hotels use more floor space per room lowers their energy efficiency relative to smaller hotels. Room size, in addition perhaps to other variables not accounted for, appears to more than offset the theoretical efficiency increases one might expect in larger hotels.



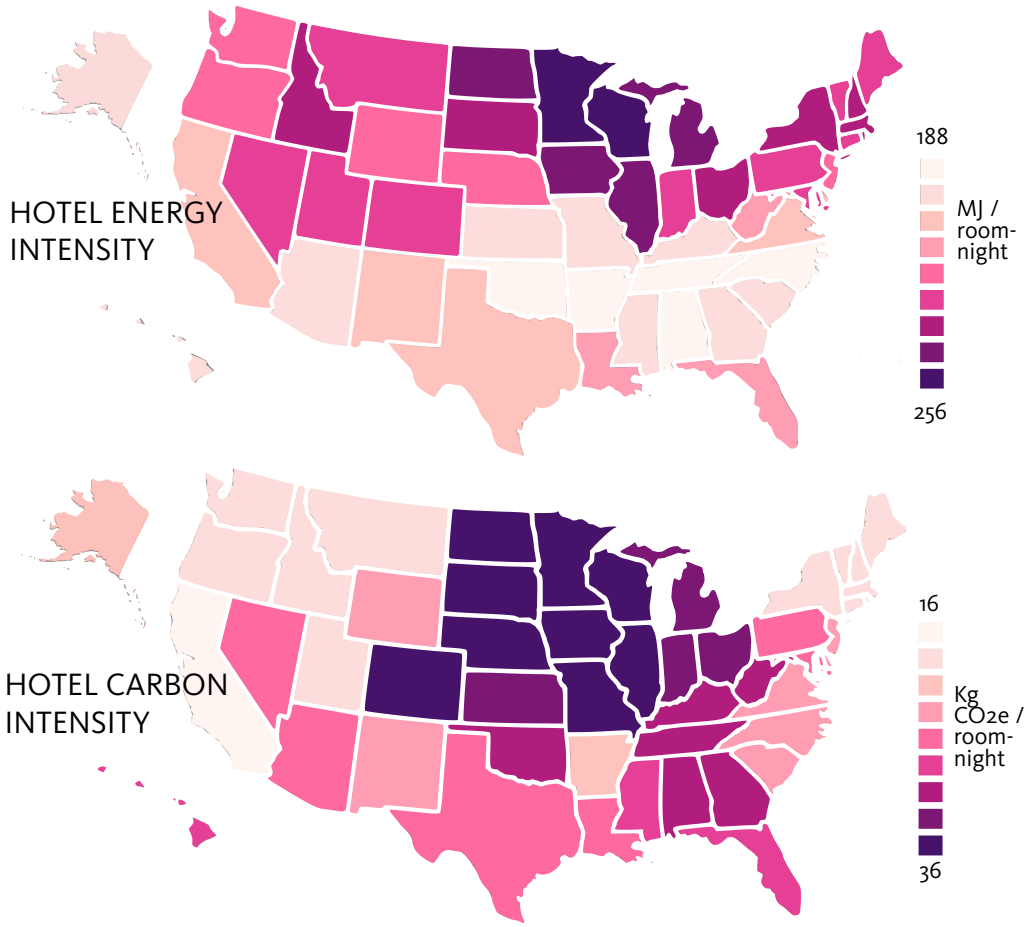




GEOGRAPHY

Energy use per room-night ranges from 188 megajoules per room-night in Arkansas to 256 in Minnesota. The states with the most energy efficient hotels lie in the inland Southeast and Lower Midwest, while the Upper Midwest has the least energy efficient lodging properties. This is due to variation in the underlying energy efficiency drivers. For instance, the average number of indoor pools varies from 0.34 in Alaska to 0.93 in North Dakota, and the average number of heating and cooling degree days ranges from 1312 in Hawaii to 6175 in Alaska.

Carbon efficiency shows a largely different geographic pattern from energy efficiency, and varies even more widely than energy efficiency, ranging from 16 kg CO_2e per room-night in California to 36 in Minnesota. While the Upper Midwest remains the hotspot for emissions intensity, the most efficient regions on carbon emissions are the West Coast and the Northeast.



The discrepancy between geographic patterns in energy efficiency and carbon efficiency is driven by regional variation in energy sources at the hotel and electric grid levels, with average hotel emissions per megajoule varying more than twofold among states. Hotels in some regions use a higher proportion of electricity than others (the statewide average fraction of a hotel's total energy needs met with electricity ranges from 49% to 66%) and the cleanliness of grid electricity varies widely, as previously noted.

BUILDING VINTAGE

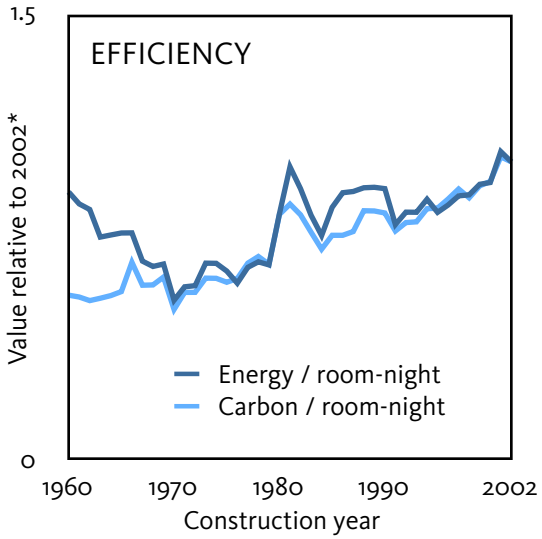
The last half century has seen an overarching trend towards less efficient hotels. Among currently operating hotels, properties built in the 2000s use more than twice as much energy per room-night as properties built from 1965 to 1975, and emit almost 2.5 times as much carbon.

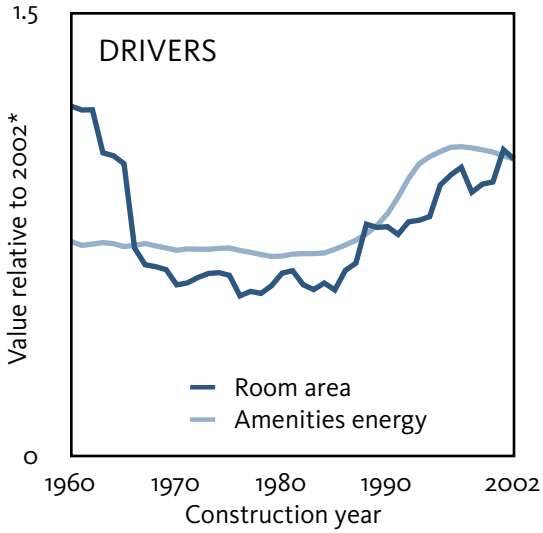
Hotel carbon intensity has increased even faster than energy intensity due to changing energy sources—a shift away from fuel oil toward electricity, which is generally dirtier, has meant that one megajoule of energy consumed by a newer hotel has nearly double the carbon impact of one consumed by an older, less electricity-dependent establishment.

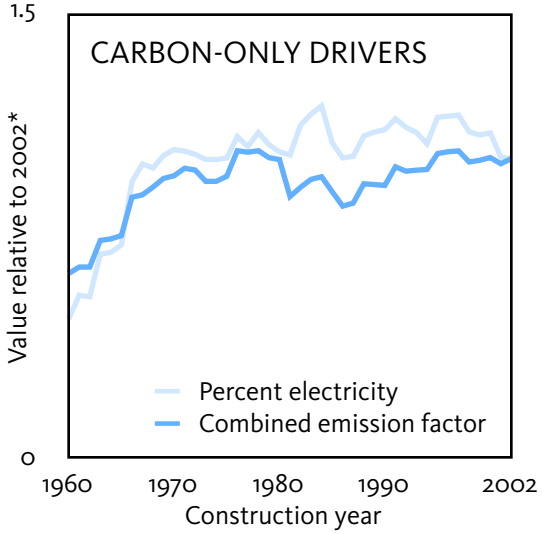
The sharpest drop in hotel efficiency, beginning in the 1980s, was driven largely by two trends: larger rooms and more amenities. An average hotel built in the 2000s has twice the floorspace per room as a property built in the 1980s, and uses 60% more energy for amenities.

Fortunately, data in the most recent years show signs of a possible reversal in efficiency trends. Room area, amenities, and carbon emission factor all decreased slightly between 2000 and 2002 (the latest year for which hotel energy data is available from the US EIA), and efficiency decreases slowed.

Hotel energy use per *square foot* has actually dropped significantly since the 1980s, and recent trends in LEED and Energy Star hotel certifications, with the increased efficiency focus they indicate, suggest this may continue. But for the lodging industry to truly move towards sustainability it will need to maintain this course while simultaneously reversing the trend of decreasing room density.







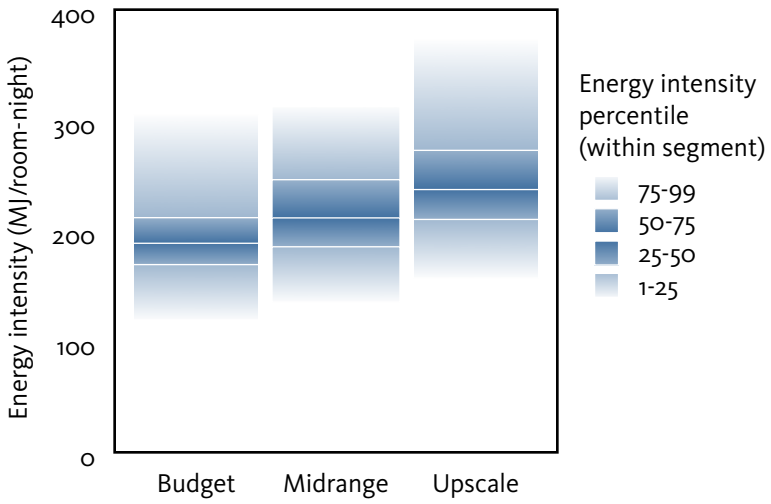
* smoothed using 10-year rolling average

SERVICE SEGMENT

It's probably no surprise that efficiency varies by price, with upscale hotels on average using 25% more energy per room-night than budget hotels. This is to be expected based on hotel characteristics: the average upscale hotel has twice as many rooms and was built a decade more recently than the average budget hotel, with midrange hotels falling in between.

But it's important to note that there's so much variability within each service class that the different service classes overlap significantly. Nationwide the cleanest upscale hotels are cleaner than most budget hotels, and the dirtiest budget hotels are as dirty as all but the dirtiest quarter of upscale hotels. The chain rankings at the beginning of this paper reflect this, and you'll recall from the case study that the overlap also occurs within individual cities.

The key message for travelers and sustainability managers is that making assumptions about the relative efficiency of two hotels based solely on their pricepoint is likely to yield erroneous conclusions—although it's still more reliable than simply assuming an industrywide average.

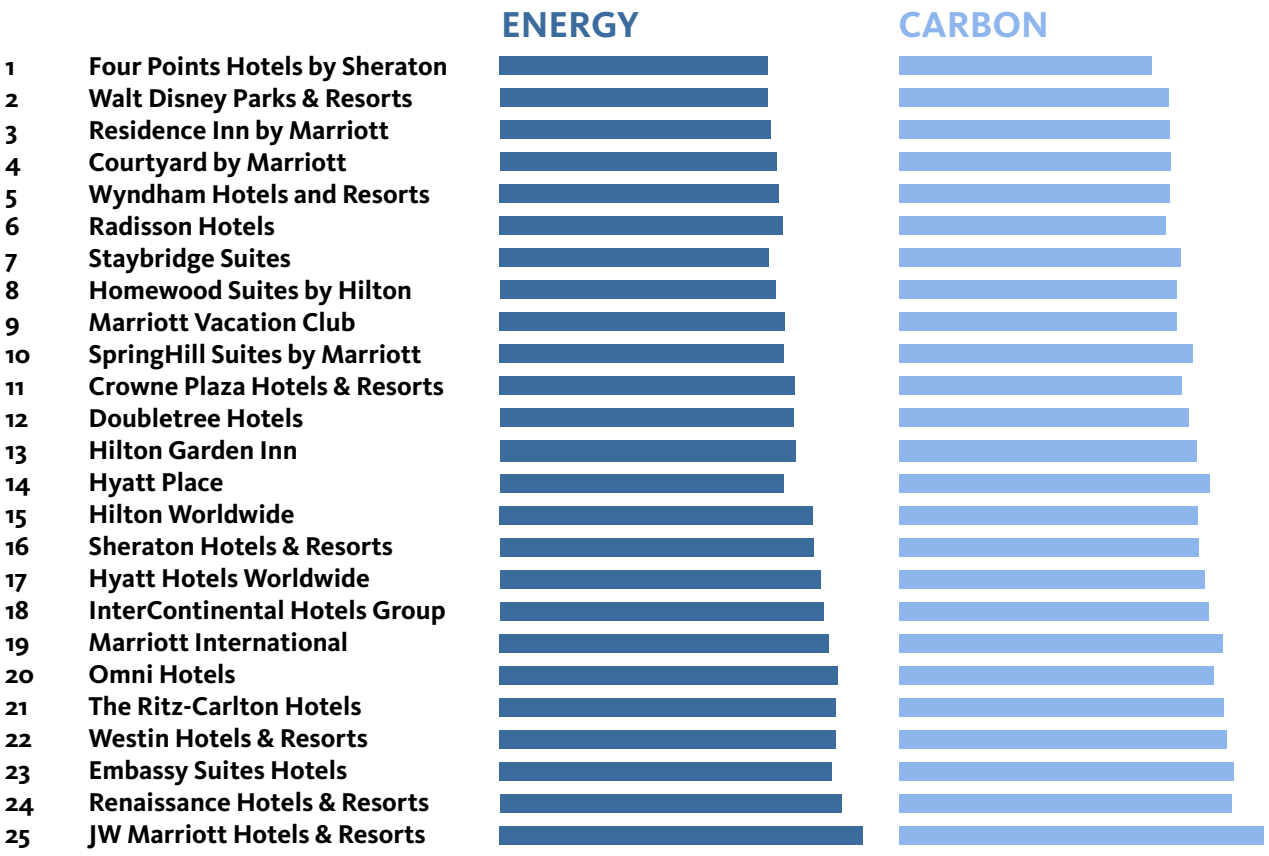


CHAIN

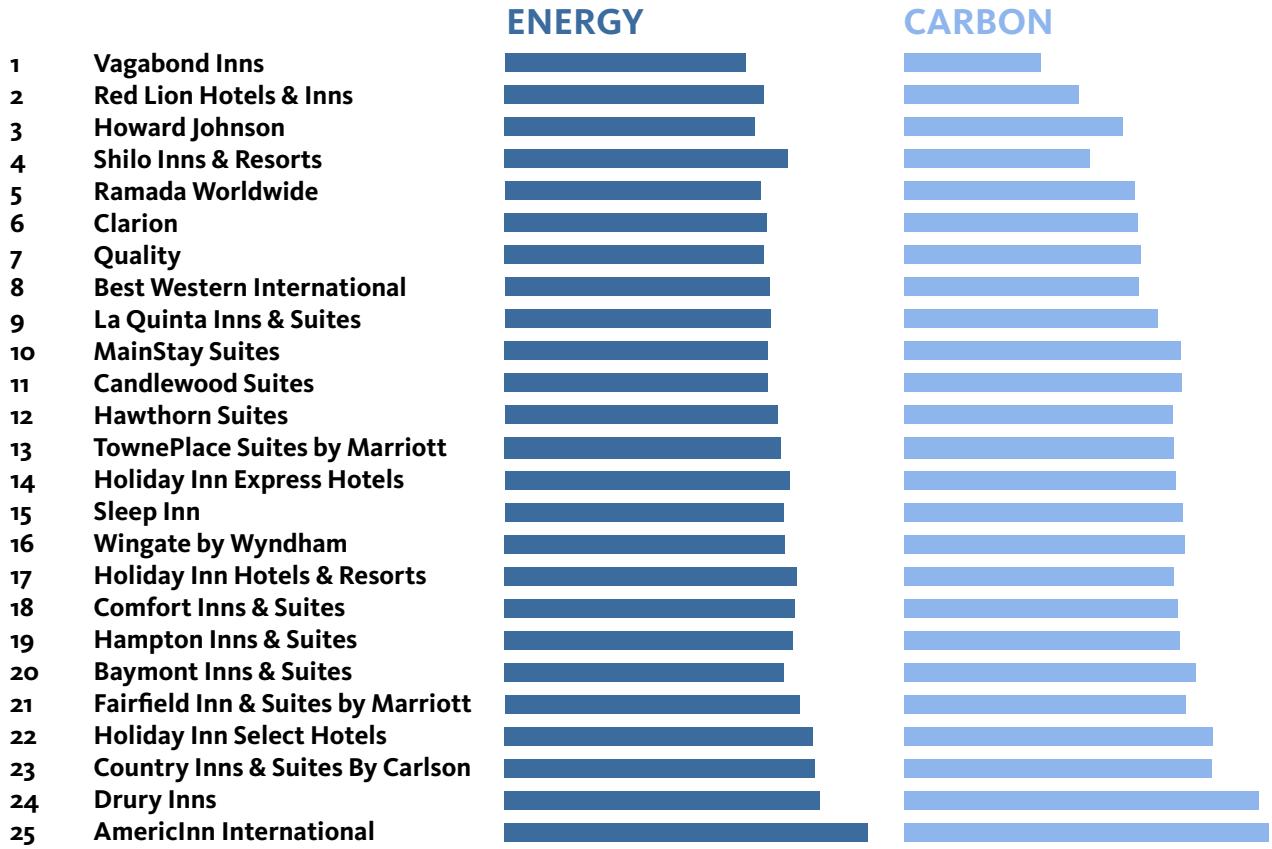
Brands vary markedly in their carbon and energy efficiency as a result of differences in their underlying drivers. The three charts below, which equate to the rankings on page 5, compare the estimated impacts per room-night of the 25 largest hotel chains in each service segment. Again, note that substantial overlap exits among the three segments—although less so when comparing chains than when comparing individual properties.

In the upscale segment, Sheraton and Disney got top efficiency scores, while JW Marriott and Rennaisance had the highest estimated impact per room-night. Vagabond and Red Lion ranked highest among midscale establishments, with AmericInn and Drury Inns modeled as least efficient. In the budget segment, Red Carpet Inns and Travelodge took top spots, with Budget Suites and Value Place estimated to be least efficient.

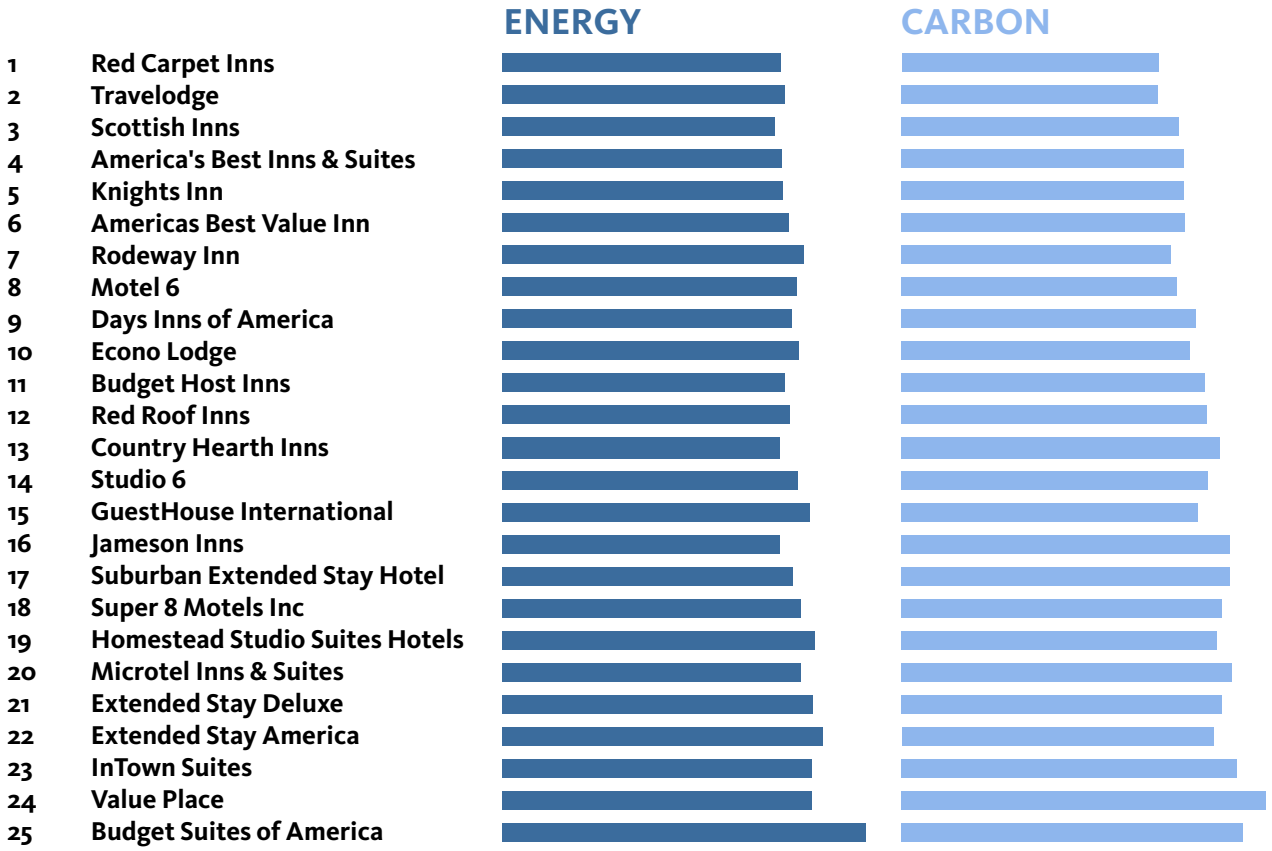
UPSCALE SEGMENT



MIDRANGE SEGMENT



BUDGET SEGMENT



Conclusions

Lodging consumers

For travelers and business travel managers, hotel efficiency variation adds a second tool to the sustainable lodging toolkit alongside reductions in travel volume. Since hotel efficiency varies dramatically at all price points, travelers on any budget have opportunities to reduce their footprint without compromising on cost or service.

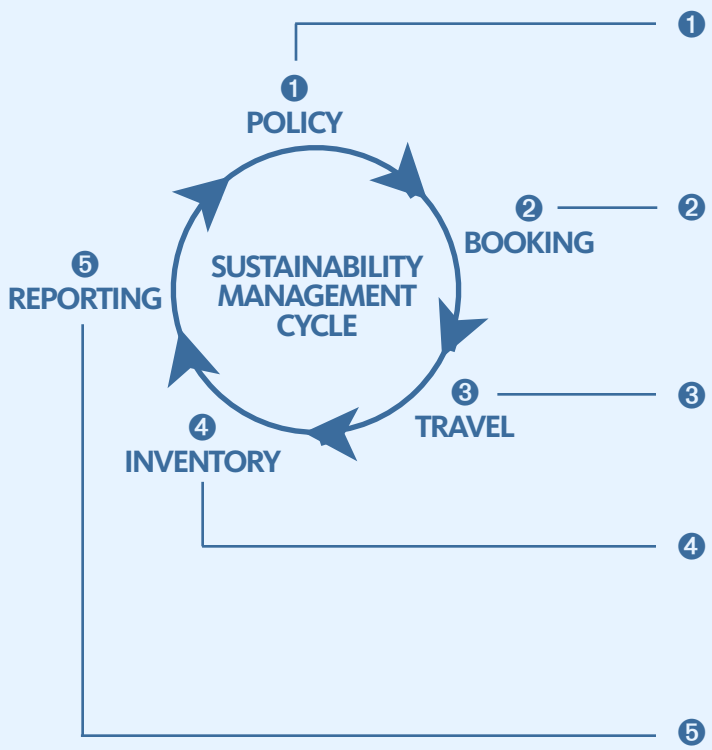
Accounting for the variation in efficiency also improves the accuracy of carbon reporting. Treating hotel impacts as uniform during travel footprint calculation introduces significant inaccuracy given the extent of real-world efficiency variation. This leaves reporting entities vulnerable to outside criticism and prevents sustainability managers from identifying trends that occur independent of travel volumes. As sustainability reporting practices mature, a more robust approach to hotel efficiency accounting is likely to become expected.

Resources are expanding to meet these growing expectations. Most organizations that calculate travel footprint at still do so using industry average, but the data necessary to operate at higher levels are rapidly becoming available.

HOTEL CARBON ACCOUNTING HIERARCHY	
****	Calculated from direct energy consumption
***	Modeled using underlying driver data
**	Estimated based on superficial indicators
*	Assumed equal to industrywide average
	Carbon inventory not performed

The 46,000 energy and emissions scores that underly this paper, regularly updated with the latest data, are accessible via Brighter Planet's CM1 service. The US Energy Information Administration study that underlies our lodging model has overcome budgetary delays and is preparing the next commercial building energy use data update. Organizations like The Carbon Accounting Company are working to improve access to empirical hotel energy use data. Initiatives like the ITP and WTTC's forthcoming hotel carbon accounting standard are helping to streamline the sustainability data pipeline. And numerous hotel chains, like companies across the economic spectrum, are growing more transparent in their data disclosure and sustainability reporting. As these efforts continue to mature, the quality and accessibility of hotel footprint data will increase, and business travel managers will be able to more efficiently and effectively take hotel sustainability into account during all phases of the management cycle.

BEST PRACTICES FOR EMPLOYEE LODGING SUSTAINABILITY MANAGEMENT



1. Pursue carbon reduction goals through both increases in lodging efficiency and reductions in travel volume.
2. Implement proactive footprint calculation that allows carbon to be considered alongside price and convenience during booking.
3. Engage employees in meeting travel sustainability goals via education and incentives.
4. Account for each hotel's unique characteristics rather than treating all lodging establishments as generic.
5. Publicly set goals for and report hotel impact per room-night in addition to total footprint.

Lodging providers

If all hotels were as efficient as the top 25%, the lodging industry's footprint would be cut by 72%, saving hotel operators $4.5 billion annually on energy and eliminating 25 million metric tons of carbon dioxide emissions per year.

Hotel operators have a strong incentive to implement efficiency measures to reduce energy costs, although this adoption is taking place at different rates in different segments of the lodging industry—one recent study demonstrated, for example, that chain hotels are doing a better job at implementing sustainability measures than are their independent counterparts.[9] While efficiency investments are often profitable after an initial payback period, the fact that they entail upfront investments may explain why larger chains with more cash on hand are leading the charge. But to the extent that an energy efficiency focus confers a competitive advantage, this fact may reinforce the increasing market domination of chains over independent establishments.

[9] http://www.environmentalleader.com/2011/10/26/hotel-chains-trump-independents-on-green-policy/

The benefits to hotels from energy efficiency go beyond cost savings as well. Many chains are betting that a sustainability focus will help to build brand, attract socially-conscious customers, engage employees, and meet the demands of investors and other stakeholders. And as the large corporations whose employees represent the most influential hotel customers begin to direct increasing attention toward their own travel footprints, hotels with an efficiency focus will find themselves at an even greater advantage.

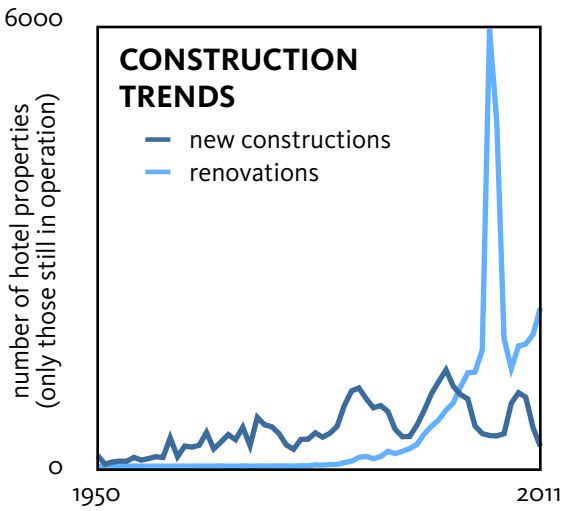
Industry trends

The overarching trend of recent decades has been decreasing efficiency in new hotels. The average hotel built in the 2000s uses twice as much energy and emits more than twice as much carbon per room-night as the average hotel built from 1965 to 1975. Two major factors driving this trend are increased prevalence of energy-consuming amenities such as pools and mini-fridges, and increased square footage per room.

In 2002, the most recent year for which empirical hotel efficiency data is available via the US EIA, newly-built hotels consumed more energy per room-night than at any point in the past century—and 2002 also marked the latest in an unprecedented 15-year stretch of precipitous and uninterrupted declines in hotel efficiency.

The data do show that this decline slowed in the early-00's, suggesting it's possible that hotels built since 2002 have reversed this troubling trend. We also know that the last 10 years have seen surging interest in efficiency initiatives like LEED and Energy Star, which gives further hope that tomorrow's hotels may be significantly more efficient than today's.

But hotel turnover is slow, and new properties represent just a drop in the bucket of operating hotels. Until they're shut down or renovated, the current stock of hotels includes tens of thousands of legacy properties that will continue to operate at the efficiency levels of the period when they were designed and built. As such, efficient new installations will need to perform far more sustainably than the current average, and become the norm for decades to come, before they will have a significant impact on the industry's average energy and emissions performance. This is especially true in a period when construction of new hotels is at its lowest point in decades (fewer new hotels were built in 2011 than in any year since 1977).



A major uptick in renovations in recent years indicates that hotel operators are increasingly modernizing old buildings—but it's still not fully clear what impact this trend will have on efficiency. If the goal is to make old hotels more like new ones, with greater area per room and more amenities, then widespread renovations could lead to a decrease in efficiency. On the other hand, if the majority of renovations are

focused on improving insulation, lighting, heating, and appliances, they could represent a major boon for energy and carbon efficiency.

Programs like LEED and Energy Star should help to encourage hotels to consider efficiency alongside other factors when renovating. But because these programs measure energy use per square foot, they could mistakenly show improvement when efficiency per room-night has actually decreased. Until the trend of increasing area per room is reversed, new hotels will need to halve their energy use per square foot simply to achieve the same efficiency per room-night as the average hotel built 40 years ago.

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