



Hotel Sustainability Benchmarking Index 2021: Carbon, Energy, and Water

By Eric Ricaurte & Rehmaashini Jagarajan

EXECUTIVE SUMMARY

The annual Cornell Hotel Sustainability Benchmarking study, published for the eighth consecutive year, finds a general reduction in energy and water usage among the participating hotels over the past three years (2017 -2019). However, a slight increase in usage is reported among full-service resorts, a new grouping established for this year's reporting. A total of 21,432 hotels from 26 international hotel chains participated by contributing information regarding their energy and water usage. Over 60% of the total data comes from hotels in the United States. While the data permit hoteliers and potential guests to see benchmarks for various hotel segments and locations, individual hotel amenities are not accounted for in terms of energy or water usage. The authors encourage additional hotels and hotel companies to participate in the study, as increased participation allows us to build a stronger and more meaningful data set of the industry for benchmarking and to drive improvements in energy, water, and carbon performance.

ABOUT THE AUTHORS



Eric Ricaurte founded Greenview as a boutique firm specializing in the metrics, measurement, and reporting of carbon and other sustainability performance indicators within travel & tourism. He is a frequent speaker, organizer, researcher, and generally ubiquitous character in the topic of sustainability measurement.

Eric began his career canoeing people through the jungle. He spent 10 years working in ecotourism across Costa Rica, Mexico and Brazil in operations and as a consultant. He started out managing eco lodges and nature park operations, and then naïvely decided to go on his own as an independent consultant. Eric built his client list to include hotels, parks, nature & cultural tour operators, receptive tour companies, and eventually destinations. During this time, he went 6 years straight without wearing a tie and his entrepreneurial ventures included co-owning a failed speedboat & outrigger canoeing tour business in Bahia, Brazil.

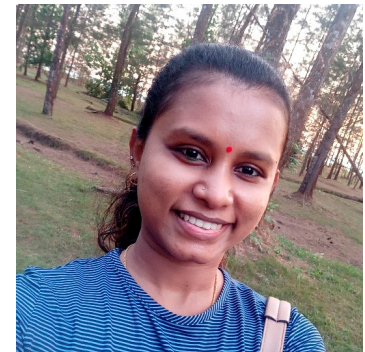
Throughout these formative years Eric spent plenty of time in forests and parks, and became fascinated with the concept of carbon sequestration for value it placed on nature and the opportunities it provided for conservation as well as tourism. He started researching the topic in 2001 and won a student research award at Cornell University for his paper titled “Carbon Offsetting, Trading, and Sequestration and their Relation to Travel & Tourism.” Fast forward 10 years later, as a research fellow at Cornell, Eric authored the study “Developing a Sustainability Measurement Framework for Hotels: Toward an Industry-wide Reporting Structure” and was selected as the technical consultant to facilitate the development of the methodology for the Hotel Carbon Measurement Initiative.

Throughout his career Eric has consulted globally for hotel properties; hotel companies; REITs; hospitality vendors; tourism operators, attractions and complexes; cruise lines; the UNWTO, WTTC, and AHLA; event organizers; and tourism destination organizations. Eric earned a Bachelor of Science degree from the Cornell University School of Hotel Administration and a Master of Science degree in Tourism & Travel Management from New York University.

Eric is a member of the UFI Committee on Sustainable Development, the International Standards Working Group of the GSTC, and on the judging panel of the HICAP Sustainable Hotel Awards. He has held a research fellowship at the Cornell University Center for Hospitality Research and been an adjunct instructor at the NYU University Tisch Center for Hospitality and Tourism. Eric is an active board member of the Orphaned Starfish Foundation. In his spare time, Eric still hangs out in forests and has enjoyed playing Capoeira for over 12 years.

Rehmaashini Jagarajan, Ph.D., is a Sustainability Manager at Greenview. She manages the on-going development of the company’s in-house data analytics and software products and their use with clients. Rehma also sets up and manages company’s related processes and data flows, as well as team’s collaboration and productivity.

Prior to Greenview, she has served as a Property Researcher at Raine & Horne International (Malaysia) specializing in market research and feasibility studies. She has experience conducting and preparing market research for the purpose of determining the highest and best use of land, ascertaining appropriate development proposals, and preparing feasibility studies relating to new development projects, subdivisions and renovation and refurbishment to existing buildings. She has also served as a valuation executive at JS Valuers Property Consultants Group Malaysia providing valuation services covering extensive range of properties for various different purposes. Rehma is a member of Malaysian Association of Facility Management (MAFM), a medium for the local Facility Management (FM) communities to interact and share knowledge or experience through activities co-organized with various parties both in public and private sectors. Rehma holds a Doctorate Degree (PhD) in Facilities Management as well as a Bachelor’s Degree in Property Management from the University of Technology Malaysia.



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The eighth annual report of the Cornell Hotel Sustainability Benchmarking (CHSB) 2021 study presents the results of the analysis of 2019 calendar-year data. It is undertaken as a collaborative effort of Cornell University’s Center for Hospitality Research (CHR), hotel participants, Greenview, and an industry advisory group. This year’s report, with three years of historical trends and year-over-year change, accompanied by its index, is the largest and latest data set for benchmarking the industry’s energy and water usage and greenhouse gas (GHG) emissions. The data set is freely available for download from the CHR. This study continues to build upon last year’s framework, expand the data set’s geographical coverage, and present historical trends across like-for-like change over the past year, as well as three years of similar data. This year’s report saw an 8-percent increase in the global data set, comprising 15,339 hotels worldwide. As a result of the global pandemic’s impact on 2020 calendar-year data, data collection will not be undertaken for CHSB2022. However, collection of 2021 calendar year data for CHSB2023 will commence in early 2022.

OVERVIEW

This study is presented as an index for the following purposes:

- To provide credible benchmarks according to industry-specific segmentation and metrics globally;
- To provide industry data analysis with a confidential data set; and
- To advance toward commonly defined, transparent, and rigorous methods for modeling energy, water, and carbon based on hotel-specific attributes and data that are applicable and current.

This index presents benchmark ranges for twelve different measures relating to energy, water, and carbon emissions, in 583 geographies, which are defined by metro area, country, climate zone, and other geographic or political regions. Data are segmented by various hotel types, including asset class, location, type of hotel, and market segment, and denoted by stars.

CHSB2021 UPDATES

This year's process and resulting index has incorporated the following updates:

- Increased granularity of segmentation in validity testing for energy and water by adding additional fences for resort and integrated resort types
- Increased granularity of segmentation in validity testing for energy and water by adding additional fences for China and United States hotels
- Addition of the hotel type "Extended Stay" to encompass hotels that offer self-catering suites and long-term accommodation for guests
- Separation of upper upscale and upscale into two different segments
- Enhanced segmentation by full-service asset class into full-service resort and full-service non resort
- Segmented validity testing to cater to seasonal resorts (i.e. winter/summer) that do not operate for all 12 months to normalize,

based on energy and water usage per month, for the number of months corresponding to each season

- Reconfigured the emission factor for Purchased Chilled Water in the public data set and confidential hotel report for countries other than the United States and Canada. The prior CHSB outputs used an emission factor of Purchased Chilled Water calculated by multiplying the emission factor of Purchased Electricity by a coefficient, and in some prior years applied a COP to the energy values to arrive at kWh first. The update corrects the emission factor calculation which per US EIA Form 1605 Appendix N is expressed the coefficient in a unit of kgCO₂e/ton-hour, converting to kWh, to arrive at the coefficient in a unit of kgCO₂e/kWh. As a result, for the 499 hotels outside of the United States and Canada in the data set with purchased chilled water figures and affected by this change, resulting emissions will be lower than the prior year and any corresponding benchmarks in the tool will also be lowered.
- Increased number of geographies from 574 to 583 across metro areas, regions, countries and climate zones
- Increased number of hotels for which benchmarks have been outputted to 15,339 (increase of 7.9%)
- Increased number of hotels participating to 21,432 (increase of 18.8%).

USES OF THE CHSB INDEX

The CHSB Index and output data set are provided to serve multiple purposes, benefiting both the participants and the industry, as follows:

Participant Benefits¹

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

¹ Participation is open and welcome for CHSB 2023, calling for 2021 data set. For further information, please email [Eric Ricaurte](mailto:Eric.Ricaurte).

2. **Enabling internal benchmarking.** Hotel properties and companies wishing to compare performance against a general competitive set across peers may use the benchmarks against their own performance.
3. **Expediting validity testing.** Validity tests are performed on the data set submitted, which the participating companies can use to identify and address data-integrity issues to improve their own reporting.
4. **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.
5. **Facilitating carbon footprint calculations.** Travelers, event organizers, and other travel buyers or intermediaries 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, thereby saving group customers and hoteliers time in transmitting property-specific data for a destination or global footprint.
6. **Supporting municipal codes and regulations.** Entities that wish to mandate performance specifications of energy, water, or GHG emissions in municipalities or regions will have more representative and accurate data from which to base their codes or regulations.

Industry Benefits

1. **Default data.** By aggregating data globally that is also segmented by geographic location and market segment, CHSB provides a publicly available, industry-based data set. Furthermore, in countries without any formalized benchmarking process, this data set fills the gap.
2. **Feasibility study support.** Entities performing feasibility studies for hotel development, renovation, and acquisition can utilize the tool's market- and location-based ranges and benchmarks to support the forecasting of energy and water usage and, in some cases, carbon taxes.
3. **Improving rating systems.** Entities that rank or score hotels based on environmental performance can incorporate benchmarks from the tool and quantification methods to tailor their own methodology.
4. **Harmonized greenhouse gas emissions calculations.** The protocols for greenhouse gas emissions accounting and verification do not provide standardized greenhouse gas emission factors for converting energy into carbon metrics. Different entities may select different factors which can invalidate the comparability across properties and companies. In receiving energy data and applying a uniform set of greenhouse gas emission factors, the index provides a single, harmonized carbon data set enabling comparability.
7. **Industry trends and carbon balance.** 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. With the Paris Climate Agreement signed in 2016, an increasing emphasis is now placed on decarbonization aligned with climate science, akin to a balance sheet, including "Science-based Targets." The data set can serve as a basis for calculating the industry-wide carbon footprint and trends over time along a path toward decarbonization by 2050, while also providing insight on performance year-over-year.
8. **Eventual normalization and use indexing.** Each study adds data to the index, and a significant data set with property attributes will support further evaluation of the drivers of energy, water, and carbon emissions in hotel operations over time.
9. **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 in a cost-effective platform.

EXHIBIT 1

Participating organizations

AINA Hospitality	MGM Resorts International
Centara Hotels & Resorts	Park Hotel Group
Chatham Lodging Trust	Park Hotels & Resorts
CPG Hospitality	Pebblebrook Hotel Trust
DiamondRock Hospitality Company	Playa Hotels & Resorts
EVENT Hospitality & Entertainment	Pro-invest Group
Hilton Worldwide	Radisson Hotel Group
Hong Kong & Shanghai Hotels	RLJ Lodging Trust
Horwath HTL Asia Pacific	Ryman Hospitality Properties
Hyatt Hotels Corporation	Six Senses Hotels Resorts Spas
InterContinental Hotels Group	Sudima Hotels
Mandarin Oriental Hotel Group	Wyndham Hotels & Resorts
Marriott International	Xenia Hotels & Resorts

DATA SETS

Input

We collected aggregated 2019 calendar-year data from the participating companies listed in Exhibit 1 (the most recent complete year of data). In total, the participants provided data for 21,432 properties globally. As part of this process, 2019 calendar-year data collected by Horwath HTL Asia Pacific, and then, analyzed with similar validity testing by Greenview, was incorporated into the data set to add an additional 1,945 non-duplicated property records. We used the data points shown in Exhibit 2 to generate the measures within the index. We did not, however, cross-check utility invoices nor verify the data, although most of the data set was verified by a third-party reviewer for participant corporate reporting of GHG inventories. Other than ascertaining the presence of onsite laundry for main linen wash for Measures 1, 7, 10 and 11, no data related to additional hotel amenities were collected.

Output

We took the following five steps to arrive at the output tables for the CHSB2021 index.

1. Harmonization

First, all data were harmonized into the following common units of measurement:

- energy in kilowatt-hours (kWh),

- water in Liters (L),
- floor area in square meters (m²), and
- greenhouse gas (GHG) emissions (also termed carbon footprint) in kilograms of carbon dioxide equivalent (kgCO₂e), converting each energy source of GHG emissions into kgCO₂e (using only carbon dioxide, methane, and nitrous oxide).

The set of emission factors applied to each respective energy type was geographically based on available data (see Appendix 10 for emission factors referenced). When the emission factor was provided by the reference source in CO₂e, the source document's value of global warming potential (GWP) was used. With raw values of methane (CH₄) and nitrous oxide (N₂O) emissions, the following GWP was applied using the IPCC Fifth Assessment Report, 100 Year horizon: GWP of CH₄: 28; and GWP of N₂O: 265. For energy generated from renewable sources (wood or other biomass) the biogenic CO₂ was not included. However, per the Greenhouse Gas Protocol, emissions from CH₄ and N₂O were included. For other renewable sources such as solar, wind, geothermal, or deep-water cooling, an emission factor of zero was assigned to the energy type.

2. 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. Exhibit 3 lists the general cut-off values for upper and lower outliers in the data set. Please refer to Appendix 1 for detailed list of validity tests performed and the thresholds for each test. When a property did not pass a specific validity test, we removed it from the data set for each corresponding measure. Exhibit 4 has the count of the data set included for each measure. While it is possible for a property to exceed the threshold due to expansive public areas or amenities, we implemented these limitations to maintain a representative data set.

EXHIBIT 2

Data collection points used to generate the external CHSB2021 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, 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 (i.e. zip code) where the hotel is located.
Room Count	The total number of guestrooms for the hotel in 2019. If a hotel's room count changed during the year, the value most representative of the hotel's room count for 2019 was used.
Area Unit	Choose either "sqft" or "sqm" to indicate the units of measurement of the floor area data being entered (either square feet or square meters).
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.
Location Type	The location segment of the property: urban, suburban, rural/highway, airport, convention, resort, timeshare, small metro/town, bed & breakfast, extended stay.
Year Opened	The year the property originally opened, regardless of whether major renovations have occurred since that year.
12-Month Operation	Confirm with a "Yes" that the hotel was in operation for all of 2019 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."
Energy Verification	Indicate whether the energy data for each property has been third-party verified per the following choices: Limited, Reasonable, Full, No, Don't know. Limited refers to a company-wide third-party "limited assurance", Reasonable refers to a companywide third-party "reasonable assurance" and "full" indicates that the specific property's data have been third-party verified onsite or through direct examination of billing and consumption.
Water Verification	Indicate whether the water data has been third-party verified per the following choices: Limited, Reasonable, Full, No, Don't know. Limited refers to a company-wide third-party "limited assurance", Reasonable refers to a companywide third-party "reasonable assurance" and "full" indicates that the specific property's data have been third-party verified onsite or through direct examination of billing and consumption.
Unit	Enter the unit of measurement for the data entered.
Occupied Rooms	The total number of occupied rooms for the hotel for each month within 2019. Rooms sold may be used as a proxy.
Water Consumption by Type	The total water consumption for each month in 2019 as provided by the utility provider by type of water source.
Energy Consumption by Type	The total energy usage for each month in 2019 as provided by the utility provider by type of energy source.

EXHIBIT 3

Summary of validity tests performed on the data set

Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
Property underwent significant renovation or closed all or significant part of floor area for a portion of the year	N/A	N/A	Excluded from Measures 1-12	2.5%
Energy Per Occupied Room Outlier (kWh/ocrm)	1000	10	Excluded from Measures 1,3,5,12	17.7%
Energy Per Square Meter Outlier (kWh/m2)	2000	20	Excluded from Measures 2,4,6,7,12	18.0%
Property did not provide any purchased electricity data	N/A	N/A	Excluded from Measures 1,2,3,4,5,6,7,12	4.2%
Property did not have 12 separate electricity data points	N/A	N/A	Excluded from Measures 1,2,3,4,5,6,7,12	19.0%
Property did not provide any occupied rooms data	N/A	N/A	Excluded from Measures 1,3,5,7,8,10,11	0.3%
Property did not have 12 separate occupancy data points	N/A	N/A	Excluded from Measures 1,3,5,7,8,10,11	8.3%
Occupancy Outlier	104%	35%	Excluded from Measures 1,3,5,7,8,10,11	11.2%
Property did not provide any water usage data	N/A	N/A	Excluded from Measures 8-11	6.2%
Property did not have 12 separate water data points	N/A	N/A	Excluded from Measures 8-11	21.8%
Water Per Occupied Room Outlier (L/ocrm)	10000	40	Excluded from Measure 8,10,11	37.0%
Water Per Square Meter Outlier (L/m2)	12500	100	Excluded from Measures 9,11	35.6%
% Of Floor Area attributes to Rooms Footprint	100%	40%	Excluded from Measures 1,7,10,11	52.6%
Average SqM per guestroom of entire building outlier	2500	20	Excluded from Measures 2,4,6	9.9%
Average size of guestroom outlier	750	15	Excluded from Measures 10,11	55.7%
Only one source of energy was indicated for calculating total energy	N/A	N/A	Notified only, no action taken	5.5%
At least one energy or water source had a high variance of a ratio of 4-to-1 between high/low months or 80% month-to-month	N/A	N/A	Notified only, no action taken	40.8%

EXHIBIT 4

Count of data set included for each measure

Measure	Description	Count of Data Set Included	% Of Data Set Excluded
Measure 1	HCMI ¹ Footprint Per Occupied Room	7782	63.7%
Measure 2	Total carbon footprint of the property divided by number of rooms	15339	28.4%
Measure 3	Total carbon footprint of the property divided by number of OCCUPIED rooms	15003	30.0%
Measure 4	Total carbon footprint of the property divided by the total floor area in SQUARE METERS	15336	28.4%
Measure 5	Total energy usage of the property divided by number of OCCUPIED rooms	15003	30.0%
Measure 6	Total energy usage of the property divided by floor area of the property in SQUARE METERS	15339	28.4%
Measure 7	HCMI Footprint of Meeting Space Per Hour Per Square Meter of Meeting Space	6519	69.6%
Measure 8	Total water usage of the property divided by the total number of OCCUPIED ROOMS	13511	37.0%
Measure 9	Total water usage of the property divided by the floor area of the property in SQUARE METERS	13802	35.6%
Measure 10	HWMI ² Footprint Per Occupied Room	3132	85.4%
Measure 11	HWMI Footprint of Meeting Space Per Hour Per Square Meter of Meeting Space	2722	87.3%
Measure 12	Percentage of property's total energy that is generated from renewable sources	15338* (Including 0%)	28.4%

¹ HCMI (Hotel Carbon Measurement Initiative) is the industry-accepted way to measure and compare scope 1 and 2 GHG emissions of hotels. It includes emissions related to fuels burned on site (e.g., in gas boilers and company vehicles) and electricity used on site. It also accounts for emissions related to any outsourced laundry and refrigerants (e.g., used in air conditioning).

² HWMI is the industry accepted way to measure and compare water consumption. It includes metered (e.g., municipal) and un-metered (e.g., borehole) sources of water used by a hotel and accounts for water used by any outsourced laundry providers. Hotels can use HWMI to calculate their water footprint per occupied room (per night) and the water footprint of an area of meeting space per hour.

For measures 10 and 11, using the methodology of the Hotel Water Measurement Initiative (HWMI), we took the remaining data set after the validity testing and excluded properties that also (1) washed laundry off-site and (2) purchased district-chilled water as an energy source. Though HWMI also allows for metrics of per guest-night in addition to per occupied room, the lack of available guest-night data was addressed by only providing output metrics based on occupied rooms.

3. Geographic and Climate Zone Segmentation

Third, data were segmented by geographic location, first by geocoding each property and then by clustering based on unified boundaries. We use the term geography, which may refer to one of the following:

- Metro Area 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 or province, autonomous region, unincorporated territory, or national region) or trans-national (a major tourist or urban market that crosses national borders, or a similar regional grouping of countries). Various geographies are used to maximize the data output depending on the data received, and to increase the ability to enable comparisons and benchmarking; or
- Climate Zone, using both the Köppen-Geiger climate classification system and Bailey’s Ecoregions of the World.

4. Property Segmentation

Fourth, properties were grouped by segments, applying the revenue-based approach and property-type segmentation used by STR Global (using 2020 global chain scales), the asset class segmentation of full-service and limited-service hotels, and a global data set of star levels for hotels as listed by Expedia. The final data set was grouped into categories together with an overall grouping that combines all segments within that geography, as shown in Exhibit 5.

We did not receive sufficient data to include separate categories for economy and midscale segments or hotels below 2 stars, as the data for those segments generally did not meet minimum thresholds in each geography to produce a meaningful output. However,

the All-Hotels option includes those properties in the output results.

EXHIBIT 5

Segmentation categories

Asset Class
Full-Service Resort
Full-Service NonResort
Limited Service
Number of Stars
2 and 2.5 Stars
3 and 3.5 Stars
4 and 4.5 Stars
5 Stars
Market Segment
Economy and Midscale
Upper Midscale
Upscale
Upper Upscale
Luxury
Type
Urban
Suburban
Small Metro/Town
Rural/Highway
Airport
Extended Stay
Resort – Summer Seasonal
Resort – Winter Seasonal
Integrated Resort
Convention
Timeshare/Service Apartment
Bed & Breakfast
All Hotels (within a given geography)

5. Minimum Output Thresholds

Finally, we set a minimum threshold of eight properties for output data to populate a geography. That is, where a specific segment within a geography contained at least eight properties, the results were populated in the tool. Consequently, 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 in CHSB2021 encompass 15,339 properties across 583 ge-

ographies. This represents an increase from the prior year's data set (i.e., 2018 calendar-year data for CHSB 2020), with 8% more properties added in the 2019 data set. The increase in data helped generate the minimum threshold required to add new geographies, either new metro areas (including non-metropolitan areas) or countries.

FINDINGS

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

Historical and Year-Over-Year Trends

Having gained publication longevity, the CHSB index is able to provide insight into historical trends. A total of 7,313 and 6,301 hotels in the data set have produced valid benchmarks for energy and water measures respectively to enable a like-for-like comparison among the 2017 to 2019 calendar years data. The approach of comparing the change over time depends on the intended view and use of the information, whether at a geography level or individual-property level. Exhibit 6 presents the change from 2017 to 2019 in three measures using three types of average change. Appendix 2 to 5 present the overall average change since 2017 for select countries and metro areas for energy and water, including the hotel count and total gross floor area to provide an overview on the origin of the data. Most of the historical trend data set (average of 75%) is from the United States, as the initial CHSB studies focused heavily on North America. That limitation will diminish over time as the data set continue to expand with additional global data each year.

In addition, we have analyzed a year-over-year output of all properties that have been part of the data set for the past two years and passed all validity tests. The resulting year-over-year data set includes a total of 9,396 and 8,063 properties for energy and water measures respectively, of which 65% are limited-service operations. Overall observations, as presented in Exhibit 7, revealed that limited-service and full-service, non-resort properties have reduced their energy and water intensity over time in most of the countries, including the United States. Appendix 6 to 9 present the overall average year-over-year change among select countries and metro areas for energy and water. Seventy-five percent of the properties are in the United States, of which around 70% are limited-service hotels.

Energy Usage Has Reduced Since 2017

The energy intensity of the like-for-like data set has reduced 3.30% overall on average since 2017, with 0.41% of overall reduction recorded from 2017 to 2018 and 3.09% of overall reduction from 2018 to 2019. The decrease is largely driven by limited-service hotels, which account for a larger portion of the data set and footprint. Among limited-service hotels, energy usage increased slightly in 2018 by 0.93% overall on average yet reduced significantly in 2019 by 3.02% overall on average. In contrast, energy usage per square meter among all full-service hotels has reduced since 2017 by 3.69% overall on average.

Water Usage Intensity Has Reduced Consistently Since 2017

The water intensity of the like-for-like data set has reduced consistently since 2017. The overall average of water usage per occupied room has reduced 3.73% since 2017. Water usage per occupied room of full-service hotels has reduced by 3.91% overall, and limited-service hotels recorded an overall average reduction of 3.79% since 2017. Both limited-service and full-service hotels also recorded a reduction in weighted average and average of averages in 2019, although a slight increase was recorded in 2018.

Full-Service Non-Resort Recorded Consistent Reduction in Energy Usage Since 2017

For this year's report, further breakdown of full-service hotels was done to separate out resorts. The breakdown of full-service hotels into full-service resort and full-service non-resort revealed a continuous reduction in energy usage among full-service non-resort properties since 2017, with an overall average decreased by 4.38%. Full-service non-resorts reduced energy usage per square meter by 3.50% overall on average in 2019. Limited-service recorded a reduction of 3.02% overall on average. This study also revealed that the reduction in energy usage per square meter among full-service non-resorts is higher than that of limited-service hotels. Indeed, while full-service non-resorts recorded continuous reduction in energy usage per square meter since 2017, limited-service recorded an increase in overall average of 0.93% in 2018. Yet, both full-service non-resort and limited-service recorded an increase in average of averages since 2017 by 1.20% and 0.33% respectively for energy usage per square meter.

EXHIBIT 6

Three-year average change by measure and service type

Measure	2017-2019 Average Change	All Hotels	Full Service	Limited	Full Service	Full Service
				Service	Resort	NonResort
Measure 4: GHG Emissions per Square Meter	Weighted Avg Change	-6.32%	-4.12%	-2.19%	0.53%	-4.65%
	Overall Avg Change	-9.56%	-9.65%	-9.24%	1.72%	-11.76%
	Avg of Averages Change	-7.23%	-5.58%	-8.21%	0.27%	-6.06%
Measure 6: Energy per Square Meter	Weighted Avg Change	-1.11%	-1.03%	-0.08%	0.13%	-1.17%
	Overall Avg Change	-3.30%	-3.69%	-1.86%	-0.13%	-4.38%
	Avg of Averages Change	0.71%	1.36%	0.33%	3.40%	1.20%
Measure 8: Water per Occupied Room	Weighted Avg Change	-1.81%	-1.59%	-0.22%	-0.16%	-1.43%
	Overall Avg Change	-3.73%	-3.91%	-3.79%	-1.64%	-4.43%
	Avg of Averages Change	-0.87%	-1.10%	-0.73%	1.26%	-1.29%

* The resulting three-year average data set included a total of 7,313 hotels for energy and GHG measures

** The resulting three-year average data set included a total of 6,301 hotels for water measures

EXHIBIT 7

Year-over-year average change by measure and service type

Measure	2018-2019 Average Change	All Hotels	Full Service	Limited	Full Service	Full Service
				Service	Resort	NonResort
Measure 4: GHG Emissions per Square Meter	Weighted Avg Change	-2.98%	-2.09%	-0.89%	-0.16%	-1.93%
	Overall Avg Change	-5.40%	-6.00%	-3.36%	-3.72%	-6.49%
	Avg of Averages Change	-2.36%	-1.37%	-2.89%	1.48%	-1.62%
Measure 6: Energy per Square Meter	Weighted Avg Change	-2.20%	-1.52%	-0.68%	-0.03%	-1.49%
	Overall Avg Change	-3.09%	-3.12%	-3.02%	-1.17%	-3.50%
	Avg of Averages Change	-1.48%	-0.35%	-2.10%	1.82%	-0.54%
Measure 8: Water per Occupied Room	Weighted Avg Change	-1.27%	-0.98%	-0.29%	-0.20%	-0.78%
	Overall Avg Change	-2.97%	-2.94%	-3.11%	-3.52%	-2.86%
	Avg of Averages Change	-0.89%	-0.91%	-0.88%	-1.50%	-0.87%

* The resulting year over year average data set included a total of 9,396 hotels for energy and GHG measures

** The resulting year over year average data set included a total of 8,063 hotels for water measures

Weighted Average Change = average change of the hotel multiplied by the percentage of that hotel's floor area to the total floor area of the like-for-like data set;

Overall Average Change = average change in the total usage or emissions of the entire data set divided by the total floor area of the like-for-like data set; and

Average of Averages Change = mean of the average change of all hotels in the like-for-like data set.

Water Usage Intensity Improved Among Full-Service Resorts

While full-service non-resorts and limited-service recorded a continuous reduction in overall average of water per occupied room since 2017, full-service resorts have recorded an increase in water usage per occupied room by 1.54% overall on average in 2018 compared to 2017. However, in 2019, full-service resorts recorded reduced water usage compared to 2018, with an overall average decreased by 3.52%, subsequently resulting in a reduction of 1.64% overall on average since 2017.

The "Efficiency Gap" in Each Market

This year's study includes a review of the ranges of performance within a selected geography and segment, adding the specification of laundry to the boundary (comparing hotels with onsite laundry among themselves, and those without among themselves). As shown in Exhibit 8, the ratio of upper quartile of performance to lower quartile of performance (upper quartile intensity divided by lower quartile intensity) is over 1.5 for both energy per square meter and water per occupied room. This indicates a greater dispersion in energy

Ratio of upper quartile to lower quartile among full-service non-resort and limited service

GEOGRAPHY	Energy Per Square Meter (Non Resort)		Water Per Occupied Room (Non Resort)	
	Full Service	Limited Service	Full Service	Limited Service
	Yes	Yes	Yes	Yes
Atlanta-Sandy Springs-Marietta, GA MSA	1.61	1.69	1.54	1.52
Chicago-Naperville-Joliet, IL-IN-WI MSA	1.83	1.84	1.94	1.76
Dallas-Fort Worth-Arlington, TX MSA	1.61	1.93	1.60	1.61
Denver-Aurora, CO MSA	1.49	1.66	1.41	1.51
Houston-Sugar Land-Baytown, TX MSA	2.00	1.53	1.63	1.85
Los Angeles-Long Beach-Santa Ana, CA MSA	1.57	1.78	1.66	1.42
Miami-Fort Lauderdale-Pompano Beach, FL MSA	1.60	1.52	1.82	1.76
New York-Northern New Jersey-Long Island, NY-NJ-PA MSA	1.79	1.62	1.68	1.56
Orlando-Kissimmee, FL MSA	1.89	1.54	1.43	1.63
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA	1.62	1.67	1.68	1.50
Phoenix-Mesa-Scottsdale, AZ MSA	1.43	1.56	1.71	1.85
Washington-Arlington-Alexandria, DC-VA-MD-WV MSA	1.80	1.67	1.48	1.82
AVERAGE	1.76	1.76	1.63	1.68

and water usage intensity among the data set, of which the best-performing hotels are doing over 1.5 times better than their peers. This year's results were tabulated for full-service non-resort and limited-service hotels and disclosed a marginal efficiency gap in energy per square meter and water per occupied room. Full-service hotels with onsite laundry recorded lower performance ratios of 1.76 and 1.63 for energy per square meter and water per occupied room. Likewise, limited-service hotels, although deemed to perform better than full-service resorts, have similar performance ratios of 1.76 and 1.68 for energy per square meter and water per occupied room, which is on par with full-service non-resorts with laundry. Performance ratios for full-service resorts were not tabulated due to an insufficient number of properties in the selected geographies. These empirical data, demonstrating the wide ratio between the upper quartile and the lower quartile across most of the markets, highlight opportunities for hotels within the upper quartile to reduce their utility use.

LIMITATIONS

Several limitations are present in this study given the data set and representation of participating companies:

1. **The results remain skewed toward the higher end of segment tiers.** CHSB2021 relies heavily on aggregate data sets from large hotel owners and operators who also manage, instead of franchise, their properties. This year's brand data set included
2. **The results are skewed toward branded chains.** Similarly, given that the vast majority of the hotels in this study are represented by branded flags, the results may not represent those of the full hotel supply. It is possible that branded hotels are more efficient than independent hotels, given the availability of capital that would allow brands to renovate and retrofit the building equipment and FF&E (furniture, fixtures, and equipment) - an avenue not always available to independent hotels. The CHSB index still needs to include more independent hotels to balance out the range and be representative of the actual hotel supply in any given geography.
3. **The results are skewed towards the United States.** Although the data set covers 57 countries, two more than last year, the majority of the data still comes from the United States. Sixty-four percent of the data set was within

the US geographies, a decrease of only 0.1% from the previous data set. As such, the ratio of the hotels in the data set to potential hotels in the country is lower outside of the US. We have continued to grow the data set both within and outside of the US, and, in the future, we will continue to seek data from outside the US to achieve a more equal global representation.

4. **The data have not been verified.** Despite our validity tests, unless all data have been verified using a third-party provider, it cannot be concluded that the data set are 100 percent accurate. Over 70 percent of the data set, however, has undergone external third-party verification as part of participants' own corporate reporting, which serves as a primary validation method.

As CHSB evolves to understand the drivers of energy, water, and carbon within hotels, we will seek to enhance comparisons by incorporating additional hotel amenities that might contribute to high energy or water usage.

OUTLOOK FOR CHSB2023

As we have outlined throughout this report, the CHSB study is an evolving index and process. Because 2020 data were impacted by the global pandemic, CHSB

will not be published in 2022. The collection of 2021 calendar year data for CHSB2023 will begin in 2022 and will aim to provide an updated index with more data and increased segmentation and granularity for participant benchmarking. We will especially continue to seek additional data from independents, smaller chains, and smaller properties that are currently underrepresented in the global data set.

Hotels are welcome to participate in CHSB2023 by contributing 2021 calendar year data. For further information about how to get involved, please email [Eric Ricaurte](#).

HOW TO USE THE INDEX

The index consists of two outputs: full data tables and a search tool for accessing the index. Twelve full data tables are provided, each a separate worksheet 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 accessed for research and calculation purposes 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.

EXHIBIT 9

Measures used in the CHSB Index (2019 calendar year data)

Measure 1	Carbon footprint of 1 room-night stay, per the Hotel Carbon Measurement Initiative (HCMI) methodology
Measure 2	Total carbon footprint of a property for the calendar year, divided by its number of rooms
Measure 3	Total carbon footprint of a property for the calendar year, divided by its number of OCCUPIED rooms within the same calendar year period
Measure 4	Total carbon footprint of a property for the calendar year, divided by its total floor area in SQUARE METERS
Measure 4a	Total carbon footprint of a property divided by its total floor area in SQUARE FEET
Measure 5	Total energy usage of a property for the calendar year, divided by its number of OCCUPIED rooms within the same calendar year period
Measure 6	Total energy usage of a property for the calendar year, divided by its floor area in SQUARE METERS
Measure 6a	Total energy usage of a property for the calendar year, divided by its floor area in SQUARE FEET
Measure 7	Carbon footprint of 1 square meter of meeting space occupied for 1 hour, per the Hotel Carbon Measurement Initiative (HCMI) methodology
Measure 8	Total water usage of a property for the calendar year, divided by its total number of OCCUPIED ROOMS within the same calendar year period
Measure 9	Total water usage of a property for the calendar year, divided by its floor area in SQUARE METERS
Measure 9a	Total water usage of a property for the calendar year, divided by its floor area in SQUARE FEET
Measure 10	Water usage of 1 room night stay, per the Hotel Water Measurement Initiative (HWMI) methodology
Measure 11	Water usage of 1 square meter of meeting space occupied for 1 hour, per the Hotel Water Measurement Initiative (HWMI) methodology
Measure 12	Percentage of a property's total energy usage within the calendar year that was generated onsite from renewable sources

Measure Values

For each measure, values are broken down as follows:

1. **Count** – the number of properties included within this geography and segment grouping;
2. **Low** – the lowest value found within the geography segment grouping (this is the best performer of the group);
3. **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;
4. **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;
5. **Median** – the middle value found within the geography and segment grouping;
6. **Upper 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;
7. **High** – the highest value found within the geography segment grouping (this is the worst performer of the group); and
8. **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.

STEP 1: click on the Tool tab.

Cornell Hotel Sustainability Benchmarking Index 2021 : Carbon, Energy and Water

Choose Geography:

Choose Segment:

Type:

Country:

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2021: ENERGY, WATER, CARBON (2019 Data Set)

2019 CALENDAR YEAR BENCHMARKS								
MEASURE	Count	Low	Lower Quartile	Mean	Median	Upper 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
MEASURE 9a: Hotel Water Usage Per Square Foot (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 10: HWMI Rooms Footprint Per Occupied Room (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 11: HWMI Meetings Footprint Per SQM-HR (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 12: Hotel % Energy From Renewables (%)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

> ...
Geographies
How to Guide
Tool
M1
M1a
M2
M3
M4
M4a
M5
M6
M6a
M7
M8
M9
M9a
M10
M11

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 dark gray-blue boxes.

Cornell Hotel Sustainability Benchmarking Index 2021 : Carbon, Energy and Water

Choose Geography:
Bangkok

Choose Segment:

Type:
Metro Area

Country:
Thailand

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2021: ENERGY, WATER, CARBON (2019 Data Set)

2019 CALENDAR YEAR BENCHMARKS

MEASURE	Count	Low	Lower Quartile	Mean	Median	Upper 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
MEASURE 9a: Hotel Water Usage Per Square Foot (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 10: HWMI Rooms Footprint Per Occupied Room (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 11: HWMI Meetings Footprint Per SQM-HR (L)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MEASURE 12: Hotel % Energy From Renewables (%)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

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

Cornell Hotel Sustainability Benchmarking Index 2021 : Carbon, Energy and Water

Choose Geography:
Bangkok

Choose Segment:
Full Service NonResort

Type:
Metro Area

Country:
Thailand

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2021: ENERGY, WATER, CARBON (2019 Data Set)

2019 CALENDAR YEAR BENCHMARKS

MEASURE	Count	Low	Lower Quartile	Mean	Median	Upper Quartile	High	SD
MEASURE 1: HCMI Rooms Footprint Per Occupied Room (kgCO2e)	47	17.11	30.70	47.26	41.42	56.13	148.11	27.45
MEASURE 2: Hotel Carbon Footprint Per Room (kgCO2e)	64	3,629.21	9,338.09	14,083.39	13,589.83	17,724.40	25,109.58	6,078.72
MEASURE 3: Hotel Carbon Footprint Per Occupied Room (kgCO2e)	63	16.57	31.71	49.71	43.02	59.31	132.01	26.11
MEASURE 4: Hotel Carbon Footprint Per Square Meter (kgCO2e)	64	55.73	88.47	126.40	112.14	147.66	474.78	63.65
MEASURE 4a: Hotel Carbon Footprint Per Square Foot (kgCO2e)	64	5.18	8.22	11.74	10.42	13.72	44.11	5.91
MEASURE 5: Hotel Energy Usage Per Occupied Room (kWh)	63	35.05	72.05	119.90	99.08	142.12	412.12	69.85
MEASURE 6: Hotel Energy Usage Per Square Meter (kWh)	64	121.42	202.41	295.23	268.90	350.30	1,004.62	140.54
MEASURE 6a: Hotel Energy Usage Per Square Foot (kWh)	64	11.28	18.80	27.43	24.98	32.54	93.33	13.06
MEASURE 7: HCMI Meetings Footprint Per SQM-HR (kgCO2e)	44	0.00	0.05	0.07	0.06	0.09	0.38	0.06
MEASURE 8: Hotel Water Usage Per Occupied Room (L)	61	275.17	874.82	1,271.06	1,116.85	1,680.38	3,560.10	647.81
MEASURE 9: Hotel Water Usage Per Square Meter (L)	63	233.28	2,528.44	3,131.72	3,131.91	3,594.65	8,769.67	1,418.53
MEASURE 9a: Hotel Water Usage Per Square Foot (L)	63	21.67	234.90	290.95	290.96	333.95	814.73	131.79
MEASURE 10: HWMI Rooms Footprint Per Occupied Room (L)	21	709.70	1,061.54	1,402.87	1,481.69	1,714.78	2,092.32	373.73
MEASURE 11: HWMI Meetings Footprint Per SQM-HR (L)	21	0.598	1.003	1.351	1.368	1.614	2.981	0.516
MEASURE 12: Hotel % Energy From Renewables (%)	64	0.00%	0.00%	0.04%	0.00%	0.00%	1.62%	0.23%

STEP 4: View the corresponding results in the gray table at the top “2019 Calendar Year Benchmarks.”

The example below is for a user that has selected to view the data set corresponding to properties within the full-service non-resort market segments in the MSA of Bangkok:

HOTEL SUSTAINABILITY BENCHMARKING INDEX 2021: ENERGY, WATER, CARBON (2019 Data Set)								
2019 CALENDAR YEAR BENCHMARKS								
MEASURE	Count	Low	Lower Quartile	Mean	Median	Upper Quartile	High	SD
MEASURE 1: HCMI Rooms Footprint Per Occupied Room (kgCO2e)	47	17.11	30.70	47.26	41.42	56.13	148.11	27.45
MEASURE 2: Hotel Carbon Footprint Per Room (kgCO2e)	64	3,629.21	9,338.09	14,083.39	13,589.83	17,724.40	25,109.58	6,078.72
MEASURE 3: Hotel Carbon Footprint Per Occupied Room (kgCO2e)	63	16.57	31.71	49.71	43.02	59.31	132.01	26.11
MEASURE 4: Hotel Carbon Footprint Per Square Meter (kgCO2e)	64	55.73	88.47	126.40	112.14	147.66	474.78	63.65
MEASURE 4a: Hotel Carbon Footprint Per Square Foot (kgCO2e)	64	5.18	8.22	11.74	10.42	13.72	44.11	5.91
MEASURE 5: Hotel Energy Usage Per Occupied Room (kWh)	63	35.05	72.05	119.90	99.08	142.12	412.12	69.85
MEASURE 6: Hotel Energy Usage Per Square Meter (kWh)	64	121.42	202.41	295.23	268.90	350.30	1,004.62	140.54
MEASURE 6a: Hotel Energy Usage Per Square Foot (kWh)	64	11.28	18.80	27.43	24.98	32.54	93.33	13.06
MEASURE 7: HCMI Meetings Footprint Per SQM-HR (kgCO2e)	44	0.00	0.05	0.07	0.06	0.09	0.38	0.06
MEASURE 8: Hotel Water Usage Per Occupied Room (L)	61	275.17	874.82	1,271.06	1,116.85	1,680.38	3,560.10	647.81
MEASURE 9: Hotel Water Usage Per Square Meter (L)	63	233.28	2,528.44	3,131.72	3,131.91	3,594.65	8,769.67	1,418.53
MEASURE 9a: Hotel Water Usage Per Square Foot (L)	63	21.67	234.90	290.95	290.96	333.95	814.73	131.79
MEASURE 10: HWMI Rooms Footprint Per Occupied Room (L)	21	709.70	1,061.54	1,402.87	1,481.69	1,714.78	2,092.32	373.73
MEASURE 11: HWMI Meetings Footprint Per SQM-HR (L)	21	0.598	1.003	1.351	1.368	1.614	2.981	0.516
MEASURE 12: Hotel % Energy From Renewables (%)	64	0.00%	0.00%	0.04%	0.00%	0.00%	1.62%	0.23%

In this example:

- A possible 64 full-service non-resort properties within the Bangkok metro area of Thailand 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 10 and 11 are the lowest count, with 21 hotels in the data set for those specific measures.
- MEASURE 1: The mean (average) HCMI rooms footprint (guest footprint of a night stay) is 47.26 kgCO2e/OCRM
- MEASURE 2: The upper quartile carbon footprint per room in a calendar year is 17,724.40 kgCO2e/OCRM (meaning that of the 64 properties counted in the benchmark for this measure, 75% fell below 17,724.40 and 25% fell at or above 17,724.40)
- MEASURE 6a: The lowest energy usage per square foot is 11.28 kWh/Sqft
- MEASURE 8: The highest water usage per occupied room is 3,560.10 L/OCRM

- For all measures the quartiles, mean, and median fall within the Low and High range

Interpreting and Using the Results

Some examples of how these figures can be used:

- An owner, operator, or potential buyer of a single hotel in the Bangkok metro area can find where the hotel falls along the energy range.
 - If the hotel is in the Upper Quartile, it can analyze internally what drivers are causing it to be in the high quartile. Some may be controllable, others may not be.
 - For additional analysis, the user may wish to choose a different segment or hotel type (e.g., full-service resort, full-service non-resort, or stars) that relates to the metro area, country, or a specific climate zone.
- A feasibility study for developing a hotel in the Bangkok metro area 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.

- An event planner organizing a citywide event in Bangkok which will require accommodations in dozens of hotels can use Measure 1, the HCMI rooms footprint (for example, choosing a higher range benchmark), and multiply that figure by the total number of rooms to calculate the total carbon footprint of the room block. The event planner can also use Measure 7 to calculate the footprint of the meeting space utilized during the event.
 - If the event planner wanted to offer its attendees an option to offset the carbon footprint of their stay, they 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 can obtain the current hotel supply and pipeline and run scenarios based on the statistics provided (e.g., high, low, mean).
- The travel and tourism industry can calculate the carbon footprint of hotel stays across multiple destinations to report on scope 3 business travel and calculate amounts for carbon offsetting.

Other Uses of CHSB

CHSB data can be used by individual hotels, hotel companies or other interested parties, such as corporate customers or travel managers, to benchmark hotel energy, carbon, and water performance. By comparing actual data from a property with the values for a similar property in a similar location, one can determine how a property is performing compared to its peers.

In addition, CHSB data feeds the Greenview Hotel Footprinting Tool¹, which allows users to find an estimation of the carbon footprint of hotel stays or meetings around the world. This is a useful tool for those who are wishing to determine the carbon footprint of hotel bookings for the purpose of calculating their Scope 3 business travel emissions as part of net-zero calculations as well as for offsetting.

The UK Government Greenhouse Gas² guidance for company reporting uses the conversion factors and data from CHSB and the Greenview Hotel Footprinting Tool.

Other instances where CHSB data has been used to support carbon calculation initiatives include:

- Euromonitor Sustainable Travel Index³ – CHSB provided source data for hotel carbon emissions
- Greenprint Performance Report⁴ – Integration of CHSB data with global building benchmarking
- Hotel Global Decarbonisation Report⁵ - CHSB used as the basis for estimating the total carbon, energy, and water footprint of the hotel industry
- Destination Water Risk Index⁶ – CHSB used as the basis for weighting the risk based on water intensity by market ■

1 [Greenview Hotel Footprinting Tool](#)

2 [UK Government Greenhouse Gas](#)

3 [Euromonitor Sustainable Travel Index](#)

4 [Greenprint Performance Report](#)

5 [Hotel Global Decarbonisation Report](#)

6 [Destination Water Risk Index](#)

APPENDIX 1: List of validity tests performed on the data set

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
All Countries	Property underwent significant renovation or closed all or significant part of floor area for a portion of the year	N/A	N/A	Excluded from Measures 1-12	2.5%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service luxury hotels	700	25	Excluded from Measures 1,3,5,12	10.8%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service Upper Upscale hotels	700	45	Excluded from Measures 1,3,5,12	18.8%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service Upscale hotels	600	40	Excluded from Measures 1,3,5,12	20.8%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service Upper Midscale hotels	600	35	Excluded from Measures 1,3,5,12	25.2%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service Midscale hotels	500	30	Excluded from Measures 1,3,5,12	40.4%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for full-service Economy hotels	400	25	Excluded from Measures 1,3,5,12	76.9%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for limited-service Upscale hotels	200	20	Excluded from Measures 1,3,5,12	12.9%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for limited-service Upper Midscale hotels	150	17	Excluded from Measures 1,3,5,12	15.4%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for limited-service Midscale hotels	100	13	Excluded from Measures 1,3,5,12	20.1%
All Countries	Energy Per Occupied Room Outlier (kWh/ocrm) for limited-service Economy hotels	75	10	Excluded from Measures 1,3,5,12	34.6%
All Countries	Energy Per Occupied Room outlier (kWh/ocrm) for resort with onsite laundry	1000	40	Excluded from Measures 1,3,5,12	14.5%
All Countries	Energy Per Occupied Room outlier (kWh/ocrm) for resort without onsite laundry	800	30	Excluded from Measures 1,3,5,12	19.6%
All Countries	Energy Per Occupied Room outlier (kWh/ocrm) for resort without laundry data	700	40	Excluded from Measures 1,3,5,12	16.5%
All Countries	Energy Per Occupied Room outlier (kWh/ocrm) for integrated resort with onsite laundry	1000	40	Excluded from Measures 1,3,5,12	0.0%
All Countries	Energy Per Occupied Room outlier (kWh/ocrm) for integrated resort without onsite laundry	1000	40	Excluded from Measures 1,3,5,12	0.0%
All Countries	Energy Per Square Meter outlier (kWh/m2) for full-service hotels	1300	80	Excluded from Measures 2,4,6,7,12	17.0%
All Countries	Energy Per Square Meter outlier (kWh/m2) for limited-service hotels	700	65	Excluded from Measures 2,4,6,7,12	18.4%

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
All Countries	Energy Per Square Meter outlier (kWh/m2) for resort with onsite laundry	2000	40	Excluded from Measures 2,4,6,7,12	10.8%
All Countries	Energy Per Square Meter outlier (kWh/m2) for resort without onsite laundry	1500	20	Excluded from Measures 2,4,6,7,12	16.4%
All Countries	Energy Per Square Meter outlier (kWh/m2) for resort without laundry data	2000	40	Excluded from Measures 2,4,6,7,12	17.4%
All Countries	Energy Per Square Meter outlier (kWh/m2) for integrated resort with onsite laundry	2000	40	Excluded from Measures 2,4,6,7,12	0.0%
All Countries	Energy Per Square Meter outlier (kWh/m2) for integrated resort without onsite laundry	2000	40	Excluded from Measures 2,4,6,7,12	0.0%
All Countries	Property did not provide any purchased electricity data	N/A	N/A	Excluded from Measures 1-7,12	4.2%
All Countries	Data did not have 12 separate electricity data points	N/A	N/A	Excluded from Measures 1-7,12	19.0%
All Countries	Property did not provide any occupied rooms data	N/A	N/A	Excluded from Measures 1,3,5,8	0.3%
All Countries	Data did not have 12 separate occupancy data points	N/A	N/A	Excluded from Measures 1,3,5,8	8.3%
All Countries	Occupancy outlier	104%	35%	Excluded from Measures 1,3,5,8,10,11	11.2%
All Countries	Property did not provide any water usage data	N/A	N/A	Excluded from Measures 8-11	6.2%
All Countries	Data did not have 12 separate water data points	N/A	N/A	Excluded from Measures 8-11	21.8%
All Countries	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry	5000	275	Excluded from Measure 8,10,11	17.5%
All Countries	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry	4500	200	Excluded from Measure 8,10,11	20.8%
All Countries	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without laundry data	5000	275	Excluded from Measure 8,10,11	44.2%
All Countries	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without onsite laundry	1700	50	Excluded from Measure 8,10,11	10.7%
All Countries	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without onsite laundry	1500	40	Excluded from Measure 8,10,11	18.9%
All Countries	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without laundry data	1500	40	Excluded from Measure 8,10,11	36.6%

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
All Countries	Water Per Occupied Room outlier (L/ocrm) for resort with onsite laundry	7500	300	Excluded from Measures 9,11	22.4%
All Countries	Water Per Occupied Room outlier (L/ocrm) for resort without onsite laundry	6500	200	Excluded from Measures 9,11	29.8%
All Countries	Water Per Occupied Room outlier (L/ocrm) for resort without laundry data	7500	300	Excluded from Measures 9,11	32.8%
All Countries	Water Per Occupied Room outlier (L/ocrm) for integrated resort with onsite laundry	7500	400	Excluded from Measures 9,11	0.0%
All Countries	Water Per Occupied Room outlier (L/ocrm) for integrated resort without onsite laundry	7500	400	Excluded from Measures 9,11	0.0%
United States Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry in United States	1400	300	Excluded from Measure 8,10,11	24.9%
United States Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry in United States	1500	300	Excluded from Measure 8,10,11	30.4%
United States Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without laundry data in United States	1400	300	Excluded from Measure 8,10,11	40.5%
United States Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels with onsite laundry in United States	1000	50	Excluded from Measure 8,10,11	16.8%
United States Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without onsite laundry in United States	1200	40	Excluded from Measure 8,10,11	30.3%
United States Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without laundry data in United States	1200	40	Excluded from Measure 8,10,11	19.8%
United States Only	Water Per Occupied Room outlier (L/ocrm) for resort with onsite laundry in United States	5000	330	Excluded from Measures 9,11	35.1%
United States Only	Water Per Occupied Room outlier (L/ocrm) for resort without onsite laundry in United States	1900	600	Excluded from Measures 9,11	46.3%
United States Only	Water Per Occupied Room outlier (L/ocrm) for resort without laundry data in United States	5000	330	Excluded from Measures 9,11	19.3%
United States Only	Water Per Occupied Room outlier (L/ocrm) for integrated resort with onsite laundry in United States	7500	400	Excluded from Measures 9,11	0.0%
United States Only	Water Per Occupied Room outlier (L/ocrm) for integrated resort without onsite laundry in United States	7500	400	Excluded from Measures 9,11	0.0%
China Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry in China	5000	700	Excluded from Measure 8,10,11	25.2%
China Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without onsite laundry in China	4000	350	Excluded from Measure 8,10,11	33.1%

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
China Only	Water Per Occupied Room outlier (L/ocrm) for full-service hotels without laundry data in China	5000	700	Excluded from Measure 8,10,11	34.1%
China Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels with onsite laundry in China	2300	260	Excluded from Measure 8,10,11	26.1%
China Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without onsite laundry in China	1700	230	Excluded from Measure 8,10,11	43.7%
China Only	Water Per Occupied Room outlier (L/ocrm) for limited-service hotels without laundry data in China	1700	230	Excluded from Measure 8,10,11	49.2%
China Only	Water Per Occupied Room outlier (L/ocrm) for resort with onsite laundry in China	8000	900	Excluded from Measures 9,11	31.9%
China Only	Water Per Occupied Room outlier (L/ocrm) for resort without onsite laundry in China	10000	500	Excluded from Measures 9,11	48.4%
China Only	Water Per Occupied Room outlier (L/ocrm) for resort without laundry data in China	8000	900	Excluded from Measures 9,11	24.0%
China Only	Water Per Occupied Room outlier (L/ocrm) for integrated resort with onsite laundry in China	7500	400	Excluded from Measures 9,11	0.0%
China Only	Water Per Occupied Room outlier (L/ocrm) for integrated resort without onsite laundry in China	7500	400	Excluded from Measures 9,11	0.0%
All Countries	Water Per Square Meter outlier (L/m2) for full-service hotels with onsite laundry	10500	300	Excluded from Measures 9,11	15.3%
All Countries	Water Per Square Meter outlier (L/m2) for full-service hotels without onsite laundry	9000	200	Excluded from Measures 9,11	19.4%
All Countries	Water Per Square Meter outlier (L/m2) for full-service hotels without laundry data	10500	300	Excluded from Measures 9,11	51.1%
All Countries	Water Per Square Meter outlier (L/m2) for limited-service hotels with onsite laundry	8000	150	Excluded from Measures 9,11	13.7%
All Countries	Water Per Square Meter outlier (L/m2) for limited-service hotels without onsite laundry	5000	100	Excluded from Measures 9,11	24.3%
All Countries	Water Per Square Meter outlier (L/m2) for limited-service hotels without laundry data	5000	100	Excluded from Measures 9,11	53.8%
All Countries	Water Per Square Meter outlier (L/m2) for resort with onsite laundry	12500	300	Excluded from Measures 9,11	22.4%
All Countries	Water Per Square Meter outlier (L/m2) for resort without onsite laundry	12000	150	Excluded from Measures 9,11	26.6%
All Countries	Water Per Square Meter outlier (L/m2) for resort without laundry data	12500	300	Excluded from Measures 9,11	35.1%

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
All Countries	Water Per Square Meter outlier (L/m2) for integrated resort with onsite laundry	12500	600	Excluded from Measures 9,11	0.0%
All Countries	Water Per Square Meter outlier (L/m2) for integrated resort without onsite laundry	12500	600	Excluded from Measures 9,11	0.0%
United States Only	Water Per Square Meter outlier (L/m2) for full-service hotels with onsite laundry in United States	4500	1000	Excluded from Measures 9,11	28.1%
United States Only	Water Per Square Meter outlier (L/m2) for full-service hotels without onsite laundry in United States	5000	900	Excluded from Measures 9,11	19.5%
United States Only	Water Per Square Meter outlier (L/m2) for full-service hotels without laundry data in United States	4500	1000	Excluded from Measures 9,11	36.2%
United States Only	Water Per Square Meter outlier (L/m2) for limited-service hotels with onsite laundry in United States	10000	150	Excluded from Measures 9,11	15.7%
United States Only	Water Per Square Meter outlier (L/m2) for limited-service hotels without onsite laundry in United States	10000	100	Excluded from Measures 9,11	32.1%
United States Only	Water Per Square Meter outlier (L/m2) for limited-service hotels without laundry data in United States	10000	100	Excluded from Measures 9,11	17.7%
United States Only	Water Per Square Meter outlier (L/m2) for resort with onsite laundry in United States	10000	300	Excluded from Measures 9,11	21.6%
United States Only	Water Per Square Meter outlier (L/m2) for resort without onsite laundry in United States	7000	150	Excluded from Measures 9,11	16.7%
United States Only	Water Per Square Meter outlier (L/m2) for resort without laundry data in United States	10000	300	Excluded from Measures 9,11	16.9%
United States Only	Water Per Square Meter outlier (L/m2) for integrated resort with onsite laundry in United States	12500	600	Excluded from Measures 9,11	0.0%
United States Only	Water Per Square Meter outlier (L/m2) for integrated resort without onsite laundry in United States	12500	600	Excluded from Measures 9,11	0.0%
China Only	Water Per Square Meter outlier (L/m2) for full-service hotels with onsite laundry in China	5000	600	Excluded from Measures 9,11	27.7%
China Only	Water Per Square Meter outlier (L/m2) for full-service hotels without onsite laundry in China	5500	500	Excluded from Measures 9,11	36.9%
China Only	Water Per Square Meter outlier (L/m2) for full-service hotels without laundry data in China	5000	600	Excluded from Measures 9,11	37.0%
China Only	Water Per Square Meter outlier (L/m2) for limited-service hotels with onsite laundry in China	9000	790	Excluded from Measures 9,11	28.3%
China Only	Water Per Square Meter outlier (L/m2) for limited-service hotels without onsite laundry in China	9500	500	Excluded from Measures 9,11	39.7%

Country	Validity Test Description	High Threshold	Low Threshold	Action Taken if Beyond Threshold or Missing	% Of Data Set Excluded
China Only	Water Per Square Meter outlier (L/m2) for limited-service hotels without laundry data in China	9500	500	Excluded from Measures 9,11	32.3%
China Only	Water Per Square Meter outlier (L/m2) for resort with onsite laundry in China	4000	800	Excluded from Measures 9,11	46.5%
China Only	Water Per Square Meter outlier (L/m2) for resort without onsite laundry in China	5000	800	Excluded from Measures 9,11	60.0%
China Only	Water Per Square Meter outlier (L/m2) for resort without laundry data in China	4000	800	Excluded from Measures 9,11	60.0%
China Only	Water Per Square Meter outlier (L/m2) for integrated resort with onsite laundry in China	12500	600	Excluded from Measures 9,11	0.0%
China Only	Water Per Square Meter outlier (L/m2) for integrated resort without onsite laundry in China	12500	600	Excluded from Measures 9,11	0.0%
All Countries	% Of Floor Area attributed to Rooms Footprint	100%	40%	Excluded from Measures 1,7,10,11	52.6%
All Countries	Average SqM per guestroom of entire building outlier	2500	20	Excluded from Measures 1,2,4,6,7,10,11	9.9%
All Countries	Average size of a guestroom outlier	750	15	Excluded from Measures 1,2,4,6,7,10,11	55.7%
All Countries	Only one source of energy was indicated for calculating total energy	N/A	N/A	Notified only, no action taken	5.5%
All Countries	At least one energy or water source had a high variance of a ratio of 4 to 1 between high/low months or 80% month-to-month	N/A	N/A	Notified only, no action taken	40.8%

APPENDIX 2: Three-year historical overall average change by selected country for energy, 2017-2019

Country	FULL SERVICE					LIMITED SERVICE					ALL				
	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6
United States	1,474	40,759,366	-8.2%	-4.0%	-3.8%	4,163	25,930,873	-9.2%	-0.8%	-1.7%	5,637	66,690,239	-8.6%	-2.9%	-3.2%
China	256	13,905,986	-9.1%	-7.2%	-4.3%	58	942,187	-13.2%	-7.8%	-8.6%	314	14,848,173	-9.4%	-6.9%	-4.6%
United Kingdom	171	2,338,595	-14.9%	1.2%	2.0%	74	344,187	-29.4%	-13.3%	-11.4%	245	2,682,782	-16.4%	-0.3%	0.7%
Canada	77	1,446,725	-10.6%	2.4%	1.0%	113	830,531	-13.4%	0.6%	-0.6%	190	2,277,256	-11.4%	1.9%	0.6%
Mexico	54	1,441,367	-6.3%	-9.1%	-10.8%	51	447,085	0.9%	-0.9%	-1.2%	105	1,888,452	-5.1%	-8.0%	-9.2%
India	45	1,379,051	-7.6%	6.1%	11.4%	17	222,993	-10.8%	2.7%	6.4%	62	1,602,044	-8.1%	5.7%	10.6%
Germany	33	780,544	-10.1%	-2.5%	-2.6%	8	65,227	-6.9%	-7.7%	-3.7%	41	845,771	-9.9%	-3.2%	-2.6%
Japan	37	1,478,580	-14.6%	1.0%	-0.8%						37	1,478,580	-14.6%	1.0%	-0.8%
Australia	27	729,740	-10.0%	-3.8%	-7.5%						27	729,740	-10.0%	-3.8%	-7.5%
United Arab Emirates	31	1,934,205	-26.2%	-21.7%	-21.8%	4	51,303	25.1%	3.5%	7.0%	35	1,985,508	-25.1%	-21.3%	-21.3%
Turkey	25	773,539	2.1%	-16.5%	-1.9%	6	83,372	4.2%	-9.5%	5.6%	31	856,911	2.2%	-16.0%	-1.4%
France	27	499,007	9.2%	-10.1%	-1.7%	4	14,683	8.3%	-6.2%	-3.4%	31	513,690	9.2%	-9.8%	-1.8%
Thailand	30	1,125,895	-10.1%	3.5%	-2.3%	5	70,593	-7.6%	0.7%	-0.2%	35	1,196,488	-10.0%	3.0%	-2.2%
Italy	20	372,273	-10.5%	-6.7%	-2.3%	8	55,537	-3.8%	-3.8%	1.7%	28	427,810	-9.8%	-6.5%	-1.9%
Saudi Arabia	19	975,647	-14.3%	-8.6%	-4.8%	3	47,759	-12.2%	-12.7%	-10.1%	22	1,023,406	-14.2%	-8.8%	-5.2%
Indonesia	20	755,758	0.1%	-9.8%	-6.5%	4	60,327	-11.9%	-37.0%	-33.1%	24	816,085	-0.4%	-11.3%	-7.7%
Hong Kong, China	15	673,503	-8.4%	14.9%	-0.6%	5	72,067	2.2%	19.6%	7.3%	20	745,570	-7.7%	14.7%	-0.1%
Russian Federation	16	434,135	-13.0%	-6.6%	-4.5%	2	19,875	13.0%	36.3%	34.9%	18	454,010	-11.6%	-4.3%	-2.5%
Netherlands	14	240,271	-10.8%	-5.8%	-5.3%	4	37,744	-8.8%	-3.6%	-1.2%	18	278,015	-10.5%	-5.8%	-4.9%
Egypt	21	1,121,180	-4.0%	-15.1%	4.3%	1	14,204	56.9%	40.4%	60.3%	22	1,135,384	-3.5%	-14.7%	4.6%
Malaysia	13	577,352	-10.1%	2.8%	2.6%						13	577,352	-10.1%	2.8%	2.6%
Singapore	11	400,635	-17.4%	-2.6%	3.3%	2	21,623	-27.8%	-23.0%	-20.4%	13	422,258	-17.9%	-3.2%	2.3%
Spain	10	267,882	-15.9%	-12.8%	-10.3%	7	43,333	-31.1%	-38.8%	-35.6%	17	311,215	-17.3%	-15.8%	-12.9%
Colombia	9	202,338	-16.6%	-4.7%	6.3%	4	33,812	-30.9%	-9.4%	-4.7%	13	236,150	-18.2%	-4.4%	5.1%
Korea	11	658,594	-7.2%	-12.1%	-8.3%	3	67,836	9.5%	5.6%	11.2%	14	726,431	-5.8%	-10.8%	-6.7%
Finland	8	123,533	-6.3%	2.2%	-0.9%						8	123,533	-6.3%	2.2%	-0.9%
Ireland	8	133,426	-1.0%	5.5%	5.6%						8	133,426	-1.0%	5.5%	5.6%
Vietnam	10	480,713	-27.7%	-5.8%	-8.8%	1	5,240	-21.6%	-5.4%	3.4%	11	485,953	-27.6%	-6.1%	-8.7%
ALL	2,725	82,998,270	-9.6%	-4.4%	-3.7%	4,588	29,834,068	-9.2%	-1.2%	-1.9%	7,313	112,832,338	-9.6%	-3.5%	-3.3%

*M4 – GHG Emission per square meter

*M5 – Energy per occupied room

*M6 – Energy per square meter

APPENDIX 3: Three-year historical overall average change by selected metro area for energy, 2017-2019

Metro Area	FULL SERVICE					LIMITED SERVICE					ALL				
	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6
New York-Northern New Jersey-Long Island, NY-NJ-PA MSA	61	1,865,299	-12.0%	-10.5%	-8.2%	99	734,754	-6.3%	-2.8%	-1.9%	160	2,600,052	-10.7%	-8.7%	-6.9%
Washington-Arlington-Alexandria, DC-VA-MD-WV MSA	59	1,799,590	-9.6%	-3.3%	-3.2%	100	810,481	-9.1%	-3.2%	-4.1%	159	2,610,072	-9.5%	-3.1%	-3.4%
Los Angeles-Long Beach-Santa Ana, CA MSA	65	1,999,522	-9.4%	-7.6%	-5.4%	67	552,559	-6.1%	0.6%	-1.0%	132	2,552,081	-8.9%	-5.8%	-4.7%
Chicago-Naperville-Joliet, IL-IN-WI MSA	59	2,105,380	-22.8%	-16.6%	-17.5%	93	712,071	-6.0%	-0.9%	0.2%	152	2,817,451	-19.6%	-14.1%	-14.5%
London, UK	56	972,660	-14.3%	2.5%	2.9%	17	81,383	-28.0%	-12.6%	-9.9%	73	1,054,043	-15.2%	1.4%	2.1%
Dallas-Fort Worth-Arlington, TX MSA	45	1,143,088	-12.1%	-1.4%	-3.6%	109	703,842	-11.7%	1.8%	0.0%	154	1,846,930	-12.0%	-0.5%	-2.5%
Shanghai	43	2,347,768	-14.8%	-5.0%	-7.1%	13	239,149	-6.1%	3.5%	2.6%	56	2,586,917	-14.2%	-4.5%	-6.4%
Atlanta-Sandy Springs-Marietta, GA MSA	39	1,164,663	-7.0%	-4.2%	-2.3%	97	641,279	-6.6%	0.7%	-2.9%	136	1,805,942	-6.9%	-1.9%	-2.5%
Miami-Fort Lauderdale-Pompano Beach, FL MSA	43	1,251,046	-2.2%	5.3%	2.1%	66	488,854	-5.5%	2.2%	1.3%	109	1,739,900	-3.1%	4.2%	1.9%
Houston-Sugar Land-Baytown, TX MSA	35	987,857	-11.0%	2.5%	2.0%	81	499,884	-13.5%	4.6%	-2.6%	116	1,487,741	-11.7%	4.2%	0.8%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA	33	626,008	-11.9%	-10.3%	-7.4%	52	384,635	-9.7%	-4.3%	-4.5%	85	1,010,643	-11.3%	-8.2%	-6.6%
Boston-Cambridge-Quincy, MA-NH MSA	29	695,614	3.1%	5.1%	5.9%	50	382,423	-4.8%	-1.3%	-2.9%	79	1,078,037	0.5%	3.3%	3.0%
Orlando-Kissimmee-FL MSA	30	1,671,302	-22.1%	-20.1%	-20.0%	45	381,176	-4.8%	3.8%	0.7%	75	2,052,478	-19.4%	-16.4%	-17.1%
San Francisco-Oakland-Fremont, CA MSA	26	1,061,676	-14.2%	-11.8%	-9.1%	42	334,441	-5.1%	2.3%	-0.7%	68	1,396,118	-12.5%	-8.7%	-7.5%
Phoenix-Mesa-Scottsdale, AZ MSA	34	880,319	12.5%	1.3%	2.7%	57	406,485	8.0%	-6.7%	-3.4%	91	1,286,804	11.3%	-1.1%	1.2%
Denver-Aurora, CO MSA	25	502,235	-17.3%	2.5%	3.3%	54	393,651	-15.1%	4.6%	3.1%	79	895,886	-16.5%	3.6%	3.2%
Beijing	24	1,269,191	-9.9%	-3.6%	-5.2%	7	131,708	-5.5%	-2.2%	-1.1%	31	1,400,899	-9.6%	-3.8%	-4.9%
Minneapolis-St. Paul-Bloomington, MN-WI MSA	23	663,826	-8.7%	1.3%	-0.1%	37	258,000	-4.9%	3.7%	3.1%	60	921,826	-7.7%	1.7%	0.7%
St. Louis, MO-IL MSA	20	641,521	-11.6%	-6.0%	-3.9%	24	147,996	-10.6%	3.2%	0.5%	44	789,517	-11.5%	-4.1%	-3.3%
Tampa-St. Petersburg-Clearwater, FL	23	517,074	-9.1%	-6.6%	-4.9%	41	229,276	-6.8%	2.5%	0.5%	64	746,350	-8.5%	-3.8%	-3.6%
San Diego-Carlsbad-San Marcos, CA MSA	23	839,105	-5.4%	1.4%	-0.8%	34	285,267	-4.1%	-1.1%	1.6%	57	1,124,372	-5.1%	0.3%	-0.3%
New Orleans-Metairie-Kenner, LA MSA	19	788,071	-22.9%	-8.7%	-8.7%	23	207,461	-15.5%	-3.8%	-1.1%	42	995,532	-21.6%	-8.2%	-7.5%
Austin-Round Rock, TX MSA	20	431,566	-11.2%	-2.2%	-3.2%	46	296,035	-11.3%	-1.3%	-2.2%	66	727,601	-11.2%	-1.9%	-2.9%
Baltimore-Towson, MD MSA	19	446,524	-9.1%	0.1%	-3.2%	29	195,078	-6.0%	1.6%	0.5%	48	641,601	-8.4%	0.1%	-2.4%
Dubai-Sharjah-Ajman	18	1,185,201	-33.6%	-30.8%	-30.6%	4	51,303	25.1%	3.5%	7.0%	22	1,236,504	-31.7%	-29.9%	-29.5%
San Antonio, TX MSA	19	582,014	-7.4%	1.8%	4.5%	43	298,301	-11.2%	-1.9%	-0.7%	62	880,315	-8.4%	1.2%	3.2%
Seattle-Tacoma-Bellevue, WA MSA	17	443,601	-25.2%	-4.9%	-7.4%	43	375,167	-25.7%	1.0%	-5.8%	60	818,768	-25.4%	-2.1%	-6.8%
Charlotte-Gastonia-Concord, NC-SC MSA	18	318,123	-7.4%	-3.5%	-4.1%	38	270,488	-8.1%	-0.9%	-3.2%	56	588,611	-7.6%	-2.3%	-3.8%
Paris	16	336,475	10.1%	-12.4%	0.2%						16	336,475	10.1%	-12.4%	0.2%
Nashville-Davidson-Murfreesboro-Franklin, TN MSA	16	346,062	-1.8%	9.4%	12.3%	45	320,037	-13.9%	0.1%	-4.0%	61	666,099	-6.8%	7.3%	6.0%
Istanbul	15	574,473	1.3%	-22.3%	-2.6%	2	24,835	14.9%	-2.8%	27.5%	17	599,309	1.8%	-21.9%	-1.7%
Hong Kong	15	673,503	-8.4%	14.9%	-0.6%	5	72,067	2.2%	19.6%	7.3%	20	745,570	-7.7%	14.7%	-0.1%
Bangkok	15	666,770	-10.6%	-2.1%	-3.2%	3	46,013	-11.2%	-4.4%	-4.1%	18	712,783	-10.6%	-2.3%	-3.3%
Toronto	14	317,116	-20.0%	3.5%	-0.5%	21	182,157	-33.2%	-7.6%	-7.7%	35	499,273	-23.6%	0.0%	-2.4%
Kansas City, MO-KS MSA	14	253,730	-13.7%	1.2%	-5.9%	36	257,001	-12.1%	4.1%	-3.4%	50	510,731	-13.1%	2.3%	-5.0%
Guangzhou	14	797,320	-6.1%	-8.7%	-0.2%						14	797,320	-6.1%	-8.7%	-0.2%
Chengdu	14	836,045	-8.5%	-7.6%	4.9%	5	60,884	-13.8%	-25.4%	-20.5%	19	896,929	-8.8%	-8.2%	3.1%
Portland-Vancouver-Beaverton, OR-WA MSA	13	298,783	-27.2%	-2.3%	-8.6%	16	121,697	-22.7%	-1.8%	-1.7%	29	420,480	-26.1%	-3.1%	-7.0%
Detroit-Warren-Livonia, MI MSA	13	180,594	-15.1%	8.1%	-0.4%	43	281,547	-19.8%	0.6%	-3.3%	56	462,142	-17.7%	3.5%	-1.9%
Cleveland-Elyria-Mentor, OH MSA	13	238,742	-23.7%	-3.2%	-7.4%	19	110,672	-6.0%	0.3%	2.7%	32	349,414	-19.2%	-3.4%	-4.9%
Columbus, OH MSA	13	286,786	-6.0%	2.9%	4.9%	29	199,946	-7.7%	3.9%	2.4%	42	486,732	-6.5%	3.8%	4.2%
Cincinnati-Middletown, OH-KY-IN MSA	13	199,660	2.3%	12.4%	19.5%	26	147,454	-2.2%	9.3%	9.4%	39	347,114	0.5%	11.8%	15.5%
Suzhou-Wuxi-Changzhou	12	642,114	-4.3%	1.8%	4.6%	3	47,650	-11.7%	-3.9%	-9.3%	15	689,764	-4.8%	2.1%	3.5%
Virginia Beach-Norfolk-Newport News, VA-NC MSA	12	185,368	-5.8%	-3.0%	-1.8%	32	207,752	-6.0%	-2.3%	-0.5%	44	393,120	-5.9%	-2.7%	-1.2%
Riverside-San Bernardino-Ontario, CA MSA	17	589,308	-7.3%	-13.4%	-12.5%	17	114,145	-6.2%	-3.8%	-6.0%	34	703,453	-7.2%	-11.9%	-11.9%
Delhi	12	442,832	-8.0%	-0.1%	7.9%	5	50,831	-10.8%	-7.3%	-3.2%	17	493,664	-8.4%	-0.8%	6.4%
Singapore	11	400,635	-17.4%	-2.6%	3.3%	2	21,623	-27.8%	-23.0%	-20.4%	13	422,258	-17.9%	-3.2%	2.3%
Tokyo	11	464,862	-21.9%	2.1%	0.2%						11	464,862	-21.9%	2.1%	0.2%
Raleigh-Cary, NC MSA	11	154,001	-5.3%	-4.2%	-1.1%	29	195,921	-5.1%	-0.8%	0.0%	40	349,922	-5.2%	-2.2%	-0.6%
Indianapolis-Carmel, IN MSA	11	269,158	-2.9%	4.9%	8.4%	36	236,772	-10.5%	-1.7%	-3.9%	47	505,929	-5.6%	4.4%	4.5%
Louisville/Jefferson County, KY-IN MSA	10	219,899	-5.1%	3.6%	5.7%	25	158,166	-2.2%	15.2%	9.8%	35	378,065	-4.0%	8.8%	7.1%
Cairo	10	630,672	-6.7%	-14.1%	1.9%	1	14,204	56.9%	40.4%	60.3%	11	644,876	-5.9%	-13.4%	2.6%

APPENDIX 4: Three-year historical overall average change by selected country for water, 2017-2019

Country	FULL SERVICE				LIMITED SERVICE				ALL			
	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9
United States	1,190	33,432,268	-4.7%	-4.5%	3,431	22,129,391	-4.3%	-5.0%	4,621	55,561,659	-4.5%	-4.7%
China	227	12,427,541	-2.7%	-0.6%	56	954,828	5.7%	5.4%	283	13,382,369	-2.0%	-0.3%
United Kingdom	163	2,369,884	-2.0%	-1.5%	97	684,273	-0.5%	0.8%	260	3,054,157	-1.9%	-1.1%
Canada	71	1,319,765	-5.8%	-6.0%	100	778,696	1.1%	0.6%	171	2,098,460	-3.8%	-4.1%
Mexico	50	1,161,553	-5.0%	-7.8%	51	580,596	-6.5%	-7.1%	101	1,742,149	-5.6%	-7.6%
Germany	42	916,048	-4.2%	-3.3%	17	113,370	1.9%	5.4%	59	1,029,418	-3.7%	-2.4%
India	41	1,133,001	-6.3%	-0.4%	11	138,761	-19.2%	-17.2%	52	1,271,762	-7.7%	-2.5%
Japan	39	1,557,695	-3.8%	-5.7%					39	1,557,695	-3.8%	-5.7%
Turkey	31	957,608	-5.5%	9.3%	6	72,979	0.5%	9.1%	37	1,030,587	-4.9%	9.2%
France	33	513,342	-7.3%	-9.7%	8	31,503	-5.9%	-2.6%	41	544,845	-7.5%	-9.2%
United Arab Emirates	34	2,145,795	-5.9%	-5.3%	6	109,582	-5.6%	-1.9%	40	2,255,377	-6.0%	-5.2%
Australia	24	668,881	-4.2%	-8.2%					24	668,881	-4.2%	-8.2%
Thailand	27	1,050,448	1.0%	-2.3%	6	87,792	9.8%	9.2%	33	1,138,239	1.2%	-1.8%
Italy	19	319,591	-9.2%	-6.6%	6	48,312	-14.7%	-7.0%	25	367,903	-10.3%	-6.6%
Russian Federation	18	463,047	-10.5%	-7.9%	5	45,585	0.2%	2.1%	23	508,632	-9.3%	-6.8%
Hong Kong, China	15	673,503	6.3%	-8.0%	6	81,338	-1.3%	-11.7%	21	754,840	5.3%	-8.3%
Saudi Arabia	16	751,957	-4.2%	-0.5%	2	31,011	31.1%	28.3%	18	782,969	-2.8%	0.5%
Indonesia	18	655,211	-0.6%	2.9%	3	38,583	3.6%	7.8%	21	693,794	-0.6%	3.0%
Egypt	21	1,471,279	-12.6%	5.6%	1	14,204	-9.1%	3.8%	22	1,485,483	-12.5%	5.6%
Netherlands	12	203,921	-4.6%	-5.0%	7	63,918	-3.8%	-0.9%	19	267,839	-4.8%	-4.0%
Singapore	11	400,635	-8.8%	-3.3%	2	22,700	12.1%	17.6%	13	423,335	-7.8%	-2.3%
Korea	14	721,829	-1.9%	3.2%	3	67,836	-3.5%	1.7%	17	789,666	-2.1%	3.0%
Switzerland	11	194,759	-5.1%	-3.9%	5	32,708	-12.8%	-11.0%	16	227,467	-6.1%	-4.8%
Spain	10	235,145	-5.5%	-2.3%	14	160,973	0.1%	6.1%	24	396,118	-5.1%	-0.9%
Poland	8	190,378	3.5%	5.0%	3	19,449	10.1%	6.5%	11	209,827	4.4%	5.2%
Malaysia	9	443,766	3.3%	4.4%	1	20,768	17.2%	15.7%	10	464,534	4.0%	4.9%
Vietnam	10	393,420	1.8%	-1.5%	1	5,240	-11.8%	-3.7%	11	398,660	1.5%	-1.5%
Colombia	8	194,040	-3.7%	4.7%	5	39,277	-6.8%	-1.6%	13	233,317	-3.6%	4.0%
ALL	2,410	74,186,122	-3.9%	-3.3%	3,891	26,688,835	-3.8%	-4.2%	6,301	100,874,957	-3.7%	-3.5%

*M8 – Water per occupied

*M9 – Water per square meter

APPENDIX 5: Three-year historical overall average change by selected metro area for water, 2017-2019

Metro Area	FULL SERVICE				LIMITED SERVICE				ALL			
	Count	SqM	Measure 4	Measure 5	Count	SqM	Measure 4	Measure 5	Count	SqM	Measure 4	Measure 5
Los Angeles-Long Beach-Santa Ana, CA MSA	68	1,939,004	-6.0%	-3.7%	65	497,211	-2.0%	-3.1%	133	2,436,215	-5.0%	-3.5%
London, UK	60	1,034,383	-3.3%	-2.4%	21	144,377	1.8%	3.9%	81	1,178,760	-2.9%	-1.9%
Washington-Arlington-Alexandria, DC-VA-MD-WV MSA	54	1,653,758	-7.1%	-6.8%	85	704,050	-9.3%	-10.2%	139	2,357,808	-7.7%	-7.8%
New York-Northern New Jersey-Long Island, NY-NJ-PA MSA	51	1,660,596	-9.9%	-7.6%	77	592,484	-5.7%	-5.1%	128	2,253,080	-8.7%	-6.9%
Shanghai	42	2,261,052	-2.0%	-3.8%	13	239,149	2.7%	1.8%	55	2,500,202	-1.7%	-3.4%
Chicago-Naperville-Joliet, IL-IN-WI MSA	39	1,334,508	-5.2%	-5.8%	77	603,023	-6.0%	-5.1%	116	1,937,532	-5.6%	-5.6%
Dallas-Fort Worth-Arlington, TX MSA	34	858,782	-5.8%	-7.5%	98	671,157	-4.0%	-6.1%	132	1,529,939	-5.0%	-6.9%
Houston-Sugar Land-Baytown, TX MSA	34	887,761	-5.9%	-5.5%	46	283,219	-8.2%	-14.3%	80	1,170,980	-5.9%	-7.7%
Atlanta-Sandy Springs-Marietta, GA MSA	34	1,008,423	-0.1%	3.0%	87	649,796	-2.8%	-5.5%	121	1,658,219	-0.8%	-0.5%
Orlando-Kissimmee, FL MSA	29	1,440,506	-14.5%	-14.2%	44	420,654	-2.6%	-7.3%	73	1,861,160	-11.8%	-12.9%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA	27	527,114	-3.4%	-0.8%	47	355,391	1.9%	1.3%	74	882,505	-1.2%	0.0%
Miami-Fort Lauderdale-Pompano Beach, FL MSA	30	940,502	3.1%	-0.4%	53	415,033	-4.8%	-6.4%	83	1,355,535	0.5%	-2.2%
San Francisco-Oakland-Fremont, CA MSA	21	703,175	-5.0%	-7.9%	35	271,998	3.0%	2.4%	56	975,173	-2.6%	-4.8%
Phoenix-Mesa-Scottsdale, AZ MSA	26	618,973	-7.6%	-6.2%	52	377,969	-9.2%	-5.9%	78	996,942	-8.4%	-6.1%
Minneapolis-St. Paul-Bloomington, MN-WI MSA	20	490,798	-4.9%	-6.6%	30	194,247	-6.5%	-7.0%	50	685,045	-5.5%	-6.7%
Denver-Aurora, CO MSA	20	442,180	0.0%	0.6%	45	347,709	0.5%	0.0%	65	789,889	0.3%	0.4%
Beijing	20	1,072,825	-2.1%	-3.3%	5	94,313	7.6%	8.3%	25	1,167,138	-1.6%	-2.5%
Dubai-Sharjah-Ajman	20	1,317,597	-4.6%	-3.9%	4	56,811	-14.3%	-11.1%	24	1,374,409	-5.2%	-4.2%
Boston-Cambridge-Quincy, MA-NH MSA	19	495,936	-13.5%	-13.9%	33	258,598	-9.4%	-9.7%	52	754,534	-12.2%	-12.5%
Seattle-Tacoma-Bellevue, WA MSA	18	430,652	7.0%	4.4%	26	235,377	-6.2%	-13.4%	44	666,029	2.9%	-1.7%
Paris	18	280,843	-9.3%	-12.8%	2	7,533	21.5%	22.1%	20	288,376	-8.5%	-11.9%
Austin-Round Rock, TX MSA	19	416,888	-3.2%	-4.2%	40	253,732	-8.5%	-8.4%	59	670,620	-5.3%	-5.8%
Istanbul	17	657,873	-10.0%	10.8%	1	10,472	-19.3%	-2.4%	18	668,346	-10.1%	10.5%
San Diego-Carlsbad-San Marcos, CA MSA	21	551,349	-13.4%	-14.7%	33	311,782	3.6%	6.0%	54	863,131	-8.7%	-8.8%
Charlotte-Gastonia-Concord, NC-SC MSA	18	318,123	-0.2%	-1.4%	33	231,882	-1.3%	-4.5%	51	550,005	-0.4%	-2.6%
Toronto	16	375,765	-3.2%	-5.3%	18	155,300	-9.7%	-8.4%	34	531,064	-5.0%	-6.1%
Tampa-St. Petersburg-Clearwater, FL	19	463,606	-4.4%	-3.9%	35	189,044	1.7%	0.3%	54	652,650	-2.5%	-2.7%
St. Louis, MO-IL MSA	15	484,090	-15.3%	-13.8%	19	124,225	-5.1%	-7.2%	34	608,315	-13.1%	-12.6%
San Antonio, TX MSA	17	607,174	-6.8%	-5.1%	42	290,006	-5.8%	-4.6%	59	897,179	-6.5%	-5.0%
Hong Kong	15	673,503	6.3%	-8.0%	6	81,338	-1.3%	-11.7%	21	754,840	5.3%	-8.3%
Bangkok	15	666,770	-2.9%	-4.0%	4	63,212	5.4%	6.1%	19	729,982	-2.6%	-3.4%
Guangzhou	14	797,320	-2.7%	6.3%					14	797,320	-2.7%	6.3%
Portland-Vancouver-Beaverton, OR-WA MSA	13	281,359	-6.7%	-11.8%	16	130,431	3.0%	3.3%	29	411,790	-4.5%	-7.7%
Nashville-Davidson-Murfreesboro-Franklin, TN MSA	13	309,011	-12.7%	-9.4%	47	375,312	-2.0%	-6.0%	60	684,322	-6.7%	-7.8%
Riverside-San Bernardino-Ontario, CA MSA	17	589,308	5.6%	6.7%	18	104,794	1.3%	-2.6%	35	694,103	5.7%	5.3%
Tokyo	11	464,862	-0.8%	-2.6%					11	464,862	-0.8%	-2.6%
Singapore	11	400,635	-8.8%	-3.3%	2	22,700	12.1%	17.6%	13	423,335	-7.8%	-2.3%
Mexico City	11	264,323	-5.1%	-3.4%	3	40,943	-22.0%	-20.0%	14	305,266	-7.4%	-5.6%
Kansas City, MO-KS MSA	11	218,842	-9.0%	-15.0%	37	271,816	-2.9%	-9.9%	48	490,658	-5.9%	-12.4%
New Orleans-Metairie-Kenner, LA MSA	11	344,650	-10.6%	-10.3%	16	181,461	-13.3%	-9.8%	27	526,110	-11.6%	-10.1%
Cairo	11	1,065,772	-11.1%	4.4%	1	14,204	-9.1%	3.8%	12	1,079,976	-11.0%	4.4%
Detroit-Warren-Livonia, MI MSA	10	173,715	2.7%	-4.6%	30	213,217	-9.1%	-11.6%	40	386,932	-4.4%	-8.6%
Chengdu	10	686,882	-10.3%	-1.1%	5	60,884	0.9%	7.5%	15	747,766	-8.9%	-0.4%
Cleveland-Elyria-Mentor, OH MSA	10	192,762	-11.8%	-13.4%	14	86,146	-17.8%	-14.3%	24	278,908	-14.3%	-13.7%

APPENDIX 6: Year-over-year overall average change by selected country for energy, 2018-2019

Country	FULL SERVICE					LIMITED SERVICE					ALL				
	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6
United States	1,782	45,281,391	-3.1%	-2.2%	-2.6%	5,453	33,825,442	-3.1%	-2.6%	-2.9%	7,235	79,106,833	-3.1%	-2.3%	-2.7%
China	305	16,997,673	-6.4%	-4.6%	-4.5%	86	1,297,870	-8.6%	-6.2%	-6.1%	391	18,295,543	-6.5%	-4.7%	-4.5%
United Kingdom	207	2,870,504	-7.7%	-2.3%	-2.5%	103	519,893	-17.7%	-11.8%	-10.7%	310	3,390,397	-8.8%	-3.5%	-3.4%
Canada	102	1,800,546	-4.0%	0.4%	-0.4%	156	1,194,410	-5.8%	-2.5%	-3.8%	258	2,994,956	-4.6%	-0.4%	-1.4%
Mexico	66	1,509,313	-0.5%	-3.4%	-3.6%	75	621,500	2.6%	0.1%	0.5%	141	2,130,813	0.2%	-2.7%	-2.8%
India	58	1,713,891	-5.4%	-6.8%	-2.5%	19	249,707	-1.0%	-5.2%	1.0%	77	1,963,598	-4.9%	-6.7%	-2.1%
TURKEY	39	1,208,779	-2.1%	-6.2%	-0.6%	22	213,811	-1.7%	-3.5%	-2.4%	61	1,422,591	-2.1%	-5.3%	-0.8%
Germany	38	918,317	-6.8%	-5.1%	-3.1%	14	107,425	-3.4%	-4.2%	-3.1%	52	1,025,741	-6.5%	-4.9%	-3.1%
Australia	37	994,439	-7.3%	-3.6%	-5.3%	2	14,522	-4.2%	1.2%	2.6%	39	1,008,961	-7.2%	-3.6%	-5.2%
United Arab Emirates	39	2,404,973	-26.7%	-13.4%	-12.8%	8	124,476	-1.5%	-2.2%	-1.6%	47	2,529,449	-25.6%	-13.0%	-12.4%
Japan	39	1,584,168	-14.6%	-0.8%	-1.7%						39	1,584,168	-14.6%	-0.8%	-1.7%
France	32	558,674	-4.0%	-3.9%	-4.1%	11	53,014	-3.0%	-1.7%	-5.4%	43	611,688	-3.9%	-3.5%	-4.2%
Thailand	40	1,455,786	-3.0%	-2.2%	-2.7%	6	79,709	-5.1%	-8.0%	-8.0%	46	1,535,495	-3.1%	-2.5%	-2.9%
Italy	23	411,251	-4.5%	-6.1%	-2.2%	10	73,095	-0.1%	-4.1%	2.2%	33	484,346	-3.9%	-6.1%	-1.7%
Saudi Arabia	22	1,236,364	-18.2%	-6.4%	-1.2%	3	36,609	-2.1%	-4.8%	0.4%	25	1,272,973	-17.8%	-6.3%	-1.2%
Netherlands	19	349,251	-0.5%	0.8%	0.8%	7	61,261	-6.4%	-8.2%	-5.6%	26	410,512	-1.2%	-0.6%	0.0%
Russian Federation	19	451,332	-9.7%	-10.9%	-9.3%	10	108,973	-6.9%	-12.0%	-6.2%	29	560,305	-9.2%	-11.5%	-8.8%
Indonesia	23	766,977	5.7%	-3.8%	0.7%	5	79,188	4.7%	-4.6%	-0.4%	28	846,165	5.6%	-3.8%	0.7%
Hong Kong, China	13	563,740	-11.8%	8.1%	-6.8%	6	85,319	-1.2%	14.6%	-1.4%	19	649,059	-10.8%	8.7%	-6.3%
Singapore	13	486,101	-2.1%	-9.4%	-2.7%	4	50,839	-3.6%	-5.5%	-3.8%	17	536,940	-2.2%	-8.5%	-2.8%
Malaysia	16	647,254	-5.2%	-8.1%	-6.1%	1	13,215	1.1%	-19.4%	1.7%	17	660,469	-5.1%	-8.8%	-6.0%
Spain	14	301,931	-2.8%	-6.5%	-3.6%	9	53,767	-5.5%	-10.9%	-6.7%	23	355,698	-3.1%	-7.1%	-3.9%
Egypt	21	1,148,237	-6.3%	-8.0%	-2.5%	1	14,204	82.4%	62.5%	78.0%	22	1,162,441	-5.8%	-7.6%	-2.0%
Colombia	11	228,597	-22.2%	3.9%	4.2%	13	90,601	-33.2%	-2.3%	-0.4%	24	319,198	-24.2%	2.4%	3.3%
Korea	12	772,398	-3.8%	-7.2%	-3.8%	2	42,572	-1.1%	-18.2%	-2.6%	14	814,969	-3.7%	-8.5%	-3.7%
Poland	9	223,477	-6.3%	-12.4%	-10.1%	10	64,140	-1.8%	-2.2%	-0.2%	19	287,617	-5.4%	-10.3%	-8.1%
Brazil	9	319,344	-4.6%	-11.2%	-2.3%	2	30,000	-4.2%	3.7%	14.1%	11	349,344	-4.6%	-10.7%	-1.9%
Belgium	9	156,661	-4.7%	-7.9%	-5.0%	6	50,037	-4.5%	-7.6%	-4.3%	15	206,698	-4.7%	-7.9%	-4.9%
New Zealand	11	154,307	-3.7%	-2.7%	-3.0%						11	154,307	-3.7%	-2.7%	-3.0%
Qatar	9	517,600	-6.5%	-9.8%	-1.0%						9	517,600	-6.5%	-9.8%	-1.0%
Ireland	8	133,426	-6.7%	-2.9%	-4.5%	1	13,575	11.0%	-2.4%	8.0%	9	147,001	-5.7%	-4.4%	-3.8%
ALL	3,296	95,129,672	-6.0%	-3.2%	-3.1%	6,100	39,599,347	-3.4%	-2.8%	-3.0%	9,396	134,729,019	-5.4%	-3.0%	-3.1%

APPENDIX 7: Year-over-year overall average change by selected metro area for energy, 2018-2019

Metro Area	FULL SERVICE					LIMITED SERVICE					ALL				
	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6	Count	SqM	Measure 4	Measure 5	Measure 6
Washington-Arlington-Alexandria, DC-VA-MD-WV MSA	75	2,095,527	-3.6%	-5.2%	-4.9%	120	1,004,964	-4.8%	-4.8%	-5.1%	195	3,100,491	-4.0%	-5.0%	-4.9%
London, UK	75	1,320,572	-6.7%	-1.2%	-1.3%	26	149,650	-13.3%	-5.8%	-5.1%	101	1,470,222	-7.2%	-1.6%	-1.6%
Los Angeles-Long Beach-Santa Ana, CA MSA	74	2,167,172	-2.7%	-3.4%	-2.3%	85	691,468	-1.4%	-0.8%	-1.1%	159	2,858,640	-2.4%	-2.7%	-2.0%
New York-Northern New Jersey-Long Island, NY-NJ-PA M	64	1,832,991	-10.1%	-8.7%	-9.9%	133	1,019,289	-3.5%	-1.9%	-2.9%	197	2,852,280	-8.2%	-6.9%	-7.9%
Chicago-Naperville-Joliet, IL-IN-WI MSA	65	2,131,473	-2.7%	-1.2%	-3.4%	104	731,503	-4.4%	-5.7%	-5.4%	169	2,862,976	-3.1%	-2.5%	-3.8%
Dallas-Fort Worth-Arlington, TX MSA	51	1,212,846	-3.0%	-2.5%	-3.0%	144	961,064	-2.7%	-1.9%	-2.4%	195	2,173,910	-2.9%	-2.3%	-2.8%
Miami-Fort Lauderdale-Pompano Beach, FL MSA	58	1,732,400	-5.7%	-4.8%	-6.2%	79	550,629	0.5%	1.3%	1.1%	137	2,283,029	-4.5%	-3.9%	-4.9%
Atlanta-Sandy Springs-Marietta, GA MSA	46	1,281,625	-4.9%	-5.8%	-5.1%	122	761,841	-4.4%	-2.1%	-4.6%	168	2,043,465	-4.7%	-4.2%	-5.0%
Shanghai	43	2,391,356	-11.8%	-4.2%	-6.6%	16	256,187	-10.9%	-6.3%	-4.9%	59	2,647,543	-11.8%	-4.8%	-6.5%
Houston-Sugar Land-Baytown, TX MSA	40	1,022,311	-2.2%	-1.3%	-1.6%	118	735,852	-4.2%	-4.5%	-5.3%	158	1,758,163	-2.9%	-2.3%	-2.9%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA	36	707,143	-6.8%	-5.9%	-7.4%	63	450,026	-2.8%	-1.7%	-2.6%	99	1,157,169	-5.7%	-4.9%	-6.1%
Boston-Cambridge-Quincy, MA-NH MSA	33	812,127	1.2%	4.1%	1.8%	66	484,669	-4.0%	0.3%	-4.1%	99	1,296,796	-0.5%	3.1%	0.0%
Phoenix-Mesa-Scottsdale, AZ MSA	44	1,063,671	-0.5%	4.0%	3.3%	71	510,918	-3.0%	-3.7%	-1.9%	115	1,574,588	-1.1%	1.6%	2.0%
San Francisco-Oakland-Fremont, CA MSA	31	1,195,300	-1.8%	-1.2%	-1.6%	50	408,154	1.5%	3.2%	1.7%	81	1,603,454	-1.1%	-0.2%	-1.0%
Orlando-Kissimmee, FL MSA	35	1,651,635	-8.4%	-7.9%	-9.1%	59	475,270	-1.2%	-1.8%	-3.4%	94	2,126,905	-7.1%	-6.8%	-8.1%
Denver-Aurora, CO MSA	27	573,112	2.6%	4.4%	5.4%	64	465,346	1.3%	-0.5%	1.1%	91	1,038,459	2.1%	2.5%	3.9%
Beijing	27	1,383,544	-6.1%	-2.3%	-3.4%	8	124,287	-4.3%	-6.7%	-4.9%	35	1,507,831	-6.0%	-2.9%	-3.5%
Dubai-Sharjah-Ajman	25	1,625,728	-32.0%	-17.2%	-16.6%	7	95,773	0.5%	-0.7%	0.5%	32	1,721,501	-30.4%	-16.4%	-15.8%
Minneapolis-St. Paul-Bloomington, MN-WI MSA	23	636,251	-4.8%	-1.7%	-4.0%	48	315,803	1.5%	4.1%	3.1%	71	952,053	-2.8%	-0.2%	-1.9%
Istanbul	23	859,653	-1.1%	-8.0%	-0.4%	7	75,232	-5.9%	-8.3%	-3.9%	30	934,885	-1.5%	-7.7%	-0.6%
St. Louis, MO-IL MSA	22	623,295	-7.5%	-4.5%	-4.6%	29	175,374	-4.8%	-4.6%	-3.1%	51	798,669	-7.0%	-4.7%	-4.3%
Seattle-Tacoma-Bellevue, WA MSA	22	550,450	0.5%	1.8%	0.2%	54	442,120	-3.4%	-0.7%	-2.9%	76	992,570	-1.0%	0.9%	-1.0%
San Diego-Carlsbad-San Marcos, CA MSA	26	900,476	-4.3%	0.0%	-3.8%	42	346,461	0.9%	3.2%	1.4%	68	1,246,937	-3.1%	0.4%	-2.6%
New Orleans-Metairie-Kenner, LA MSA	22	816,407	-7.5%	-4.5%	-5.8%	24	209,121	0.2%	-0.5%	1.2%	46	1,025,528	-6.2%	-4.2%	-4.7%
San Antonio, TX MSA	23	730,375	-0.1%	3.1%	1.6%	59	403,883	-3.1%	-4.1%	-4.0%	82	1,134,258	-0.9%	1.0%	0.2%
Tampa-St. Petersburg-Clearwater, FL	24	527,525	-1.9%	-2.7%	-2.0%	61	348,786	-5.1%	-4.5%	-4.3%	85	876,312	-3.0%	-3.2%	-2.8%
Baltimore-Towson, MD MSA	20	414,961	-6.2%	-6.2%	-5.5%	40	260,015	-1.0%	-0.1%	0.7%	60	674,975	-4.6%	-4.5%	-3.8%
Charlotte-Gastonia-Concord, NC-SC MSA	21	330,692	-5.8%	-9.3%	-6.9%	52	362,317	-5.3%	-4.2%	-5.3%	73	693,009	-5.6%	-6.6%	-6.2%
Paris	19	382,269	-5.2%	-4.6%	-4.6%	2	10,558	5.0%	8.3%	1.2%	21	392,827	-4.8%	-4.1%	-4.4%
Toronto	19	445,447	-8.4%	-0.8%	-3.6%	30	304,805	-14.1%	-4.5%	-5.5%	49	750,252	-10.0%	-2.2%	-4.2%
Portland-Vancouver-Beaverton, OR-WA MSA	18	352,143	1.2%	5.3%	2.2%	27	200,224	1.4%	2.2%	2.0%	45	552,366	1.3%	3.9%	2.2%
Nashville-Davidson-Murfreesboro-Franklin, TN MSA	18	277,475	-4.8%	-4.6%	-6.2%	59	403,305	-6.5%	-4.6%	-6.8%	77	680,780	-5.6%	-4.5%	-6.5%
Kansas City, MO-KS MSA	18	392,174	-1.9%	2.9%	2.8%	44	290,932	-4.4%	-2.8%	-3.3%	62	683,106	-2.7%	1.3%	1.0%
Austin-Round Rock, TX MSA	19	423,021	-1.0%	-1.3%	-1.2%	64	409,141	-2.6%	-5.1%	-3.1%	83	832,162	-1.6%	-3.1%	-1.9%
Bangkok	17	822,484	-2.7%	-6.8%	-2.8%	4	55,129	-6.3%	-14.1%	-10.5%	21	877,612	-2.9%	-7.1%	-3.2%
Cleveland-Elyria-Mentor, OH MSA	16	322,450	-12.0%	-6.3%	-9.6%	26	155,457	-1.8%	-3.1%	-2.4%	42	477,907	-9.1%	-6.2%	-7.8%
Columbus, OH MSA	16	308,236	-3.5%	-6.0%	-4.3%	36	225,466	-3.2%	-6.0%	-4.0%	52	533,702	-3.4%	-6.1%	-4.2%
Cincinnati-Middletown, OH-KY-IN MSA	16	236,090	4.0%	1.4%	5.9%	36	207,950	-6.2%	-5.7%	-5.6%	52	444,039	-0.2%	-1.0%	1.3%
Riverside-San Bernardino-Ontario, CA MSA	20	545,888	-2.1%	0.3%	0.0%	29	191,381	-2.4%	0.1%	-1.9%	49	737,269	-2.2%	0.6%	-0.4%
Virginia Beach-Norfolk-Newport News, VA-NC MSA	15	238,255	-4.4%	-5.2%	-5.6%	44	290,913	-3.6%	-3.2%	-2.8%	59	529,167	-4.0%	-4.3%	-4.2%
Guangzhou	15	858,303	-10.1%	-9.4%	-5.6%						15	858,303	-10.1%	-9.4%	-5.6%
Detroit-Warren-Livonia, MI MSA	15	332,350	-2.5%	-0.5%	-4.4%	57	358,466	-4.1%	-0.7%	-4.3%	72	690,816	-3.2%	-0.6%	-4.3%
Suzhou-Wuxi-Changzhou	13	757,024	-4.9%	-3.7%	-4.0%	3	36,517	-11.4%	-8.2%	-14.1%	16	793,541	-5.0%	-3.1%	-4.3%
Shenzhen	14	784,283	-3.0%	-2.8%	-4.8%	7	81,077	-10.8%	11.5%	6.7%	21	865,360	-3.6%	-1.7%	-4.1%
Singapore	13	486,101	-2.1%	-9.4%	-2.7%	4	50,839	-3.6%	-5.5%	-3.8%	17	536,940	-2.2%	-8.5%	-2.8%
San Jose-Sunnyvale-Santa Clara, CA MSA	13	263,829	-6.0%	-3.0%	-6.2%	22	167,658	1.1%	4.8%	1.5%	35	431,488	-3.7%	-0.5%	-3.7%
Hong Kong	13	563,740	-11.8%	8.1%	-6.8%	6	85,319	-1.2%	14.6%	-1.4%	19	649,059	-10.8%	8.7%	-6.3%
Chengdu	13	856,816	-12.9%	-7.6%	-6.1%	6	71,757	-6.0%	-8.3%	-7.2%	19	928,573	-12.4%	-7.6%	-6.2%
Delhi	13	530,338	-10.5%	-8.9%	-5.9%	5	50,831	2.6%	2.1%	4.6%	18	581,169	-8.9%	-7.0%	-0.3%
Raleigh-Cary, NC MSA	12	174,976	-3.6%	-5.9%	-3.4%	33	223,203	-3.7%	-4.5%	-3.8%	45	398,179	-3.7%	-5.0%	-3.6%
Salt Lake City, UT MSA	13	240,330	-0.3%	2.0%	0.1%	29	204,831	-6.3%	-5.3%	-7.7%	42	445,161	-2.5%	-0.4%	-2.7%
Indianapolis-Carmel, IN MSA	12	216,251	-1.1%	-1.6%	-0.6%	46	289,535	-5.9%	-8.2%	-7.8%	58	505,786	-3.5%	-4.5%	-4.0%
Jacksonville, FL MSA	14	330,008	0.8%	3.8%	0.7%	42	241,864	-0.5%	2.4%	0.6%	56	571,872	0.4%	3.1%	0.7%
Tokyo	11	476,288	-23.8%	-1.0%	-2.5%						11	476,288	-23.8%	-1.0%	-2.5%
Milwaukee-Waukesha-West Allis, WI MSA	11	178,832	-1.8%	-2.4%	-1.2%	24	149,530	2.1%	3.3%	1.9%	35	328,362	-0.3%	0.0%	-0.1%
Amsterdam	12	239,058	-3.3%	-2.2%	-2.4%	5	48,676	-4.3%	-18.5%	-11.0%	17	287,734	-3.4%	-5.5%	-3.5%
Vancouver	10	178,598	-4.8%	8.1%	5.7%	7	48,519	-9.6%	-4.4%	-6.2%	17	227,117	-5.4%	5.9%	3.6%
Sacramento-Arden-Arcade-Roseville, CA MSA	10	202,561	-1.6%	0.3%	-2.1%	33	206,329	-2.8%	-0.7%	-1.8%	43	408,890	-2.2%	-0.3%	-2.0%
Pittsburgh, PA MSA	10	161,753	-2.2%	0.5%	-0.2%	65	401,246	-4.8%	-4.7%	-4.8%	75	562,998	-3.9%	-2.8%	-3.1%
Mexico City	10	276,750	0.1%	-1.5%	-1.9%	4	40,963	3.7%	-4.2%	1.1%	14	317,712	0.4%	-2.2%	-1.7%
Louisville/Jefferson County, KY-IN MSA	10	234,337	1.4%	-4.8%	1.1%	27	168,453	-5.3%	-3.2%	-4.0%	37	402,790	-1.1%	-3.1%	-0.7%

APPENDIX 8: Year-over-year overall average change by selected country for water, 2018-2019

Country	FULL SERVICE				LIMITED SERVICE				ALL			
	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9
United States	1,423	36,006,629	-3.8%	-4.0%	4,487	28,620,501	-3.5%	-3.6%	5,910	64,627,130	-3.7%	-3.8%
China	273	15,189,189	-2.6%	-2.7%	75	1,133,097	-1.0%	-0.6%	348	16,322,287	-2.6%	-2.6%
United Kingdom	207	2,851,657	-2.3%	-2.9%	117	843,629	-2.2%	-1.4%	324	3,695,286	-2.4%	-2.7%
Canada	98	1,696,883	-2.8%	-4.2%	134	976,132	0.8%	-0.6%	232	2,673,015	-1.8%	-3.1%
Mexico	61	1,364,825	-1.2%	-2.6%	75	788,431	1.3%	0.8%	136	2,153,256	-0.8%	-1.8%
India	52	1,503,418	-5.6%	-0.9%	10	138,282	-12.7%	-4.7%	62	1,641,700	-6.3%	-1.1%
Germany	50	1,108,527	-0.9%	1.4%	23	148,284	-2.3%	-0.6%	73	1,256,811	-1.0%	1.2%
France	44	672,177	-8.5%	-8.4%	12	49,460	6.3%	3.8%	56	721,637	-7.2%	-7.4%
Turkey	41	1,298,686	-0.6%	4.3%	22	209,838	0.6%	1.6%	63	1,508,524	0.0%	3.9%
Japan	45	1,733,477	-3.6%	-4.3%	1	17,600	3.6%	3.8%	46	1,751,077	-3.5%	-4.2%
Australia	35	949,505	-3.0%	-5.3%	2	14,522	8.6%	10.1%	37	964,027	-2.9%	-5.1%
United Arab Emirates	40	2,461,133	-2.6%	-1.9%	8	151,597	-6.6%	-6.2%	48	2,612,729	-2.7%	-2.1%
Italy	24	399,644	-7.8%	-5.1%	9	67,550	-8.9%	-2.5%	33	467,194	-8.3%	-4.8%
Saudi Arabia	22	1,337,019	1.4%	7.1%	3	36,609	9.9%	15.9%	25	1,373,628	1.7%	7.3%
Russian Federation	21	527,843	-4.1%	-1.6%	15	150,134	-6.4%	-0.3%	36	677,976	-5.0%	-1.3%
Thailand	27	1,188,682	-3.1%	-1.9%	7	96,908	8.0%	8.0%	34	1,285,589	-2.4%	-1.4%
Spain	20	370,591	-2.0%	1.0%	15	165,427	5.5%	9.6%	35	536,018	-1.2%	2.1%
Singapore	17	567,471	-4.2%	2.0%	3	39,056	-15.7%	-14.5%	20	606,528	-4.7%	0.8%
Netherlands	16	263,856	-1.7%	-2.3%	10	83,426	-2.9%	-0.2%	26	347,283	-2.4%	-1.8%
Switzerland	13	204,362	-1.3%	-1.7%	5	32,708	-10.8%	-7.9%	18	237,070	-2.7%	-2.5%
Colombia	13	256,543	2.0%	2.6%	13	90,601	-2.2%	-0.3%	26	347,143	1.0%	2.1%
Egypt	21	1,510,209	-3.3%	2.8%	1	14,204	-8.9%	-0.2%	22	1,524,413	-3.4%	2.7%
Hong Kong, China	12	512,739	8.9%	-6.6%	8	109,217	7.1%	-6.4%	20	621,956	8.3%	-6.6%
Indonesia	14	584,368	-0.6%	5.4%	5	64,824	9.6%	16.6%	19	649,192	0.0%	6.1%
Malaysia	13	555,967	-1.5%	0.7%	2	33,983	1.4%	9.7%	15	589,949	-1.7%	1.1%
Poland	11	210,470	-3.1%	2.3%	13	78,634	3.3%	5.8%	24	289,104	-0.9%	3.4%
Korea	14	811,808	-2.9%	1.6%	2	42,572	-6.6%	11.3%	16	854,379	-3.7%	2.0%
New Zealand	11	147,645	-2.9%	-3.2%					11	147,645	-2.9%	-3.2%
Belgium	9	226,932	-6.5%	-4.0%	7	53,098	1.3%	4.8%	16	280,030	-5.0%	-2.2%
Brazil	9	357,879	-2.5%	7.6%	1	25,000	-42.3%	-39.2%	10	382,879	-4.1%	5.5%
Portugal	10	284,204	-1.8%	0.4%	5	25,073	2.7%	4.1%	15	309,277	-1.3%	0.8%
Qatar	9	515,991	-9.6%	0.1%					9	515,991	-9.6%	0.1%
Austria	8	200,851	4.5%	-0.3%	1	9,312	-6.2%	-10.5%	9	210,162	4.1%	-0.7%
Vietnam	9	380,482	-0.6%	-2.3%	1	5,240	-6.8%	-0.7%	10	385,723	-0.8%	-2.3%
ALL	2,916	84,539,633	-2.9%	-2.8%	5,147	34,737,390	-3.1%	-3.0%	8,063	119,277,024	-3.0%	-2.8%

APPENDIX 9: Year-over-year overall average change by selected metro area for water, 2018-2019

Metro Area	FULL SERVICE				LIMITED SERVICE				ALL			
	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9	Count	SqM	Measure 8	Measure 9
London, UK	77	1,284,936	-2.8%	-3.5%	23	172,588	-8.2%	-7.7%	100	1,457,524	-3.4%	-3.4%
Los Angeles-Long Beach-Santa Ana, CA MSA	79	1,994,709	-5.1%	-4.4%	83	616,720	-6.8%	-7.1%	162	2,611,429	-5.5%	-5.5%
Washington-Arlington-Alexandria, DC-VA-MD-WV MSA	62	1,737,745	-4.4%	-4.0%	99	829,967	-6.9%	-6.9%	161	2,567,712	-5.2%	-5.2%
New York-Northern New Jersey-Long Island, NY-NJ-PA MSA	54	1,604,815	-7.7%	-8.7%	107	839,727	-3.3%	-4.2%	161	2,444,541	-6.2%	-6.2%
Chicago-Naperville-Joliet, IL-IN-WI MSA	46	1,469,605	-0.7%	-2.7%	89	639,011	0.2%	0.8%	135	2,108,616	-0.7%	-0.7%
Dallas-Fort Worth-Arlington, TX MSA	40	962,608	-7.6%	-8.4%	128	881,721	-6.3%	-6.8%	168	1,844,330	-7.0%	-7.0%
Atlanta-Sandy Springs-Marietta, GA MSA	39	1,118,084	-1.8%	-0.5%	101	703,807	-2.4%	-4.9%	140	1,821,891	-1.8%	-1.8%
Shanghai	38	2,078,051	-1.8%	-3.7%	15	220,828	-2.2%	-0.4%	53	2,298,879	-2.3%	-2.3%
Houston-Sugar Land-Baytown, TX MSA	36	912,300	-4.1%	-4.4%	76	498,917	-6.9%	-7.1%	112	1,411,217	-5.0%	-5.0%
Miami-Fort Lauderdale-Pompano Beach, FL MSA	35	1,074,697	-3.7%	-5.0%	68	500,746	-4.4%	-5.3%	103	1,575,444	-4.0%	-4.0%
Orlando-Kissimmee, FL MSA	30	1,253,718	-4.4%	-7.0%	45	304,827	-2.6%	-5.3%	75	1,558,545	-4.0%	-4.0%
San Francisco-Oakland-Fremont, CA MSA	27	796,969	-6.5%	-6.2%	40	328,562	-4.3%	-3.5%	67	1,125,531	-5.9%	-5.9%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA	27	539,369	4.6%	3.8%	53	402,329	-0.8%	-0.9%	80	941,698	2.4%	2.4%
Denver-Aurora, CO MSA	27	576,950	-2.5%	-1.5%	61	478,220	1.4%	3.7%	88	1,055,170	-0.8%	-0.8%
Phoenix-Mesa-Scottsdale, AZ MSA	33	703,742	-8.1%	-7.5%	62	434,497	-4.4%	-1.6%	95	1,138,239	-7.4%	-7.4%
Paris	24	408,905	-10.7%	-10.1%	4	18,091	9.3%	4.0%	28	426,996	-9.7%	-9.7%
Dubai-Sharjah-Ajman	25	1,592,306	-1.0%	-0.5%	6	84,231	-8.2%	-7.5%	31	1,676,538	-1.4%	-1.4%
Istanbul	23	864,790	-2.3%	4.4%	7	75,232	-10.4%	-6.1%	30	940,022	-2.8%	-2.8%
Boston-Cambridge-Quincy, MA-NH MSA	23	625,491	3.2%	0.4%	42	318,834	-4.6%	-8.0%	65	944,325	0.7%	0.7%
Seattle-Tacoma-Bellevue, WA MSA	22	513,227	3.8%	2.8%	38	324,347	-7.1%	-7.2%	60	837,574	-0.3%	-0.3%
Toronto	22	493,402	-6.5%	-9.4%	25	202,933	-5.6%	-6.5%	47	696,336	-6.4%	-6.4%
Beijing	23	1,189,445	-1.2%	-1.8%	6	101,892	-3.7%	-2.2%	29	1,291,337	-1.6%	-1.6%
San Diego-Carlsbad-San Marcos, CA MSA	24	621,706	-7.5%	-10.8%	37	327,381	-0.4%	-1.7%	61	949,086	-5.5%	-5.5%
Minneapolis-St. Paul-Bloomington, MN-WI MSA	20	478,787	-0.7%	-2.9%	35	228,630	-2.7%	-4.0%	55	707,417	-1.4%	-1.4%
Austin-Round Rock, TX MSA	20	434,840	-4.9%	-4.6%	59	382,217	-14.4%	-12.5%	79	817,056	-9.3%	-9.3%
San Antonio, TX MSA	20	634,180	-7.5%	-8.4%	54	369,813	-2.8%	-2.5%	74	1,003,994	-6.0%	-6.0%
Singapore	17	567,471	-4.2%	2.0%	3	39,056	-15.7%	-14.5%	20	606,528	-4.7%	-4.7%
Tampa-St. Petersburg-Clearwater, FL	21	481,954	0.5%	1.1%	50	274,276	-4.3%	-4.4%	71	756,229	-1.4%	-1.4%
St. Louis, MO-IL MSA	17	489,481	-5.1%	-5.2%	26	157,552	-10.0%	-8.9%	43	647,033	-6.5%	-6.5%
Portland-Vancouver-Beaverton, OR-WA MSA	17	324,925	-1.2%	-4.9%	26	191,460	-2.8%	-2.6%	43	516,385	-2.0%	-2.0%
Nashville-Davidson-Murfreesboro-Franklin, TN MSA	16	248,936	0.0%	-2.0%	57	432,812	2.3%	0.2%	73	681,748	1.2%	1.2%
Cleveland-Elyria-Mentor, OH MSA	15	308,668	-8.9%	-10.9%	24	151,402	-9.4%	-8.6%	39	460,071	-9.3%	-9.3%
New Orleans-Metairie-Kenner, LA MSA	14	371,805	1.4%	3.1%	19	201,773	-3.0%	-0.7%	33	573,578	0.1%	0.1%
Kansas City, MO-KS MSA	14	336,594	-10.2%	-9.4%	43	307,305	-5.8%	-6.4%	57	643,899	-8.2%	-8.2%
Guangzhou	14	811,386	-4.1%	0.2%					14	811,386	-4.1%	-4.1%
Bangkok	14	748,744	-5.3%	-0.8%	5	72,328	3.9%	7.5%	19	821,072	-4.6%	-4.6%
Chengdu	14	973,605	-3.5%	-2.0%	6	71,757	6.1%	7.3%	20	1,045,362	-2.8%	-2.8%
Charlotte-Gastonia-Concord, NC-SC MSA	15	240,525	-4.1%	-1.9%	44	307,584	-1.7%	-3.1%	59	548,110	-2.5%	-2.5%
Suzhou-Wuxi-Changzhou	13	770,018	-1.2%	-2.8%	2	25,717	-5.7%	-9.3%	15	795,735	-1.1%	-1.1%
Virginia Beach-Norfolk-Newport News, VA-NC MSA	12	203,500	0.2%	-2.1%	40	270,866	-2.8%	-2.9%	52	474,366	-1.7%	-1.7%
Hong Kong	12	512,739	8.9%	-6.6%	8	109,217	7.1%	-6.4%	20	621,956	8.3%	8.3%
Detroit-Warren-Livonia, MI MSA	12	197,248	-0.8%	-6.5%	39	243,217	-0.7%	-3.1%	51	440,465	-1.1%	-1.1%
Amsterdam	13	242,458	3.0%	2.8%	7	63,743	-1.4%	5.1%	20	306,201	1.4%	1.4%
Columbus, OH MSA	12	171,778	-4.8%	-1.5%	28	174,342	0.5%	2.3%	40	346,120	-2.1%	-2.1%
Tokyo	11	476,288	-1.9%	-3.4%					11	476,288	-1.9%	-1.9%
Shenzhen	11	675,010	-0.1%	-2.7%	8	96,161	-2.6%	-5.8%	19	771,171	-0.1%	-0.1%
Riverside-San Bernardino-Ontario, CA MSA	15	385,125	1.7%	3.3%	29	181,236	-4.5%	-6.0%	44	566,361	0.6%	0.6%
San Jose-Sunnyvale-Santa Clara, CA MSA	11	235,700	-9.2%	-12.2%	20	143,808	-3.8%	-6.6%	31	379,508	-6.9%	-6.9%
Jacksonville, FL MSA	11	246,483	-9.6%	-11.9%	38	211,130	0.1%	-1.0%	49	457,613	-5.7%	-5.7%
Mexico City	11	269,259	1.1%	-0.1%	3	30,602	-6.3%	0.5%	14	299,860	0.2%	0.2%
Berlin	11	296,932	-1.2%	2.6%	5	38,445	-0.3%	1.5%	16	335,377	-0.9%	-0.9%
Delhi	11	438,233	-10.5%	-3.4%	4	34,508	3.3%	8.6%	15	472,741	-9.0%	-9.0%
Vancouver	10	178,598	-2.3%	-4.6%	6	35,048	19.9%	18.4%	16	213,646	1.4%	1.4%
Moscow	10	290,170	-4.0%	-2.5%	3	36,963	-3.3%	1.9%	13	327,133	-4.2%	-4.2%
Indianapolis-Carmel, IN MSA	10	177,957	-0.4%	1.4%	35	230,169	-10.9%	-10.5%	45	408,126	-6.4%	-6.4%
Memphis, TN-AR-MS MSA	10	150,774	2.5%	-0.8%	17	104,723	8.6%	6.6%	27	255,497	4.6%	4.6%
Cincinnati-Middletown, OH-KY-IN MSA	10	143,823	4.8%	11.3%	34	204,903	-1.5%	-1.9%	44	348,726	1.6%	1.6%
Cairo	10	996,670	-0.1%	5.9%	1	14,204	-8.9%	-0.2%	11	1,010,874	-0.3%	-0.3%

APPENDIX 10: Greenhouse gas emission factors applied for measures 1, 2, 3, 4, And 7

	Australia	Canada	China (including Macau)	Taiwan	Hong Kong	United Kingdom	United States, Puerto Rico, other US Territories	All Other Countries and Territories
Purchased Electricity	National Greenhouse Accounts Factors July 2019	National Inventory Report 1990-2017 (Submitted April 2019)	International Energy Agency CO2 Emissions from Fuel Combustion 2019	International Energy Agency CO2 Emissions from Fuel Combustion 2019	International Energy Agency CO2 Emissions from Fuel Combustion 2019	UK Government GHG Conversion Factors for Company Reporting 2019	EPA eGRID 2016 (updated February 15, 2018)	International Energy Agency CO2 Emissions from Fuel Combustion 2019
Natural Gas	National Greenhouse Accounts Factors July 2019	2016 Climate Registry - Default Emissions Factors April 2016	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	UK Government GHG Conversion Factors for Company Reporting 2019	EPA Emission Factors for GHG Inventories March 2018	WRI Stationary Combustion Tool V4.1
Butane, Propane	National Greenhouse Accounts Factors July 2019	2016 Climate Registry - Default Emissions Factors April 2016	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	EPA Emission Factors for GHG Inventories March 2018	WRI Stationary Combustion Tool V4.1
Liquefied Petroleum Gas (LPG)	National Greenhouse Accounts Factors July 2019	2016 Climate Registry - Default Emissions Factors April 2016	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	Hong Kong Carbon Accounting guidelines. Table 1.1 - 1.3 (revised 2010)	UK Government GHG Conversion Factors for Company Reporting 2019	EPA Emission Factors for GHG Inventories March 2018	WRI Stationary Combustion Tool V4.1
Liquefied Natural Gas (LNG)	National Greenhouse Accounts Factors July 2019	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	UK Government GHG Conversion Factors for Company Reporting 2019	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1
Compressed Natural Gas (CNG)	National Greenhouse Accounts Factors July 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019
Stationary Gasoline/ Petrol	National Greenhouse Accounts Factors July 2019	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	UK Government GHG Conversion Factors for Company Reporting 2019	EPA Emission Factors for GHG Inventories March 2018	WRI Stationary Combustion Tool V4.1

	Australia	Canada	China (including Macau)	Taiwan	Hong Kong	United Kingdom	United States, Puerto Rico, other US Territories	All Other Countries and Territories
Stationary Diesel, Fuel Oil #1-#6	National Greenhouse Accounts Factors July 2019	2016 Climate Registry - Default Emissions Factors April 2016	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	Hong Kong Carbon Accounting guidelines. Table 1.1 - 1.3 (revised 2010)	UK Government GHG Conversion Factors for Company Reporting 2019	EPA Emission Factors for GHG Inventories March 2018	WRI Stationary Combustion Tool V4.1
City Gas / Towngas	National Greenhouse Accounts Factors July 2019	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)	WRI Stationary Combustion Tool V4.1 (Natural Gas as a proxy)
Biomass	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)
Charcoal	National Greenhouse Accounts Factors July 2019	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)	WRI Stationary Combustion Tool V4.1 (CH4 and N2O Only)
Kerosene	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1	WRI Stationary Combustion Tool V4.1
Ethanol	National Greenhouse Accounts Factors July 2019	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)	EPA Emission Factors for GHG Inventories March 2018 (CH4 and N2O Emissions only)
Purchased Steam, Heat, and Hot Water	UK Government GHG Conversion Factors for Company Reporting 2019	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, August 2017	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	UK Government GHG Conversion Factors for Company Reporting 2019	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, August 2017	UK Government GHG Conversion Factors for Company Reporting 2017 v02
Purchased Chilled Water	US EIA form 1605 (2010). Appendix N	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, August 2017	US EIA form 1605 (2010). Appendix N	US EIA form 1605 (2010). Appendix N	US EIA form 1605 (2010). Appendix N	US EIA form 1605 (2010). Appendix N	US Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions, August 2017	US EIA form 1605 (2010). Appendix N

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