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Hotel Sustainability Benchmarking Index 2016: Energy, Water, and Carbon

Eric Ricaurte
Greenview

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Abstract

Several studies have been undertaken or attempted by industry and academe to address the need for lodging industry carbon benchmarking. However, these studies have focused on normalizing resource use with the goal of rating or comparing all properties based on multivariate regression according to an industry-wide set of variables, with the result that data sets for analysis were limited. This approach is backward, because practical hotel industry benchmarking must first be undertaken within a specific location and segment.[1] Therefore, the CHSB study's goal is to build a representative database providing raw benchmarks as a base for industry comparisons.[2] These results are presented in the CHSB2016 Index, through which a user can obtain the range of benchmarks for energy consumption, water consumption, and greenhouse gas emissions for hotels within specific segments and geographic locations.

Keywords

Cornell Hotel Sustainability Benchmarking (CHSB) study, hotel industry, energy efficiency, carbon offsets, travel and tourism

Disciplines

Environmental Studies | Hospitality Administration and Management | Tourism and Travel

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EXECUTIVE SUMMARY

This report presents the results of the third annual Cornell Hotel Sustainability Benchmarking (CHSB) study, an update to the CHSB2015 study, which was undertaken as a collaborative effort of the Cornell University Center for Hospitality Research, Greenview, and an industry advisory group. This report and its accompanying index are intended to advance the knowledge base and data sets for benchmarking activities relating to energy, water, and greenhouse gas emissions for the industry's benefit. The inaugural study, published in May 2014, and the second study, published in July 2015, remain freely available for download from the Cornell Center for Hospitality Research. This third study builds on the study's framework and provides enhanced benchmarks—including a 40-percent increase in the global data set, and adding segmentation by global climate zone and by hotel type in the accompanying index. This year's benchmarks include 4,557 properties located in 191 geographic categories. The tool offers improved benchmarks, especially for a property to chart its progress over time, or for travelers to calculate their own personal carbon offset. However, due to the variability among hotels, comparisons among hotels are generally not appropriate without further analysis of their drivers.

ABOUT THE AUTHOR

Eric Ricaurte is founder of Greenview, a hotel sustainability and research firm. Eric graduated from Cornell University with a bachelor's degree in hotel administration, and holds a master's degree from New York University where he has been an adjunct instructor. He has over twenty years professional experience globally, and has published a number of papers on sustainability for Cornell University Center for Hospitality Research.

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Several studies have been undertaken or attempted by industry and academe to address the need for lodging industry carbon benchmarking. However, these studies have focused on normalizing resource use with the goal of rating or comparing all properties based on multivariate regression according to an industry-wide set of variables, with the result that data sets for analysis were limited. This approach is backward, because practical hotel industry benchmarking must first be undertaken within a specific location and segment.[1] Therefore, the CHSB study's goal is to build a representative database providing raw benchmarks as a base for industry comparisons.[2] These results are presented in the CHSB2016 Index, through which a user can obtain the range of benchmarks for energy consumption, water consumption, and greenhouse gas emissions for hotels within specific segments and geographic locations.

[1] See: Eric Ricaurte, "Determining Materiality in Hotel Carbon Footprinting: What Counts and What Does Not," *Cornell Hospitality Report*, Vol. 12, No. 12 (2012), Cornell Center for Hospitality Research; and Glenn Withiam, "2012 Cornell Hospitality Research Summit: Toward Sustainable Hotel and Restaurant Operations," *Cornell Hospitality Proceedings*, Vol. 5, No. 4 (2013), Cornell Center for Hospitality Research. Also see: Daphne A. Jameson and Judi Brownell, "Telling Your Hotel's 'Green' Story: Developing an Effective Communication Strategy to Convey Environmental Values," *Cornell Hospitality Tools*, Vol. 3, No. 2 (2012), Cornell Center for Hospitality Research.

[2] Cornell Hotel Sustainability Benchmarking Index.

EXHIBIT 1

Participating organizations

Diamond Resorts
Hilton Worldwide
Host Hotels & Resorts
Hyatt Hotels Corporation
InterContinental Hotels Group
Mandarin Oriental Hotel Group
Marriott International
Park Hotel Group
Saunders Hotel Group
The Hongkong and Shanghai Hotels
Wyndham Worldwide

Uses of the CHSB Index

The CHSB Index and output data sets are intended to serve multiple purposes to benefit both the study participants and the travel and tourism sector, as follows:

Industry Benefits

Default data. By aggregating data globally that is also segmented by geographic location and market segments, CSHB provides a publicly available, base industry data set. Furthermore, in countries without any formalized benchmarking process, the research may fill the gap for basic environmental data uses in these countries.

Feasibility study support. By providing market- and location-based ranges of benchmarks, entities performing feasibility studies for hotel development, renovation, and acquisition can utilize the tool to support the forecasting of energy and water usage, and in some cases carbon taxes.

Improving rating systems. Entities that rank or score hotels based on environmental performance can incorporate benchmarks from the report and apply quantification methods to tailor their own methodology.

Expediting carbon footprint calculations. Lodging customers seeking to calculate the carbon footprint of their own hotel stays may make a credible calculation using the CHSB results. Carbon offset programs can use CHSB figures to develop credible and transparent estimates of carbon footprint values to establish standardized offset levels. This will expedite the calculation, and save group customers and hoteliers time in transmitting property-specific data for a destination or global footprint.

Supporting municipal codes and regulations. Entities that wish to mandate performance specifications of energy, water, or greenhouse gas (GHG) emissions in municipalities or regions will have more representative and accurate data on which to base their codes or regulations.

Industry trends. General knowledge of hotel environmental performance and industry trends can be explored in each year's industry report. With an established data set, overall performance on an industry level can be analyzed and communicated.

Eventual normalization and use indexing. Via future studies that apply the base data sets, further evaluation can be performed regarding the drivers of energy, water, and carbon emissions in hotel operations.

Participant Benefits[3]

Expediting validity testing. Validity tests are performed on the data sets submitted, which the participating companies can use to identify and address data integrity issues to improve their own reporting.

Supporting portfolio data collection efforts. Entities with large hotel portfolios may use the study to encourage properties to submit valid data in a timely manner to improve corporate reporting.

Enabling internal benchmarking. Hotel properties and companies wishing to compare performance against a general competitive set may use the benchmarks against their own performance.

Advancing internal modeling. Hotel companies with internal benchmarking systems may take lessons learned, correlations, and regression studies into consideration for improving their own internal regression modeling.

Calculating portfolio footprints. Participating companies that do not currently calculate carbon emissions or aggregate their energy footprint will receive the energy and carbon footprint of their portfolios in the individual reports, uniformly calculated across the entire data set.

Data Set

Input

We collected aggregate 2014 calendar-year data from the participating companies listed in Exhibit 1 (the most recent complete year data). In total, the participants provided data for 8,880 properties worldwide. Property data were provided in each participating firm's aggregate data sets, so we did not engage individual properties. We used the data points shown in Exhibit 2 to generate the measures within the tool. While we did not cross-check utility invoices or verify the data, the majority of the participants' data sets were verified by a third-party review. Other than laundry for measures 1 and 7, no additional data points were collected to filter or harmonize for coverage

[3] The call for participation for hotel companies to participate in CHSB 2017 opens in summer 2016, calling for 2015 data sets. For further information, please email Eric Ricaurte at eer3@cornell.edu.

EXHIBIT 2:

Data collection points used to generate the external CHSB2016 benchmarks

Data Point	Description
Internal Brand Code	Unique identifier code used by the property's parent brand.
Participant Code	Unique identifier code used by the participating entity, if different from the brand code. For example, an owner of a franchisee of a portfolio of hotels may use separate identifiers, so as to avoid duplication of properties within the data set.
Hotel Name	Name of Hotel.
Address	Street address of hotel.
City	City where the hotel is located.
State or Province	State or province where the hotel is located.
Country	Country where the hotel is located.
Postal Code	Postal code (e.g., ZIP code) where the hotel is located.
Rooms	The total number of guestrooms for the hotel in 2014. If a hotel's room count changed during the year, the value most representative of the hotel's room count for 2014 was used.
Total Area	Total floor area of conditioned space of the property. Total Area value should equal Rooms Area + Meeting Space Area + Other Area
Rooms Area	Total area of conditioned space of the rooms and corridors, per the HCMI guidance.
Meeting Space Area	Total area of conditioned space of the meeting space and pre-function space in the hotel, per HCMI guidance.
Other Area	The total remaining area of conditioned space within the property not covered by rooms and meeting space.
STR Segment	The chain scale segment of the hotel, per STR category (Economy, Midscale, Upper Midscale, Upscale, Upper Upscale, Luxury). If a property is considered Independent, a proximate scale referring to the STR list of global chain scales was used, identifying a segment appropriate for comparable brands.
Location Type	The location segment of the property by selecting for each property among the following categories: urban, suburban, rural/low-density, airport, convention, resort, timeshare.
12-Month Operation	Confirm with a "Yes" that the hotel was in operation for all of 2014 without any shutting down or major renovation that would significantly alter the energy consumption or occupancy (either rooms or meeting space) during the period.
Laundry	Choose either "Included" or "Not Included" to denote whether the energy consumption includes the washing of bedroom linens. For properties with partial in-house wash, the determining factor is whether bedroom linens are included in that wash. For example, linen wash of restaurant linens or guest clothing only, would be considered "not included."
Occupied Rooms	The total number of occupied rooms for the hotel for each month within 2014. Rooms sold may be used as a proxy.
Water	The total water consumption for each month in 2014 as provided by the utility provider.
Energy Consumption by Type	The total energy usage for each month in 2014 by type of energy source.

Exhibit 3

Validity tests performed on the data set

Validity Test Description	High Threshold	Low Threshold	Action taken if beyond threshold or missing	Percentage of Data Set Excluded
Property underwent significant renovation or was not open the entire 12-month period	N/A	N/A	Excluded from Measures 1-9	5.03%
Energy per occupied room outlier (kWh per occupied room)	1,250	25	Excluded from Measures 1, 3, 5	38.1%
Energy per square meter outlier (kWh per m^2)	1,500	80	Excluded from Measures 2, 4, 6, 7	37.7%
Property did not have 12 separate electricity data points	N/A	N/A	Excluded from Measures 1-7	38.2%
Property did not have 12 separate occupancy data points	N/A	N/A	Excluded from Measures 1, 3, 5, 8	13.4%
Occupancy outlier	104%	35%	Excluded from Measures 1, 3, 5, 8	10.1%
Property did not have 12 separate water data points	N/A	N/A	Excluded from Measures 8-9	39.7%
Water per occupied room outlier (L per occupied room)	13,500	45	Excluded from Measure 8	34.9%
Water per square meter outlier (L per m^2)	15,000	100	Excluded from Measure 9	36.1%
Percentage of floor area attributed to rooms footprint	N/A	40%	Excluded from Measure 1	3.5%
Percentage of floor area attributed to meetings footprint	99%	N/A	Excluded from Measure 7	21.72%

of amenities by the utilities. Consequently, for example, we do not identify whether energy and water bills included restaurants, spas, fitness centers, or shared areas with other tenants within the building.

Output

We took the following five steps to arrive at the output tables for the CHSB2016 index.

Harmonization. First, all data were harmonized into common units of measure:

- energy in kilowatt-hours (kWh),
- water in liters (L),
- floor area in square meters (m^2), and
- greenhouse gas emissions (also termed carbon footprint) in kilograms of carbon dioxide equivalent ($kgCO_2e$), converting each energy source of GHG emissions into $kgCO_2e$ (using only carbon dioxide, methane, CH_4, and nitrous oxide, N_2O).

The set of emission factors applied to each energy type was geographically based on available data (see the appendix, page 13, for emission factors referenced). When the emission factor was provided by the reference source in CO_2e, the source document's value of global warming potential (GWP) was used. With raw values of methane and nitrous oxide emissions, the following GWP was applied using the *IPCC Fifth Assessment Report*, 100 Year horizon: GWP of CH_4 = 28; and GWP of N_2O = 265.

Validity testing. Second, we performed validity tests to identify outliers or data which may have been incorrectly submitted. Participants received an initial output with validity test results, and were given the option to correct and update data, or to override validity flags by confirming that the data were correct (e.g., a utility that invoices and provides data on a bimonthly basis).

We repeated the tests with updated data, setting the thresholds to the highest or lowest values that had been re-confirmed by participants (see Exhibit 3). When a property did not pass a specific validity test, we removed it from the data set for each corresponding measure. We implemented these limitations to maintain a representative data set, even though the report could have been accurate, say, if a property exceeded the threshold due to expansive public areas or amenities.

EXHIBIT 4

Measures used in the CHSB Index (2014 calendar year data)

Measure 1	HCMI footprint per occupied room
Measure 2	Total carbon footprint of the property divided by number of rooms
Measure 3	Total carbon footprint of the property divided by number of occupied rooms
Measure 4	Total carbon footprint of the property divided by the total floor area in square meters
Measure 4a	Total carbon footprint of the property divided by the total floor area in square feet
Measure 5	Total energy usage of the property divided by number of occupied rooms
Measure 6	Total energy usage of the property divided by floor area of the property in square meters
Measure 6a	Total energy usage of the property divided by floor area of the property in square feet
Measure 7	HCMI footprint of meeting space per hour per square meter of meeting space
Measure 8	Total water usage of the property divided by the total number of occupied rooms
Measure 9	Total water usage of the property divided by the floor area of the property in square meters
Measure 9a	Total water usage of the property divided by the floor area of the property in square feet

Geographic and climate zone segmentation. Third, data sets were segmented by geographic location, first by geocoding each property and then by clustering based on unified boundaries. For the CHSB2016 index, segmentation by climate zone was added to enable benchmarking based on climate zones that span several regions across the globe. CHSB uses the term *geography*, which may refer to one of the following:

- **City**, which is generally a major city and its surrounding towns or jurisdictions as defined by a Metropolitan Statistical Area (MSA), National Capital Region (NCR), or Greater Metropolitan Area;
- **Country**;
- **Region**, which may be sub-national (a state, province, or national region) or trans-national (a major tourist or urban market that crosses national borders). Various geographies are used to maximize the data output depending on the data received, and increase the ability to enable comparisons and benchmarking; or
- **Climate Zone,** using the Köppen-Geiger climate classification system.

Property segmentation. Fourth, properties were grouped by segment, applying the revenue-based approach and property type segmentation used by STR Global (using 2015 Global Chain Scales). The final data set was grouped into categories and an overall grouping that combines all segments within that geography:

- **Market Segment:** Economy and Midscale, Upper Midscale, Upscale and Upper Upscale, or Luxury;
- **Type,** Urban**,** Suburban, Small/Metro/Town, Airport, Resort, Convention, or Timeshare; or
- **All** (i.e., all properties within the geography).

We did not receive sufficient data to include separate categories for economy and midscale segments for most markets, as the data for those segments generally did not meet minimum thresholds in each geography to produce a meaningful output (as explained next). However, those properties are included in the results as part of the All category.

Minimum Output Thresholds

Finally, we set a minimum threshold of eight properties for output data to populate a geography. Where a specific segment within a geography returned at least eight properties, the results were populated in the tool. Data for cities, regions, climate zones, or countries with fewer than eight properties were excluded from the final outputs. After we applied the validity tests and removed geographies with fewer than eight properties, the final output tables represent data from up to 4,557 properties across 191 geographies.

Findings

The exercise of aggregating inputs and producing the outputs, as well as the resulting data set, continue to demonstrate several findings for consideration.

Now having a broader data set with more geographies and segmentation, we do see some general tendencies within the data set. Many of tendencies are generally understood or anticipated, but we now have industry-wide empirical data to demonstrate those tendencies. These include:

- Water usage per occupied room tends to be higher for luxury hotels than other segments, across all geographies. Per square meter, however, this tendency does not hold; and
- Resort hotels generally have higher energy and water usage both per occupied room and per square meter, across all climate zones. In specific geographies, however, other hotel types may be higher in certain statistics.

Benchmark Complications

That said, we continue to see issues that complicate the benchmarks for specific properties within a geography. First, the wide range of energy and water use, even within market segments and geographic location, sheds light on the difficulty of attempting fair comparison among hotels. While comparison of specific properties against the benchmarks is not publicly available, through data analysis we noted that one property might demonstrate energy usage in the low end per occupied room, but the high end per square meter. On the other hand, another property may demonstrate metrics in the low end for energy usage, but in the high end for water usage. These observations allude to the question of whether hotels should be compared to each other for utility performance, or whether it is more important for a hotel to be compared against itself over time.

Second, the change in carbon emission factors indicates a divergence between a hotel's performance and its carbon footprint. With each CHSB study, greenhouse gas emission factors are updated to reflect the most recently published factors. In general, the emission factors for purchased electricity tend to decrease over time per kilowatt-hour of electricity consumed. As an example, the emission factor for electricity purchased in Washington, D.C., as per the regional eGRID system published by the U.S. EPA, has decreased 25 percent since 2007. This means that if 75 percent of a hotel's carbon footprint is driven by electricity, then a hotel in Washington, D.C., could see an apparent reduction in its carbon footprint of nearly 19 percent without actually reducing its energy usage. Regardless of normalization, further study could help outline the drivers of energy, water, and carbon that can be controlled by the hotel versus those that are outside hotel owner or operator's control.

Finally, the variation of carbon footprint benchmarks across countries illustrates the current state of carbon emissions globally. While it may not be "fair" or even logical to compare hotels' carbon footprints across countries, it should be noted that such a comparison is valid among hotels at a particular destination, particularly to emphasize the use of renewable energy as a driver of carbon comparison among hotels within a geography.

We cannot forget that the planet faces serious challenges to sustainable development, and the current trajectory of climate change has dire implications. This has been reinforced through the recent Paris Agreement resulting from the COP21 conference last December, with a global call for greenhouse gas emissions reduction that is based on scientifically calculated limits of CO_2 in the atmosphere that will not increase global temperatures above 2 degrees Celsius. Through this agreement, we will see an increase in the prevalence of country-level initiatives to increase energy efficiency, renewable energy, and carbon mitigation.

While benchmarking on energy and water usage remains a valuable exercise to evaluate operational performance and building design, further analysis and methods of evaluating performance will emerge. Consider the following property-specific scenarios:

- A hotel operating at a relatively low level of energy efficiency, wasteful in its energy usage, that nevertheless derives 100 percent of its energy from renewable sources, and further is able to sell the excess renewable energy generated to neighboring buildings or back to the grid;
- A hotel located in a country whose government has taken significant steps to reduce carbon emissions that benefit the property (and company's portfolio) from reduced emission factors, but which has done nothing itself to become more low-carbon;
- A hotel with the highest levels of water efficiency that is obtaining its potable water by energy-intensive desalination processes, or from a groundwater source in a water-stressed community;
- A hotel purchasing carbon offsets equivalent to 100 percent of its energy usage, to protect or restore forest areas within its destination and strengthen the destination's resilience; or
- A hotel obtaining a significant portion of its energy footprint from district heating and cooling systems powered by waste-to-energy, in a situation where the hotel and its neighbors are encouraged to maximize waste output instead of minimization and recycling.

As CHSB evolves over time, we will continue to expand the breadth and depth of benchmarking to keep pace with the evolving trends in benchmarking energy, water, and carbon. The primary step, however, continues to be compiling a credible and representative data set from which benchmarking and analysis can be enabled.

Limitations

Limitations of this third annual study relate to the data set and to the representation of participating companies.

The results are skewed toward full-service properties. As CHSB2016 relies heavily on large owners or operators of hotels to submit aggregate data sets, these trend toward chain-managed, full-service hotels rather than franchise properties. As brands tend to manage full-service hotels and franchise limited-service hotels, the resulting data set contains only 246 hotels within the Economy or Midscale segment. While this does not affect the benchmarking within other segments, on the whole, the benchmarks for an MSA or country likely skew higher than the actual hotel supply of the same geography, given that the limited-service hotels, being comparatively small, will consume less energy and water. As franchisee data collection becomes more common among brands, this is expected to improve in the next study.

The results are skewed toward branded chains. Similarly, given that the vast majority of the hotels are represented by branded flags, they may not represent the actual hotel supply. It is possible that branded hotels are more efficient than independent hotels, given the availability of capital to renovate and retrofit the building equipment and FF&E than independent hotels. CHSB will need to seek to include more independent hotels to balance out the range and be representative of the actual hotel supply in any given geography.

The results do not distinguish a property's amenities. With the exception of Measures 1 and 7 for HCMI, which adjust for outsourced laundry, the benchmarks are collective of all types of hotels within the revenue-based segmentation and geographic location. Fair comparison between two properties remains troublesome since properties may have distinct attributes (e.g., laundry, swimming pool, spa, irrigated landscaping). Furthermore, the raw data generate a significantly wide range of "performance" within each geography and segment. This year we have attempted to improve the range of benchmarking to account for hotel types, for example, comparisons for resorts or convention hotels. However this broad generalization does not cover the range of amenities even within a particular hotel type.

The data have not been verified. Even passing validity tests, unless all data have been verified using a third-party provider that ensures the data, it cannot be concluded that the data sets are 100-percent accurate. As data verification becomes more common and even mandated, CHSB may be able to include verification in a validity test, or to analyze subsets of verified versus non-verified data.

District heating and cooling remain a challenge to harmonize. We see an increase in property data including energy usage from purchased district steam, heat, hot water, and chilled water. These sources of energy are not as easily harmonized into energy through common unit conversions or greenhouse gas emission factors. The common practice for large portfolios globally of applying default factors becomes less representative of those specific cities. Furthermore, unlike regional electricity grids which are based on averages, district heating and cooling is generally a closed system with specific sources for specific hotel properties and should be characterized as such. Finally, some of the increase in district heating and cooling is generated from waste-to-energy facilities, where the application of greenhouse gas emission factors across the lifecycle of the waste is not as clear. For CHSB2016, we applied specific coefficients to district heating and cooling where data were available and for cities with more than eight properties within the published data set (see the appendix for further detail). Going forward we will seek further detail to publish more precise energy conversions and greenhouse gas emission factors.

As CHSB evolves to explicate the drivers of energy, water, and carbon within hotels, we will seek to enhance comparisons to incorporate additional attributes. However, it should be noted that only certain attributes of hotel operations are controllable by the owner or operator, whether through procedures, capital equipment, FF&E, or amenities. The behavior of the guest may be a determining factor that will require additional study. For example, should hotels be compared based on the average duration of guests' showers?

Outlook for CHSB2017

As the CHSB study is an evolving tool and process, next year's study will once again aim to provide an updated tool with a larger data set, further segmentation, and additional filtering by attributes that are clear drivers of energy and water use. We will seek additional data from independents, smaller chains, and limited service properties currently underrepresented in the global data set.

The call for participation for CHSB 2017 opens in summer 2016, calling for 2015 data sets. For further information, please email Eric Ricaurte at eer3@cornell.edu. ■

How to Use the Index

The index consists of two outputs: full data tables and a search tool for the index. Twelve full data tables are provided, each a separate tab containing the benchmarks for a single measure.

Each data table contains the list of geographies and the benchmarks per segment. The data tables can be used for research and calculation purchases for multiple properties and regions.

Geographies

Benchmarks are provided for cities, regions, countries, or climate zones. See the **Geographies** tab in the tool for a complete listing.

Measure Values

For each measure, values are broken down in the following:

Count—the number of properties included within this geography and segment grouping;

Low—the lowest value found within the geography segment grouping (this is the *best* performer of the group);

Lower Quartile—the 25-percent marker within the data set. Twenty-five percent of the properties within the geography and segment were at or below this figure;

Mean—the "average" or total output for the corresponding measure for the properties within the geography and segment, divided by the number of corresponding properties;

Median—the middle value found within the geography and segment grouping;

Higher Quartile—the 75-percent marker within the data set. Seventy-five percent of the properties within the geography and segment were at or below this figure;

High—the highest value found within the geography segment grouping (this is the *worst* performer of the group); and

SD—the standard deviation across the data set of properties within the geography and segment.

The *Tool* tab contains a searchable index per geography, segment, and measure. Steps to use the tool are outlined below.

The example on the following pages is for a user that has selected to view the data set corresponding to properties within the upscale and upper upscale market segments in Guangdong, China:

In this example:

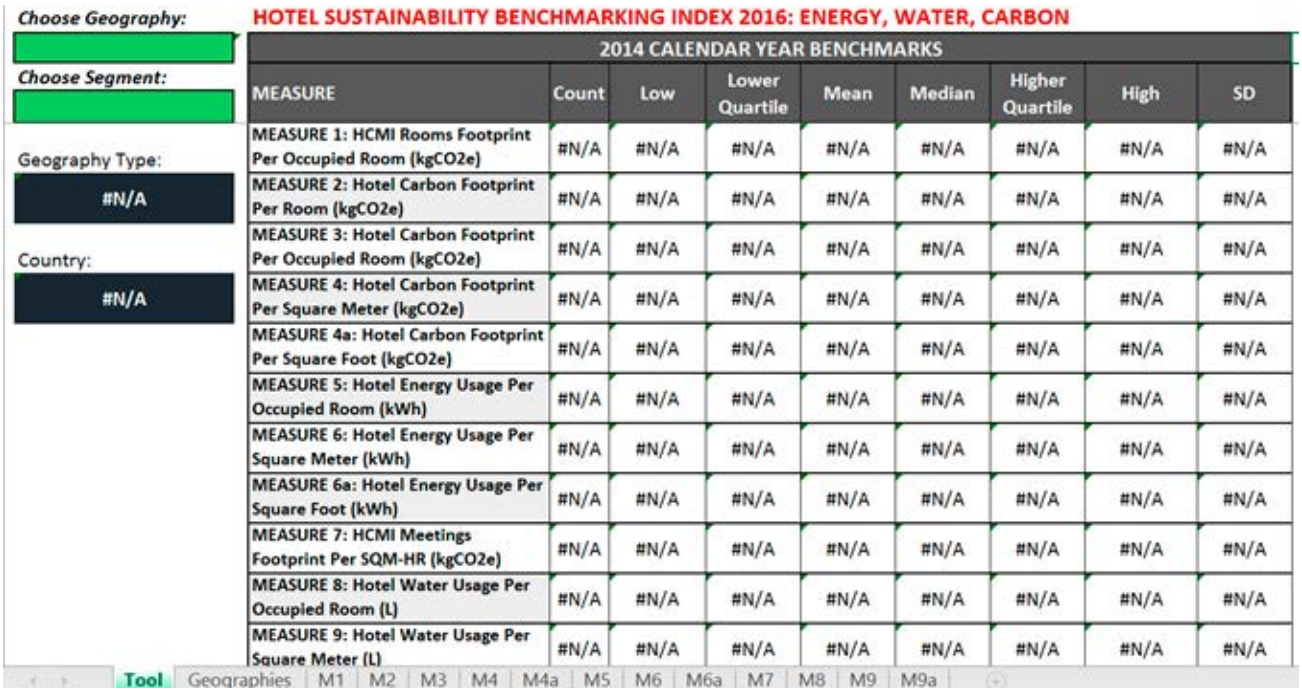
- A possible 21 hotels within the Guangdong province of China, across all segments comprise the benchmarks, though for each there may be less if some hotels did not have complete data that passed all validity tests. For example, *Measure 7* is the lowest count with 19 hotels in the data set for that specific measure;
- *Measure 1:* The mean (average) HCMI rooms footprint (guest footprint of a night stay) is 59.69 $kgCO_2e$/OCRM;
- *Measure 6a:* The lowest energy usage per square foot is 7.49 kWh/Sq ft;
- *Measure 8:* The highest water usage per occupied room is 7,665.70 L/OCRM; and
- *For all measures:* the quartiles, mean, and median all fall within the Low and High range.

Interpreting and Using the Results

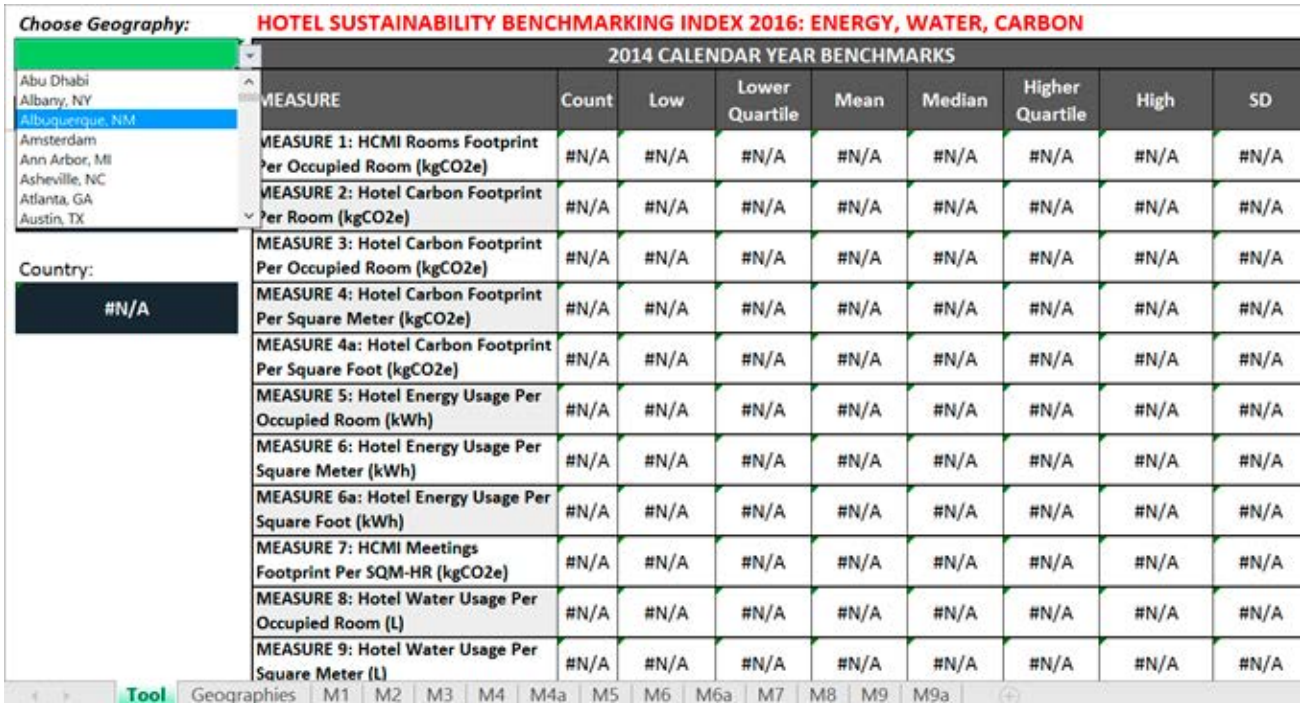
Some examples of how these figures can be used to benefit from the tool:

- An owner, operator, or potential buyer of a single hotel in Guangdong Province can find where the hotel falls along the energy range.
- If the hotel is in the Higher Quartile, it can analyze internally what drivers are causing it to be in the high quartile. Some may be controllable, others not controllable.
- For further detail, the user may wish to choose a segment or hotel type that more closely aligns with the hotel in question (e.g., Upper Upscale or Luxury), or the specific city (e.g., Shenzhen) as available.
- A person creating a feasibility study for developing a hotel in Guangdong Province can choose where along this range to use the benchmark to estimate energy usage per occupied room, and conversely by changing to Measure 6, can perform further analysis based on floor area
- A citywide event planner organizing an event in Guangdong Province—which will require accommodation for dozens of hotels—can use the mean HCMI rooms footprint and multiply that figure by the total number of rooms in order to calculate the total carbon footprint of the room block.
- If the event planner wanted to offer its attendees an option to offset the carbon footprint of their stay, it could incorporate the same figure as the base calculation for the attendee's carbon footprint.
- Researchers or policymakers from a municipality, region, or country seeking to understand the impact of water usage from hotels in their geography could obtain the current hotel supply and pipeline and run scenarios based on the statistics provided (i.e., high, low, mean).

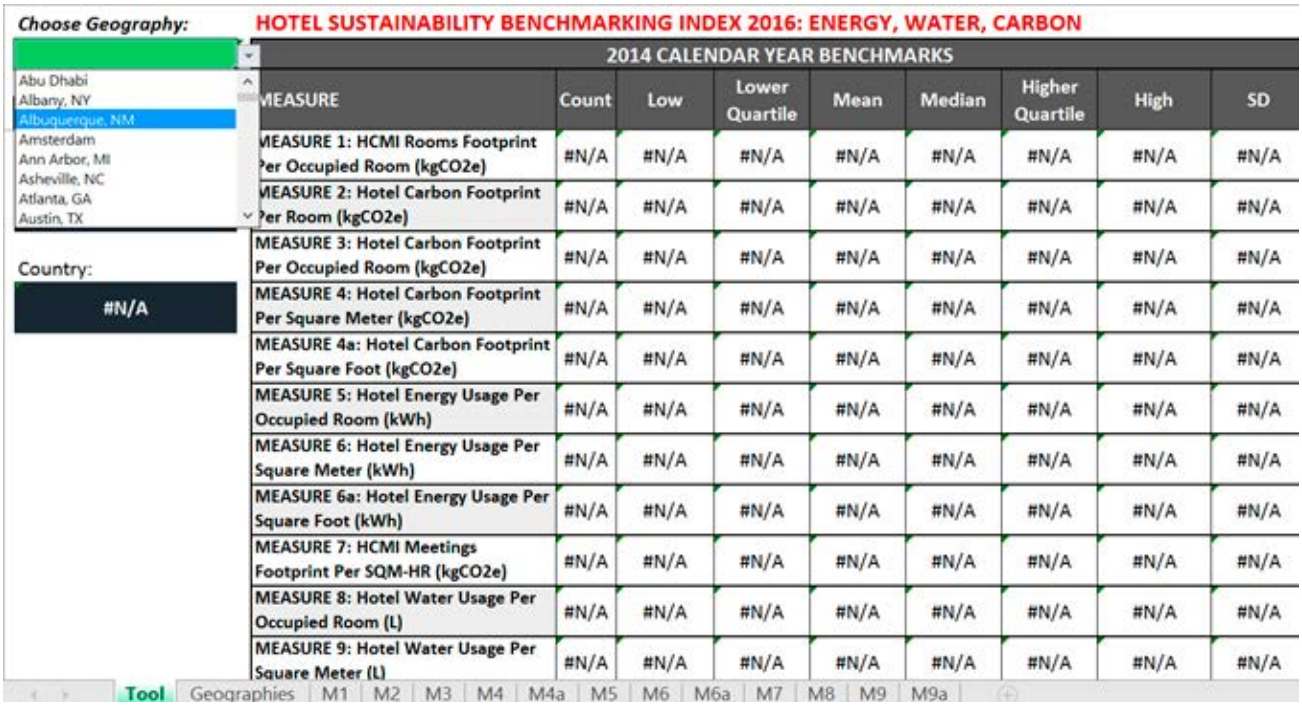
Step 1: Click on the Tool tab.



Step 2: Select the Geography to be used, choosing from the dropdown list. For further description of each Geography, refer to the **Geographies** tab. Upon selecting the Geography, the **Geography Type** and **Country** will populate automatically in the gray boxes.



Step 3: Select the market segment to be filtered from the dropdown list.



Choose Geography:

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2016: ENERGY, WATER, CARBON

Abu Dhabi
Albany, NY
Albuquerque, NM
Amsterdam
Ann Arbor, MI
Asheville, NC
Atlanta, GA
Austin, TX

Country:

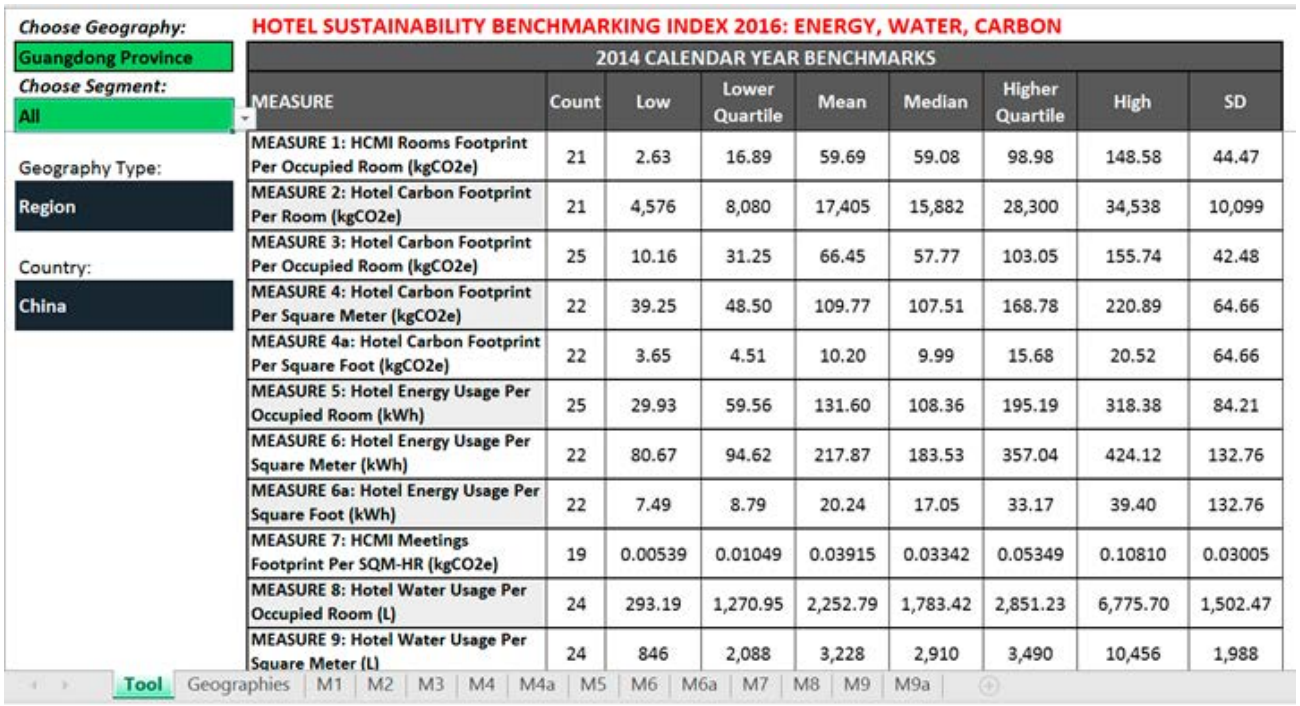
#N/A

2014 CALENDAR YEAR BENCHMARKS

MEASURE	Count	Low	Lower Quartile	Mean	Median	Higher Quartile	High	SD
MEASURE 1: HCMI Rooms Footprint Per Occupied Room (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 2: Hotel Carbon Footprint Per Room (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 3: Hotel Carbon Footprint Per Occupied Room (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 4: Hotel Carbon Footprint Per Square Meter (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 4a: Hotel Carbon Footprint Per Square Foot (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 5: Hotel Energy Usage Per Occupied Room (kWh)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 6: Hotel Energy Usage Per Square Meter (kWh)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 6a: Hotel Energy Usage Per Square Foot (kWh)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 7: HCMI Meetings Footprint Per SQM-HR (kgCO2e)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 8: Hotel Water Usage Per Occupied Room (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 9: Hotel Water Usage Per Square Meter (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Tool | Geographies | M1 | M2 | M3 | M4 | M4a | M5 | M6 | M6a | M7 | M8 | M9 | M9a

Step 4: View the corresponding results in the gray table at the top "2014 Calendar Year Benchmarks."



Choose Geography:

Guangdong Province

Choose Segment:

All

Geography Type:

Region

Country:

China

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2016: ENERGY, WATER, CARBON

2014 CALENDAR YEAR BENCHMARKS

MEASURE	Count	Low	Lower Quartile	Mean	Median	Higher Quartile	High	SD
MEASURE 1: HCMI Rooms Footprint Per Occupied Room (kgCO2e)	21	2.63	16.89	59.69	59.08	98.98	148.58	44.47
MEASURE 2: Hotel Carbon Footprint Per Room (kgCO2e)	21	4,576	8,080	17,405	15,882	28,300	34,538	10,099
MEASURE 3: Hotel Carbon Footprint Per Occupied Room (kgCO2e)	25	10.16	31.25	66.45	57.77	103.05	155.74	42.48
MEASURE 4: Hotel Carbon Footprint Per Square Meter (kgCO2e)	22	39.25	48.50	109.77	107.51	168.78	220.89	64.66
MEASURE 4a: Hotel Carbon Footprint Per Square Foot (kgCO2e)	22	3.65	4.51	10.20	9.99	15.68	20.52	64.66
MEASURE 5: Hotel Energy Usage Per Occupied Room (kWh)	25	29.93	59.56	131.60	108.36	195.19	318.38	84.21
MEASURE 6: Hotel Energy Usage Per Square Meter (kWh)	22	80.67	94.62	217.87	183.53	357.04	424.12	132.76
MEASURE 6a: Hotel Energy Usage Per Square Foot (kWh)	22	7.49	8.79	20.24	17.05	33.17	39.40	132.76
MEASURE 7: HCMI Meetings Footprint Per SQM-HR (kgCO2e)	19	0.00539	0.01049	0.03915	0.03342	0.05349	0.10810	0.03005
MEASURE 8: Hotel Water Usage Per Occupied Room (L)	24	293.19	1,270.95	2,252.79	1,783.42	2,851.23	6,775.70	1,502.47
MEASURE 9: Hotel Water Usage Per Square Meter (L)	24	846	2,088	3,228	2,910	3,490	10,456	1,988

Tool | Geographies | M1 | M2 | M3 | M4 | M4a | M5 | M6 | M6a | M7 | M8 | M9 | M9a

Greenhouse gas emission factors applied for measures 1, 2, 3, 4, and 7

Country	Australia	Canada	China (including Taiwan)	Hong Kong	United Kingdom	United States, Puerto Rico, other US Territories	All Other Countries
Purchased Electricity	National Greenhouse Accounts Factors 8/2015	2015 Climate Registry - Default Emissions Factors 4/2015	WRI GHG-emissions-from-purchased-electricity (V4_7)	HK Electric Investment Sustainability Report 2013	DEFRA Carbon Smart 2015 V2	EPA eGRID 2015 (2012 data) Regional Emission Factors	Int'l Energy Agency Data Serv. 2014. "CO_2 Emissions from Fuel Combustion (2013 Edition)".
Natural Gas	National Greenhouse Accounts Factors 8/2015	2015 Climate Registry - Default Emissions Factors 4/2015	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	DEFRA Carbon Smart 2015 V2	EPA Emission Factors for GHG Inventories Updated 4/4/2014	WRI Stationary Combustion Tool V4.1
Butane, Propane	National Greenhouse Accounts Factors 8/2015	2015 Climate Registry - Default Emissions Factors 4/2015	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	EPA Emission Factors for GHG Inventories Updated 4/4/2014	WRI Stationary Combustion Tool V4.1
Liquefied Petroleum Gas (LPG)	National Greenhouse Accounts Factors 8/2015	2015 Climate Registry - Default Emissions Factors 4/2015	WRI Stationary Combustion Tool V4.1	Hong Kong Carbon Accounting guidelines. Table 1.1 - 1.3 (rev. 2010)	DEFRA Carbon Smart 2015 V2	EPA Emission Factors for GHG Inventories Updated 4/4/2014	WRI Stationary Combustion Tool V4.1
Liquefied Natural Gas (LNG)	National Greenhouse Accounts Factors 8/2015	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	DEFRA Carbon Smart 2015 V2	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1
Compressed Natural Gas (CNG)	National Greenhouse Accounts Factors 8/2015	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2
Stationary Gasoline/ Petrol	National Greenhouse Accounts Factors 8/2015	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	DEFRA Carbon Smart 2015 V2	EPA Emission Factors for GHG Inventories Updated 4/4/2014	WRI Stationary Combustion Tool V4.1
Stationary Diesel, Fuel Oil #1-#6	National Greenhouse Accounts Factors 8/2015	2015 Climate Registry - Default Emissions Factors 4/2015	WRI Stationary Combustion Tool V4.1	Hong Kong Carbon Accounting guidelines. Table 1.1 - 1.3 (rev. 2010)	DEFRA Carbon Smart 2015 V2	EPA Emission Factors for GHG Inventories Updated 4/4/2014	WRI Stationary Combustion Tool V4.1
City Gas / Towngas	National Greenhouse Accounts Factors 8/2015	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	Towngas Sustainability Report 2013 + HK Carbon Accounting Guidelines 2010	WRI Stationary Combustion Tool V4.1	"Greenhouse Gas Inventory and Tracking in Portfolio Manager," 8/31/2009: Table 2; Indirect Greenhouse Gas Emission Factors (District Energy)	WRI Stationary Combustion Tool V4.1
Purchased Steam, Heat, and Hot Water	Not Applicable	DEFRA Carbon Smart 2015 V2	DEFRA Carbon Smart 2015 V2	Not Applicable	DEFRA Carbon Smart 2015 V2	NYC: Inventory of NYC GHG Emissions Nov. 2014 App. H (2013 Data Table); all other: US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, 4/2015	Paris: Legifrance decree JORF n°0262 du 13 nov. 2014 p. 19088; all other: DEFRA Carbon Smart 2015 V2
Purchased Chilled Water	Not Applicable	Toronto: Enwave Toronto (deep water cooling), all other: US EIA form 1605 (2010). App. N	US EIA form 1605 (2010). Appendix N	US EIA form 1605 (2010). App. N	US EIA form 1605 (2010). Appendix N	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, August 2015	Paris: Legifrance decree JORF n°0262 du 13 nov. 2014 p. 19088; all other: US EIA form 1605 (2010). App. N

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Christopher K. Anderson, Director
Carol Zhe, Program Manager
Glenn Withiam, Executive Editor
Kate Walsh, Interim Dean, School of Hotel Administration

Center for Hospitality Research
Cornell University
School of Hotel Administration
389 Statler Hall
Ithaca, NY 14853

607-254-4504
chr.cornell.edu