Methodology Paper – Green Stay Initiative

HRS Green Stay Initiative

HRS developed the Green Stay Initiative at the request of global corporates who require transparent sustainability data to ensure they progress towards reaching their own internal climate goals, as well as complying to new government laws and regulations. Based on the Sustainable Hospitality Alliance's methodologies "Hotel Carbon Measurement Initiative", "Hotel Water Measurement Initiative" and "Hotel Waste Calculation Methodology", Green Stay facilitates the reporting of carbon, water and waste metrics by thousands of hotels globally following principles of the Greenhouse Gas Protocol.

This enables large corporate customers, responsible for booking millions of room nights every year, to have hotels emissions data at hand for procurement and reporting purposes. When it comes to reporting, the new Corporate Sustainability Reporting Directive and European Sustainability Reporting Standards will require large companies in the European Union to disclose more information on their Scope 3 emissions, which include business travel (air, hotel, rail and car). HRS' Green Stay Initiative supports companies to comply with these new regulations, specifically on the ESRS Disclosure Requirements E1-6 – Gross Scopes 1, 2, 3 and Total GHG emissions within AR48 (Scope 3).

Green Stay Assessment: Scope 1, 2 and 3 requirements and boundaries

Green Stay enables hotel suppliers to assess their environmental impact through a footprint assessment in a proprietary audit platform. The process is fully digital and enables hotels to complete the assessment by reporting on the following elements:

General Inputs
- Report year and location
- Total area of guest rooms, corridors and meeting spaces
- Total number of guest rooms
- Total count of occupied guest rooms in report year

Scope 1 & 2
- Total Electricity consumption (in kilowatt-hours)
- Electricity carbon emission (in grams per kWh). When provided, market-based calculation is used
- Total Gas consumption (in kilowatt-hours)
- Total Oil consumption (in liters)
- Total district heating consumption (in kilowatt-hours)
- District heating carbon emission (in grams per kWh)
- Renewable energy is consumed or generated
- Set boundaries when there are private areas not accessible to guests
- Report gas leak or major maintenance on AC systems in reporting year
- Fuel used by company vehicles (e.g. shuttle bus, site car, landscaping equipment)

Scope 3
- Laundry is outsourced to a contractor (use of energy and water)

The footprint metrics fulfill the following criteria and boundaries:

- Values represent all activities within the premises related to the accommodation of hotel guests or the hosting of meetings or events respectively, where those are not associated with dedicated service charges or operated by third-parties (i.e. direct building uses and ancillary activities including restaurants, laundry, meeting spaces, shops, golf courses, spas, gardens, gyms).
- Footprint values do not include footprints from private spaces (e.g. hairdressers, private apartments).
- Footprint values include footprints from laundry services provided within the establishment or outsourced to a supplier. When outsourced, estimations are used based on laundry tonnage to calculate the total energy, gas and fuel/oil used following the Hotel Carbon Measurement Initiative.
- Carbon footprint values represent emissions according to the Greenhouse Gas Protocol and the scopes 1 and 2 as specified therein.
- Scope 3 emissions of hotels are considered only when laundry is outsourced.
- Carbon footprint values are calculated using the location-based or market-based method as specified in the GHG Protocol and with emission factors relating to the given report year.
- Emission factors are collected from sources such as IPPC, Association of Issuing Bodies (AIB), governmental agencies (e.g. US EPA), DEFRA UK, Climate Transparency, Our World in Data, World Resources Institute, The Climate Registry, UN Framework Convention on Climate Change, among others.
- Carbon footprint values include emissions from mobile fuels used at the establishment (e.g. landscaping equipment, shuttle services, site cars) when applicable.
- Carbon footprint values include fugitive emissions (e.g. leaked refrigerants) when applicable.
- Carbon footprint values represent all emissions before offsetting and therefore do not include any carbon credits.
- Carbon footprint values represent emissions only related to a guest stay (per occupied room) and not the complete Corporate Carbon Footprint of a hotel.
- All input data that was used to derive the footprint values is archived in order to serve any later verification.

Based on the information provided by the hotel supplier in the Hotel Assessment, Green Stay calculates the following footprint metrics:

1. Kilogram of carbon equivalent per occupied room night
2. Kilogram of carbon equivalent per square meter of meeting space per hour
3. Liters of water per occupied room night
4. Liters of water per square meter of meeting space per hour
5. Kilogram of solid waste sent into landfilling per occupied room night
6. Kilogram of solid waste sent into landfilling per square meter of meeting space per hour

Greenhouse Gases Groups Covered by the Green Stay Initiative

The Green Stay Initiative considers different groups of greenhouse gases (GHGs) in its methodology. These gases are categorized based on their sources and their contributions to the hotel's overall carbon footprint.

Greenhouse Gas	Scope	Source
Carbon dioxide (CO2)	1, 2 & 3	Electricity, mobile fuels, gas (heating), oil and outsourced laundry
Chlorodifluoromethane (HCFC-22/R22)	1	Refrigerants and Fugitive Gases (HVAC)
Pentafluoroethane (HFC-125)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,2,2-Tetrafluoroethane (HFC-134)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,1,2-Tetrafluoroethane (HFC-134a)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,2-Trifluoroethane (HFC-143)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,1-Trifluoroethane (HFC-143a)	1	Refrigerants and Fugitive Gases (HVAC)
1,1-Difluoroethane (HFC-152a)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,1,2,3,3,3-Heptafluoropropane (HFC-227ea)	1	Refrigerants and Fugitive Gases (HVAC)
Hydrofluorocarbon (HFC-23)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,1,3,3,3-Hexafluoropropane (HFC-236fa)	1	Refrigerants and Fugitive Gases (HVAC)
1,1,1,3,3-Pentafluoropropane (HFC-245fa)	1	Refrigerants and Fugitive Gases (HVAC)
Difluoromethane (HFC-32)	1	Refrigerants and Fugitive Gases (HVAC)
Methyl Fluoride (HFC-41)	1	Refrigerants and Fugitive Gases (HVAC)
Hydrofluorocarbon (HFC-43-I0mee)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluorobutane (PFC-3-1-10)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluorocyclobutane (PFC-318)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluoroethane (PFC-116)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluorohexane (PFC-5-1-14)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluoromethane (PFC-14)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluoropentane (PFC-4-1-12)	1	Refrigerants and Fugitive Gases (HVAC)
Perfluoropropane (PFC-218)	1	Refrigerants and Fugitive Gases (HVAC)

	1	Refrigerants and Fugitive Gases (HVAC)
R-404A	1	Refrigerants and Fugitive Gases (HVAC)
R-410A	1	Refrigerants and Fugitive Gases (HVAC)
Sulphur hexafluoride (SF6)	1	Refrigerants and Fugitive Gases (HVAC)

Biogenic Emissions covered by the Green Stay Initiative

Biogenic emissions refer to carbon in wood, paper, grass trimmings, and other biofuels that was originally removed from the atmosphere by photosynthesis and, under natural conditions, would eventually cycle back to the atmosphere as CO2 due to degradation processes. Following the GHG Protocol guidelines, Green Stay separates out biogenic emissions, which means they are not added to the net greenhouse gas footprint, but provided separately in reports as a best practice for completeness and transparency. Below is a list of relevant biogenic emissions considered in the assessment:

Activity	Fuel	Unit	Source
Biofuel	Bioethanol	litres	Mobile Fuel
	Biodiesel ME	litres	Mobile Fuel
	Biomethane	kg	Mobile Fuel
	Biodiesel ME (from used cooking oil)	litres	Mobile Fuel
	Biodiesel ME (from tallow)	litres	Mobile Fuel
	Biodiesel HVO	litres	Mobile Fuel
	Biopropane	litres	Mobile Fuel
	Bio Petrol	litres	Mobile Fuel
	Renewable petrol	litres	Mobile Fuel
Biomass	Wood logs	tonnes	Heating
		kWh	Heating
	Wood chips	tonnes	Heating
		kWh	Heating
	Wood pellets	tonnes	Heating
		kWh	Heating
	Grass/straw	tonnes	Heating
		kWh	Heating
Biogas	Biogas	tonnes	Heating
		kWh	Heating
	Landfill gas	tonnes	Heating
		kWh	Heating

Anomaly Detection

The Anomaly Detection in GSI automatically challenges the inputs made by hotel suppliers and flags anomalies per data input or calculated output metric achieved. The Anomaly Detection renders dynamically on the third order standard deviation from the mean value when the similarity cluster has at least 10 valid data sets available, or on static global bandwidths per unit otherwise. When a Hotel Assessment has flagged anomalies, the hotel supplier is informed on the submission of the data in real time and required to correct the data in order to correct the anomalies. Until the anomalies have been resolved, the Hotel Assessment is not further processed in GSI.

Data Quality Score

The Data Quality Score (DQS) is a composite metric ranging from 0 to 1, calculated by combining various confidence factors associated with the reliability of reported data by the hotels based on the following criteria:

1. **Report Year**: The confidence in the data decreases linearly for each year prior to the latest report year (e.g. 2023).

- Formula: Confidence (report year) = $1 - 0.1 \times (2023 - year)$
- Example: For 2022, the confidence is 0.9; for 2021, it is 0.8, and so on.

2. **Emission Factor**: hotels can report electricity consumption using location-based by only adding the total consumption in kilowatt-hours for a year or the market-based by adding the electricity carbon emission in grams per kWh.

- Location-based method: calculates emissions based on the average carbon intensity of the electricity grid in the specific location where the energy consumption occurs. Location-based factors provide a generalized estimate, which may not accurately reflect specific energy procurement strategies. The reliance on average data reduces the confidence in precision. If a hotel uses electricity from a grid with an average emission factor, the total emissions are calculated based on this average. Therefore, the Confidence Factor is **0.8**
- Market-based method: This method calculates emissions based on the specific energy sources that a company contracts for or purchases, such as through renewable energy certificates (RECs) or direct contracts with renewable energy providers. Market-based factors reflect deliberate choices and specific energy procurement strategies, providing a more accurate and tailored representation of a hotel's emissions. This specificity increases confidence in the accuracy of the data to **1.0**.

3. **Green Stay Level**:

- Professional level: this level requires an external verification, which renders a Confidence Factor of **1.0**
- Advanced level: since this level does not require an external verification, the Confidence Factor is **0.8**

4. **Anomaly Detection**: if an anomaly is detected, the confidence factor is automatically set to **0**.

The final DQS is the product of all individual confidence factors. For example:

- **Assessment A**: Report Year 2023, emission method market-based, and Professional level
  DQS = 1 x 1 x 1 = **1**
- **Assessment B**: Report Year 2021, emission method location-based, and Advanced level
  DQS = (1 − 0.1 × (2023−2021)) × 0.8 × 0.8 = **0.512**

Additionally, "data_quality_flags" are used to indicate why a hotel's data quality score is less than 1. For example:

- data_quality_flags: ["location_based_method"], ["data_not_latest"].

Benchmarking

Different local circumstances need to be considered when aiming to benchmark footprint metrics of hotel suppliers. For example, renewable or sustainable forms of energy might be easily accessible at reasonable cost for hotels in Norway or France, while hotels in Poland may largely depend on an energy mix in the accessible grid that is based on fossil energy sources. Consequently, a hotel's carbon footprint in Poland can be 10 times larger than another in France, while the carbon emissions for both can be deemed low in comparison to other hotels in the same locations.

To overcome this, the carbon, water and waste metrics resulting from the Hotel Assessment are benchmarked based on a quartile distribution analysis (standard statistical function; no proprietary algorithm) among all available metrics within the destination of the hotel. The footprint figures in the categories of energy, water and waste are each associated with an efficiency class A, B, C or D related to the country or territory provided within the report, each representing a 25th percentile of the total distribution in the destination. GSI Locations represent whole countries with the exceptions of Australia, Canada, China, Russia and the USA, where the GSI Locations represent states or administrative regions respectively.

Given the efficiency classes are based on all report submissions at a given time, they may change over time with new reports being submitted for other lodging facilities in the same country or territory.

Scientific Backfilling to Calculate Footprint Estimates

As hotel suppliers embark on their sustainability journey differently, it is necessary to populate gaps in the availability of actual Footprint Metrics. GSI therefore entails a Backfilling Mechanism based on a backfilling algorithm that calculates virtual Footprint Metrics for each hotel supplier where actual data has not been provided through the means of the Hotel Assessment yet. The backfilling algorithm calculates those figures from averages calculated on a sample of actual Hotel Assessments provided.

The sample selection for the backfilling algorithm is achieved along three location scope levels and four peer scope levels:

- Location 0:
 Same city in the same country.

- Location 1:
  Geographically closest city in the same country.
- Location 2:
  Geographically closest city regardless of the country.

The lowest available location scope is used for a property under backfilling.

- Scope 1:
  Same hotel star category and availability of a wellness facility and restaurant.
- Scope 2:
  Hotel star category and availability of a wellness facility or restaurant together not deviating by more than 2.
- Scope 3:
  Closest quartile of peers in having the least distance in the hotel star category or availability of a wellness facility or restaurant, ignoring the location scope.

For each property to backfill, the GSI system selects the closest matching combination of location and peer scope.

Example display of CO_2 footprint on Procurement Platform with Backfilled Data:
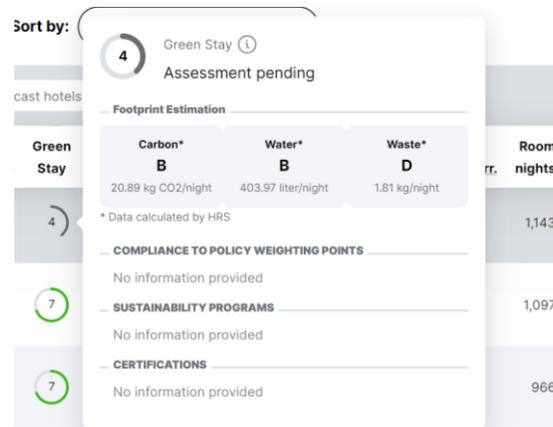
The confidence factor determines the sample size available under the scope selection in comparison to the average size of records available in each emission location in percent.

The backfilling algorithm updates the backfill dataset daily and based on the latest available actual Hotel Assessments.

Error function analysis on the backfilling algorithm against the actual record data set has shown an average error of 6% with a standard deviation (level 1) of 3 percentage points. In an outlook the algorithm will be evolved with machine learning techniques, once higher data coverage is achieved.