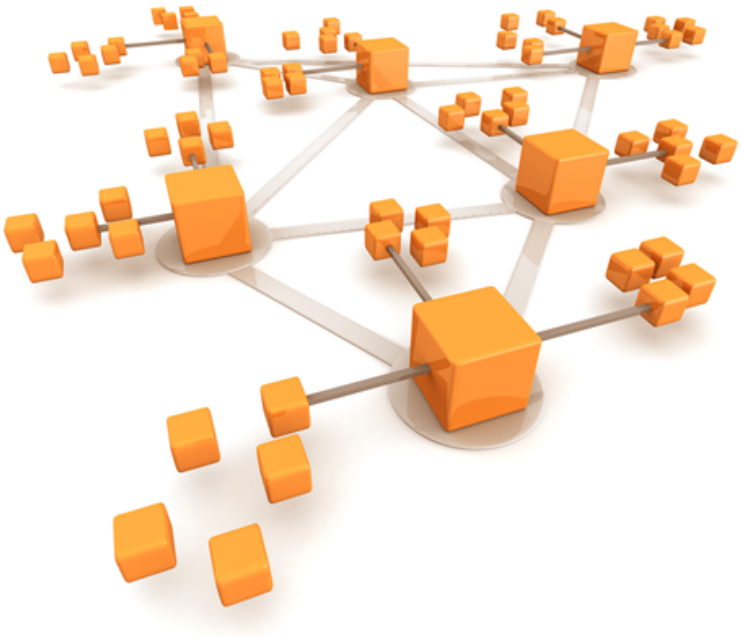

Environmental Impacts of Home Sharing: Phase 1 Report

April 30, 2014

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Project Overview

In 2014, Airbnb engaged Cleantech Group to conduct an initial, high-level analysis of how the environmental impact of stays at Airbnb properties compare to that of stays at hotels. The study was conducted to understand Airbnb's environmental impact in cities and communities around the world.

Scope of analysis

As part of this initial study, Cleantech Group reviewed the following five impact areas associated with Airbnb properties and hotels:

1. Energy and greenhouse gas impacts
2. Water impacts
3. Waste impacts
4. Chemical impacts
5. Induced travel impacts

Geographies

The study primarily analyzed impacts in North America (Canada & the U.S.) and the European Union. These two regions represent the vast majority of Airbnb guest-nights in 2013.

While other regions were qualitatively reviewed, they have been excluded from this report due primarily to lack of availability, quality, and comparability of aggregate data across regions outside of North America and the EU.

All findings are based on an analysis of public sources and proprietary Airbnb data, including survey responses from over 8,000 Airbnb guests and hosts. For additional data on methodology, assumptions and sources please see the Appendix.

Project Findings

This initial analysis indicates that the environmental impact of stays at Airbnb properties is significantly lower than that of stays at hotels across the impact categories analyzed. Selected key findings include:

Key Finding #1 – Lower Energy & Greenhouse Gas (GHG) Impact of an Airbnb Guest vs. a Hotel Guest

Per guest-night, an Airbnb guest uses an estimated 63% to 71% less energy than a hotel guest in North America. Per guest-night, CO_2 emissions associated with energy usage are an estimated 61% to 82% lower than for hotel stays. In the EU, the difference is even greater: an Airbnb guest uses 78% to 84% less energy than a hotel guest. Per guest-night, CO_2 emissions associated with energy usage are at least an estimated 88% lower.

Key Finding #2 – Lower Water Impact of an Airbnb Guest vs. a Hotel Guest

Per guest-night, an Airbnb guest uses an estimated 12% to 39% less water than a hotel guest in North America. In the EU, the difference is even greater: an Airbnb guest uses an estimated 48% to 57% less water than a hotel guest.

Key Finding #3 – Lower Waste Generation of an Airbnb Guest vs. a Hotel Guest

Per guest-night, residences in North America generate 32-53% less waste than hotels. 92% of Airbnb guests report that they generate the same or less waste at Airbnb properties than when at their homes, suggesting that Airbnb guests also generate at least 32-53% less waste than hotels, per guest-night. In the EU, residences generate approximately the same amount or up to 28% less waste than hotels. 92% of Airbnb guests in the EU also report they generate the same of less waste at Airbnb properties than when at their homes.

Key Finding #4 – Sustainability Awareness

Initial survey analysis suggests that Airbnb guests and hosts may be more sustainability-aware than typical residents. They report high rates of recycling (89%+ of hosts enable guests to recycle at least one waste category, and 90%+ of guests recycle when available), ownership of efficient appliances (79%+ of hosts own at least one energy efficient appliance), and use of "green" cleaning products (70%+ of hosts use at least "some" green cleaning products).

Key Finding #5– Induced Travel

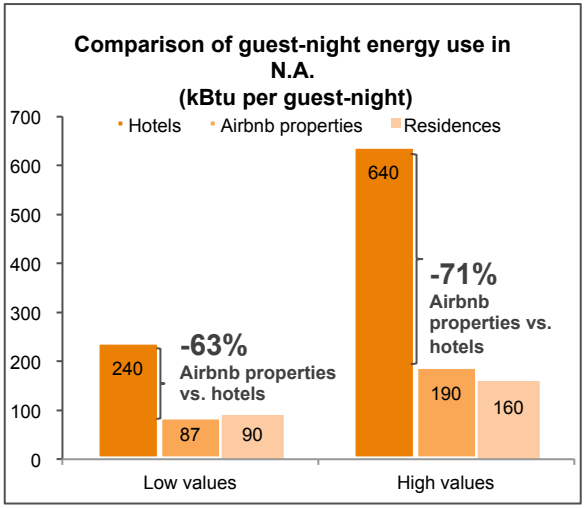
Airbnb induces approximately 1 to 3% of guests to travel, and approximately 20% of guests to extend their trips due to the increased convenience and/or lower cost of Airbnb properties relative to hotels, and possibly other factors. However, the estimated GHG emissions associated with these trips was significantly lower than the estimated total avoided GHG emissions associated with using Airbnb properties instead of hotels in 2013. In other words, the incremental GHG emissions associated with induced travel are very significantly outweighed by the avoided GHG emissions associated with using Airbnb properties instead of hotels.

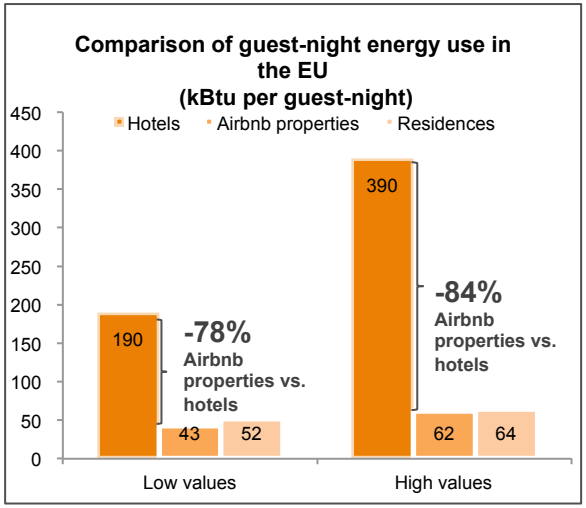
- In North America, guests who decided to travel as a result of Airbnb contributed to up to an estimated 17,000 metric tons CO_2 in 2013 from travel to Airbnb properties. However, the estimated GHG emissions associated with these induced trips were significantly lower than the estimated total avoided GHG emissions associated with staying at an Airbnb property instead of a hotel (at least 160,000 metric tons CO_2 in North America in 2013).
- In the EU, guests who decided to travel as a result of Airbnb contributed to up to an estimated 7,500 metric tons CO_2 in 2013 from travel to Airbnb properties. However, the estimated GHG emissions associated with these induced trips were significantly lower than the estimated total avoided GHG emissions associated with staying at an Airbnb property instead of a hotel (at least 370,000 metric tons CO_2 in the EU in 2013).

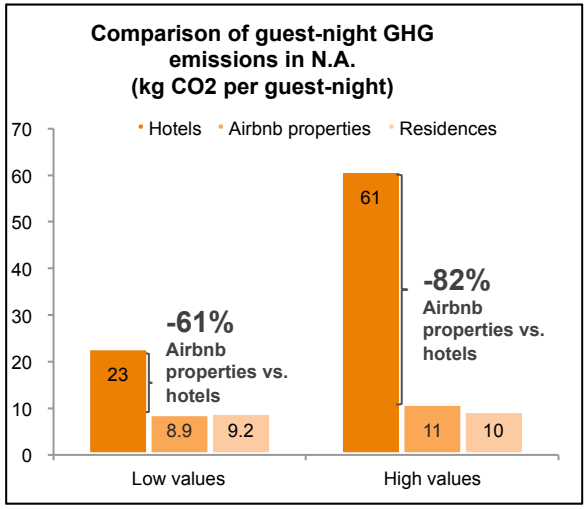
Energy and Greenhouse Gas (GHG) Impacts

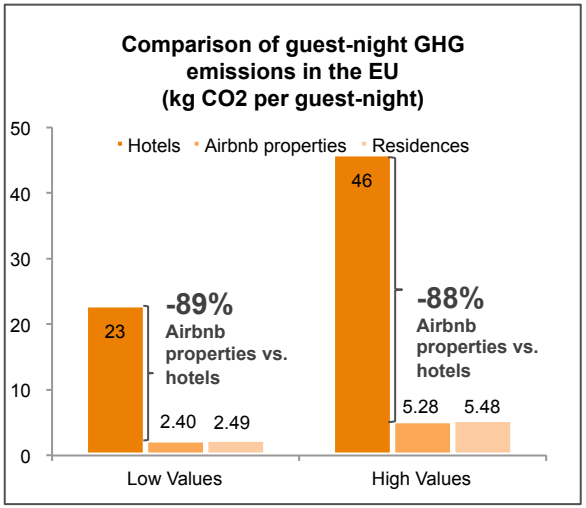
Output	N. America	EU
% reduction in guest-night energy consumption at Airbnb properties compared to hotels	Per guest-night, Airbnb guests use an estimated 63-71%[1, 2] (150-450 kBtu) less energy[3] than hotel guests.	Per guest-night, Airbnb guests use an estimated 78-84%[4] (150-330 kBtu) less energy[4] than hotel guests.
% reduction in guest-night GHG emissions at Airbnb properties compared to hotels	Per guest-night, CO_2 emissions associated with energy usage for Airbnb stays are an estimated 61-82% (14-50 kg CO_2) lower than for hotel stays.	Per guest-night, CO_2 emissions associated with energy usage for Airbnb stays are at least an estimated 88% (20 kg CO_2) lower than for hotel stays.
Lower guest-night energy consumption and GHG emissions in Airbnb properties compared to residences	Per guest-night, Airbnb guests use up to 15% (20 kBtu) more energy per guest-night than residents.[5] Per guest-night CO_2 emissions associated with energy usage at Airbnb properties are also up to 15% (1 kg CO_2) higher than those of residents.[6]	Per guest-night, Airbnb guests use at least 4% (2.4 kBtu) less energy per guest-night than residents. Per guest-night CO_2 emissions associated with energy usage at Airbnb properties are an estimated 4% (0.2 kg CO_2) lower than those of residents.
Additional GHG footprint of having all 2013 Airbnb guest-nights in this region at a hotel; and equivalency to annual emissions from cars	If all Airbnb guests in 2013 had stayed in hotels instead of at Airbnb properties, the additional CO_2 emissions attributed to those guest nights would have been at least an estimated 160,000 metric tons CO_2, equivalent to the annual CO_2 emissions of 33,000 cars on U.S. roads.	If all Airbnb guests in 2013 had stayed in hotels instead of at Airbnb properties, the additional CO_2 emissions attributed to those guest nights would have been at least an estimated 350,000 metric tons CO_2, equivalent to the annual CO_2 emissions of 200,000 cars on EU roads.
% total hosts who have an ENERGY STAR(or similar) appliance	Airbnb properties may outperform other homes on measures of efficiency. 83% of Airbnb hosts report owning at least one Energy Star-qualified appliance at their property, while only 52% of American homes have such an appliance.	Airbnb properties may outperform other homes on measures of efficiency. 79% of Airbnb hosts report owning at least one energy efficient-labeled appliance at their property, while only 77% of EU homes have such an appliance.

[1] Based on a per night increase of 10-25% in energy use due to the Airbnb party. The total amount of this increase was divided among Airbnb guests in the party, in addition to splitting the house baseline. See Assumptions for more details.
[2] Low values for Airbnb calculated based on comparing an efficient U.S. house to a 5th percentile efficient U.S. hotel; high values for Airbnb calculated based on comparing an average U.S. house to a 50th percentile efficient U.S. hotel; low and high values for North American hotels were generated by applying different daily occupancy rates to hotels (58% vs. 73%).
[3] This includes electricity use and associated primary energy in addition to fuel consumed on-site at residences and hotels (e.g. natural gas-fueled water heaters).
[4] Low values for Airbnb are calculated based on comparing a 40th percentile efficient EU home to a representative efficient European hotel chain; high values for Airbnb are calculated based on comparing a 60th percentile efficient EU home to a representative 3rd quartile home.
[5] Range puts Airbnb per guest-night energy consumption between from 15% *higher* to 3% *lower* than residents.
[6] Since Airbnb energy calculations are based on residential data, energy and GHG percentage changes are the same.


Comparison of guest-night energy use in N.A.
(kBtu per guest-night)
Hotels
Airbnb properties
Residences
700
600
500
400
300
200
100
0
240
87
90
640
190
160
-63%
Airbnb properties vs. hotels
-71%
Airbnb properties vs. hotels
Low values
High values


Comparison of guest-night energy use in the EU
(kBtu per guest-night)
Hotels
Airbnb properties
Residences
450
400
350
300
250
200
150
100
50
0
190
43
52
390
62
64
-78%
Airbnb properties vs. hotels
-84%
Airbnb properties vs. hotels
Low values
High values

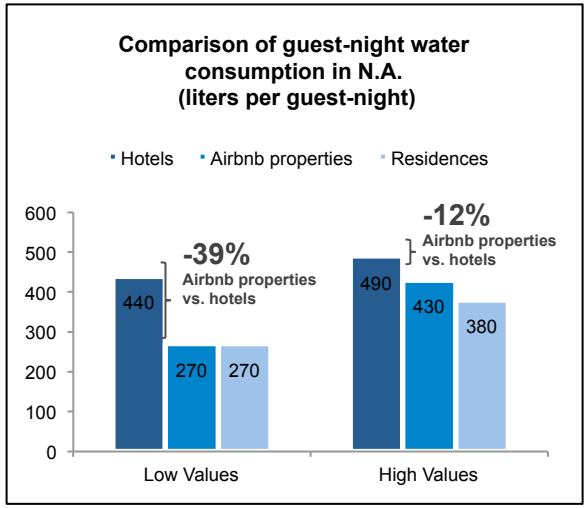

Comparison of guest-night GHG emissions in N.A.
(kg CO2 per guest-night)
Hotels
Airbnb properties
Residences
70
60
50
40
30
20
10
0
23
8.9
9.2
61
11
10
-61%
Airbnb properties vs. hotels
-82%
Airbnb properties vs. hotels
Low values
High values

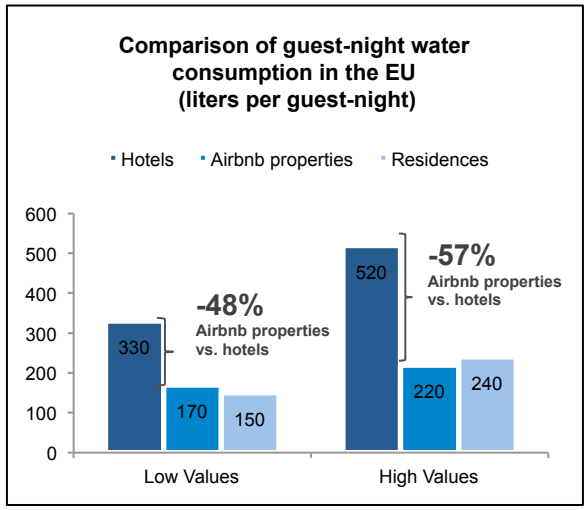

Comparison of guest-night GHG emissions in the EU
(kg CO2 per guest-night)
Hotels
Airbnb properties
Residences
50
40
30
20
10
0
23
2.40
2.49
46
5.28
5.48
-89%
Airbnb properties vs. hotels
-88%
Airbnb properties vs. hotels
Low Values
High Values

Water

Output	N. America	EU
% reduction in guest-night water consumption in Airbnb properties compared to hotels	Per guest-night, Airbnb guests use 12-39%[7] (59-170 liters) less water than hotel guests.[8]	Per guest-night, Airbnb guests use 48-57%[9] (160-290 liters) less water than hotel guests.
% reduction in guest-night water consumption in Airbnb properties compared to residences	Per guest-night, Airbnb guests use up to 15% (58 liters) more water per guest-night than residents.[10]	Per guest-night, Airbnb guests use up to 13% (19 liters) more water per guest-night than residents.[11]
Additional water footprint of having all 2013 Airbnb guest-nights in this region at a hotel; and equivalency to number of Olympic pools	If all Airbnb guests in 2013 had stayed in hotels instead of at Airbnb properties, the additional water use attributed to those guest-nights would have been at least an estimated 670 million liters, equivalent to 270 Olympic swimming pools.	If all Airbnb guests in 2013 had stayed in hotels instead of at Airbnb properties, the additional water use attributed to those guest-nights would have been at least an estimated 2.7 billion liters, equivalent to 1,100 Olympic swimming pools.
Frequency of hosts who wash guest sheets and towels every day	Less than 1% of Airbnb hosts report washing guest sheets and towels every day. This suggests that Airbnb guests use significantly less water and detergent due to laundering practices than hotels that change sheets every day.	Less than 2% of Airbnb hosts report washing guest sheets and towels every day. This suggests that Airbnb guests use significantly less water and detergent due to laundering practices than hotels that change sheets every day.

[7] Low values for Airbnb calculated based on comparing a Canadian home to a representative efficient North American hotel chain; high values for Airbnb calculated based on comparing a U.S. home based on domestic water withdrawals and number of U.S. households and average household size to a representative U.S. hotel chain.
[8] Based on a per night increase of 10-25% in water use due to the Airbnb party. The total amount of this increase was divided among Airbnb guests in the party, in addition to splitting the house baseline. See Assumptions for more details.
[9] Low values for Airbnb calculated based on comparing an EU home to a representative efficient EU-located hotel chain; high values for Airbnb calculated based on comparing an EU home to the average hotel water consumption in Scandinavia.
[10] Range puts the difference in per guest-night water consumption at an Airbnb from 15% *higher* to 3% *lower* than people in residential homes.
[11] Range puts the difference in per guest-night water consumption at an Airbnb from 13% *higher* to 8% *lower* than people in residential homes.


Comparison of guest-night water consumption in N.A. (liters per guest-night)
Hotels
Airbnb properties
Residences
600
500
400
300
200
100
0
440
270
270
490
430
380
-39%
Airbnb properties vs. hotels
-12%
Airbnb properties vs. hotels
Low Values
High Values


Comparison of guest-night water consumption in the EU (liters per guest-night)
Hotels
Airbnb properties
Residences
600
500
400
300
200
100
0
330
170
150
520
220
240
-48%
Airbnb properties vs. hotels
-57%
Airbnb properties vs. hotels
Low Values
High Values

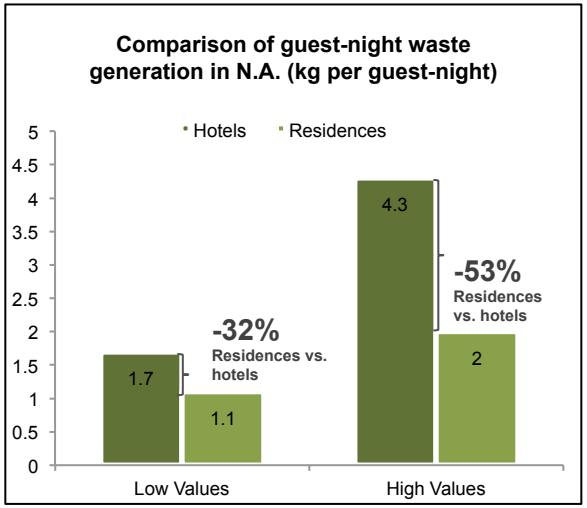
Waste

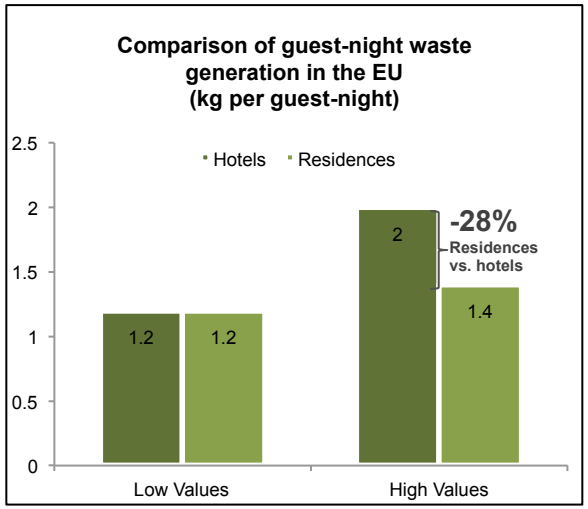
Output #	N. America	EU
% reduction in guest-night waste generation in residences compared to hotels; Percentage of Airbnb guests who report an increase in waste generation during an Airbnb vs. their typical amount	Per guest-night, residences generate 32-53% (0.5-2.3 kg) [12] less waste than hotels. 92% of Airbnb guests report that they generate the same or less waste at an Airbnb property than when at their homes, suggesting that Airbnb guests also generate at least 32-53% less waste than hotels, per guest-night.[13]	Per guest-night, depending on their waste-efficiency, residences generate approximately the same amount or up to 28% (0.56 kg) less waste than hotels. [13,14] 92% of Airbnb guests report that they generate the same or less waste at an Airbnb property than when at their homes, suggesting that the same claim holds true for Airbnb guests relative to hotels, per guest-night.
% Airbnb hosts who recycle; Percentage of Airbnb guests who recycle	95% of Airbnb hosts say they recycle at least one item type at their property. 94% of guests say they recycle when services are available. Hosts cite the lack of recycling services in their area as the biggest barrier to recycling.	89% of Airbnb hosts say they recycle at least one item type at their property. 90% of guests say they recycle when services are available. Hosts cite the lack of recycling services in their area as the biggest barrier to recycling.
% hosts who purchase single-use bar soap, shampoo bottles, or other personal care products for guests; Percentage of hosts who throw away these single-use products after each guest stay	47% of Airbnb hosts purchase single-use bar soap, shampoo products, and personal care products for their guests. 66% of those hosts dispose of these at the end of every visit. In contrast, large hotels typically supply all incoming guests with new, single-use bottles.	42% of Airbnb hosts purchase single-use bar soap, shampoo products, and personal care products for their guests. 49% of those hosts dispose of these at the end of every visit. In contrast, large hotels typically supply all incoming guests with new, single-use bottles.

[12] Low value is based on comparing a Canadian home to a representative efficient North American hotel chain; high value is based on comparing U.S. municipal solid waste per capita to hotels in selected regions of the U.S

[13] Due to lack of data availability, high value for residential waste was based on municipal waste generation per capita (vs. residential sector-specific waste)

[14] Low value is based on comparing municipal solid waste per person in the EU to hotels waste in Germany and Austria.


Comparison of guest-night waste generation in N.A. (kg per guest-night)
Hotels
Residences
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1.7
1.1
4.3
2
-32%
Residences vs. hotels
-53%
Residences vs. hotels
Low Values
High Values


Comparison of guest-night waste generation in the EU (kg per guest-night)
Hotels
Residences
2.5
2
1.5
1
0.5
0
1.2
1.2
2
1.4
-28%
Residences vs. hotels
Low Values
High Values

Chemicals

Output	N. America	EU
% Airbnb hosts who use "green" or "sustainable" certified cleaning products	Most Airbnb hosts (82%) report using at least some cleaning products that are "green" or "sustainable" certified (e.g., EcoLogo, Green Seal Certified, Design for the Environment).[15]	Most Airbnb hosts (72%) report using at least some cleaning products that are "green" or "sustainable" certified (e.g., EcoLogo, Green Seal Certified, Design for the Environment).[15]

[15] Based on survey responses

Induced Travel

Output	N. America	EU
GHG emissions from guests who decided to travel as a result of Airbnb	Guests who decided to travel as a result of Airbnb (and wouldn't have traveled otherwise) contributed to up to an estimated 17,000 metric tons CO_2 in 2013 from travel to Airbnb properties.[16, 17] However, the estimated GHG emissions associated with these induced trips was significantly lower than the estimated avoided GHG emissions associated with stays at an Airbnb property instead of a hotel (at least 160,000 metric tons CO_2 in North America in 2013).	Guests who decided to travel as a result of Airbnb (and wouldn't have traveled otherwise) contributed to up to an estimated 7,500 metric tons CO_2 in 2013 from travel to Airbnb properties.[16,17] However, the estimated GHG emissions associated with these induced trips was significantly lower than the estimated total avoided GHG emissions associated stays at an Airbnb property instead of a hotel (at least 370,000 metric tons CO_2 in the EU in 2013).
% guests who walk/cycle more while staying at Airbnb vs. hotel; Percentage of guests who use public transportation more while staying at Airbnb vs. hotel	Airbnb guests often explore their destinations using public or alternative transportation. Compared to staying at a hotel, 14% say that they walk or cycle more while staying at an Airbnb and 12% say they use public transportation more.	Airbnb guests often explore their destinations using public or alternative transportation. Compared to staying at a hotel, 14% say that they walk or cycle more while staying at an Airbnb and 14% say they use public transportation more.

[16] The availability of renting out a property through Airbnb may induce some hosts to travel, but current data does not allow us to estimate that effect.
[17] Based on survey data, government data describing the average distance and mode of transportation, and government data describing the average emissions factor of transportation modes.

Appendix

Description of Sources

Cleantech Group examined a range of public sources (government and corporate data sources, along with proprietary data about Airbnb properties and survey responses from 4,092 Airbnb hosts and 4,448 Airbnb guests from over 70 countries[18]). For geography-specific calculations, only responses from the relevant geographies were used.

- **Hotels:** Where possible, aggregate data on hotel resource consumption in the region was used to calculate hotel impacts. Where these sources were unavailable, data from a specific hotel chain was used (e.g., Marriott's sustainability report was used to calculate the "low" value for water consumption at North American hotels).
- **Residences:** Data from government sources on residential/municipal resource consumption was used to calculate per-person, per-night impacts.
- **Airbnb properties:** In this analysis, there were no direct measures (e.g., host utility bills) of the impact of guests at Airbnb properties. As a result, guest-night impacts at an Airbnb were estimated from residential data, survey data, and other Airbnb data (e.g., party size).

The focus of these claims is on impacts that occur *at* Airbnb properties and hotels, as well as the impact of Airbnb on inducing guest travel (i.e. the impacts of other types of travel were not analyzed in this phase of work). These estimates were compared to estimates of impacts at residences and hotels.

Cleantech Group took care to produce accurate estimates of the environmental performance of various property types and people's behaviors, but further analysis is necessary to verify estimates and narrow the range of values shown.

Ranges and Disclaimers

Cleantech Group has relied on the best available public information we could find to produce this initial analysis over the course of a brief initial phase of work with Airbnb. While we have taken care to ensure that the analysis and conclusions are reasonable, Cleantech Group assumes no liability for the accuracy of the sources, data, and conclusions contained in this presentation, the Excel spreadsheet model, the final report, or the implications from any use of this material.

To account for the uncertainty in the data consulted to date in this initial analysis, "high" and "low" values have been calculated for each output. For calculations of differences between stays at Airbnb properties and residences or hotels, "low" values for Airbnb guests were subtracted from the "low" values for residences or hotels. A similar approach was used for "high" values.

In general, "low" and "high" values were selected to conservatively estimate the lower environmental impact of Airbnb properties while minimizing the impact of outliers in the data consulted. Due to differences in data availability across regions and impact categories, the precise meaning of "low" and "high" is dependent on the specific calculation. For example, in order to calculate hotel energy use in North America, the "low" value was calculated from an Energy Star report detailing energy use for a fifth percentile hotel (i.e., 95% of hotels used more energy per square foot). The "high" value was calculated using the median value for hotel energy use from the same source. See calculations and claim footnotes for more details.

[18] Respondent breakdown by geography: North America (37%); EU (39%); Latin America (9.6%); Africa (6.7%); Asia (2.3%); Australia (1.5%); Unspecified (3%)

Geographic Scope

This initial analysis focused on impacts in North America (including only the U.S. and Canada) and the EU.

Other regions have been excluded due to the lack of availability, quality, and comparability of aggregate data across regions outside of North America and the EU. As the third-largest Airbnb region by guest-nights, Asia was examined in particular. Airbnb's impact in Asia was ultimately not quantified in this phase for several reasons, including:

- The wide variation in the characteristics of typical hotels and residences across the region (e.g., Tokyo vs. Bangkok).
- The limited number of survey responses from Asia, creating the potential for a non-representative data set.

Main Data and Methodological Assumptions

1. All of a hotel's resource use was attributed to guest-nights. This means that resource use by non-occupied hotel rooms was also included in guest-night calculations to fully account for the environmental impact of hotels. In addition, due to the aggregated nature of the data available for our analysis, hotel resource use for amenities (restaurants, conference rooms, golf courses, etc.) that are also used by non-guests was not subtracted out.
2. The term "guest-night" is used to describe a per-person per-night impact at a hotel, Airbnb, and residences. This is a standard measure in the hospitality industry.
3. Residential data was used as the basis for estimating guest-night impacts at Airbnb properties, with adjustments for the addition of Airbnb guests (see point #4 below)
4. The per guest-night energy/water consumption of an Airbnb guest is the weighted average of estimated energy/water consumption by guests who replace hosts at their property and of guests who join hosts at their property. For guests who rent an entire property, average residential resource consumption was spread across the Airbnb party. For guests who join a host, the household resource baseline was divided among all occupants at the property. Based on survey data, we further assumed an increase of 10-25% in resource consumption per Airbnb guest over the baseline due to the presence of the Airbnb party. The total amount of this increase was added to the per-guest baseline of the home and also attributed to the Airbnb party.
5. The number of guests per occupied hotel room is assumed to be 1.6. Based on an estimated breakdown of 60% leisure travelers (party size of 2) and 40% business travelers (party size of 1). For Airbnb parties, Airbnb data on average party size in the geography was used. For residences, government data on average household size was used. See the Excel model for details.

Sources

The following is an abbreviated list of external sources relied on for this analysis:

Accor Financial Report, 2012

Accor Group Annual Report, 2012

American Hotel & Lodging Association: *Lodging Industry Profile*, 2013

Ecotrans: *Environmental Initiatives by European tourism businesses*, 2007

EnergyStar Portfolio Manager: *Energy use in hotels*, 2011

Environment Canada: *Residential Water Use Indicator Data*, 2009

European Commission's Climate Action website

European Environmental Agency

Eurostat: *Generation of waste by economic activity*, 2010

Eurostat: *Statistical books, Energy balance sheets*, 2009-2010

Eurostat: *Electricity consumption of households*, 2012

Eurostat: *Statistics Explained*, 2011

Government of Canada: *Statistics Canada, Census*, 211

Hilton Worldwide Report, 2012

Marriott Sustainability Report, 2013

OECD StatExtracts, 2012

PricewaterHouse Coopers: *Thriving or surviving – European cities hotel forecast 2013*

P. Bohdanowicz, I. Martinac: *Determinants and benchmarking of resource consumption in hotels – Case study of Hilton International and Scandic in Europe*, 2004

Rezidor Sustainability Report, 2013

U.S. Geological Survey: *Estimated water use in the U.S.*, 2005

U.S. Environmental Protection Agency: *Climate leadership, Emission Factors for Greenhouse Gas Inventories*, 2011

U.S. Environmental Protection Agency: *A Quantitative Assessment of the Environmental Resource Impacts of the Hospitality Sector (Lodging Facilities) in US EPA Region 2*, 2008

U.S. Environmental Protection Agency: *WaterSense, Indoor water use in the United States*, 1999

U.S. Environmental Protection Agency: *Report on municipal solid waste generation in the U.S.*, 2012

United States Census Bureau, 2012

U.S. Energy Information Administration: *Total Energy*, 2011

U.S. Energy Information Administration: *Residential Energy Consumption Survey*, 2009

U.S. Department of Energy: *Buildings Energy Data Book*, 2009, 2010

U.S. Bureau of Transportation Statistics: *National Transportation Statistics,* 2010