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FRESH: A Food-service Sustainability Rating for Hospitality Sector Events

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Abstract

This report presents a metric called FRESH (for Foodservice Impact Rating for Environmentally Sustainable Hospitality Events). FRESH can be used to evaluate the performance of any foodservice meal period or event in the hospitality sector with regards to its sustainability, based on seven measurements. These measures are: a (post-consumer) food-waste indicator, a no-show indicator (when unexpectedly few people show up), an over-show measure (when too many people show up), a planning indicator (measuring intentional overproduction), a portion-size indicator (measuring per-guest consumption against expectations), an economies of scale indicator, and a post-event indicator (which depends on disposal approaches). FRESH can help managers, authorities, and potential guests evaluate the sustainability of food production in any establishment.

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EXECUTIVE SUMMARY

This report presents a metric called FRESH (for **F**oodservice Impact **R**ating for **E**nvironmentally **S**ustainable **H**ospitality Events). FRESH can be used to evaluate the performance of any food-service meal period or event in the hospitality sector with regards to its sustainability, based on seven measurements. These measures are: a (post-consumer) food-waste indicator, a no-show indicator (when unexpectedly few people show up), an over-show measure (when too many people show up), a planning indicator (measuring intentional overproduction), a portion-size indicator (measuring per-guest consumption against expectations), an economies of scale indicator, and a post-event indicator (which depends on disposal approaches). FRESH can help managers, authorities, and potential guests evaluate the sustainability of food production in any establishment.

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Hassan Arafat, Ph.D., is professor of water and environmental engineering at the Masdar Institute. After obtaining his PhD from the University of Cincinnati in 2000, he worked at Argonne National Laboratory as a researcher and project manager for the United States Department of Energy (DOE). His research at Argonne focused on separation processes development for nuclear waste treatment at the DOE sites in the United States. Subsequently, Arafat served as a faculty member at the chemical engineering department at An-Najah University (Nablus, Palestine) and as the director of the Water Technologies Research Unit in that department. In 2010, he joined Massachusetts Institute of Technology (MIT, USA) as a visiting scholar then moved to Abu Dhabi (UAE). The focus of Arafat's current research is on sustainable desalination processes and innovative membrane technologies. He is a recipient of several prestigious awards, notably the Mondialogo Award by Daimler Co. and UNESCO in 2005, and the University of Cincinnati Distinguished Dissertation Fellowship in 1999. Arafat has also received three international research fellowships. He has co-authored more than 190 peer-reviewed journal publications, conference papers, and official technical reports (published by the US-DOE). A frequent presenter at international events and institutes throughout the world, Arafat has supervised 27 graduate students and postdoctoral fellows.graduate students and postdoctoral fellows.

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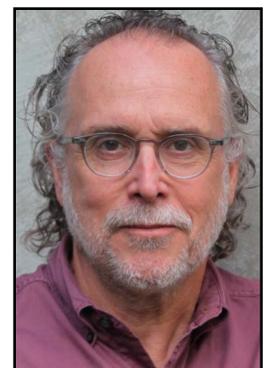
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F ood waste is a substantial component of the overall waste generated by hospitality sector establishments. For example, it can account for about 56 percent of the waste from restaurants and 28 percent of the waste from hotels.[1] Additionally, in the United States about 41 billion kg of food was lost by food services and consumers in 1995, accounting for 26 percent of all edible food available in the country.[2] Since these are values from more than 20 years ago, it is likely that today's food waste is even higher.

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[1] Iowa Waste Reduction Center (IWRC), "The Hotel at Kirkwood Center," 2013. http://iwrc.org/services/food-waste/case-studies/hotel-at-kirkwood/.

[2] A. Sarjahani, E.L. Serrano, and R. Johnson, "Food and Non-Edible, Compostable Waste in a University Dining Facility," *J. Hunger Environ. Nutr.*, vol. 4, pp. 95–102, 2009. doi:10.1080/19320240802706874

A lot of this food waste is avoidable; in the United Kingdom, for example, of the 920,000 tons of food wasted at hospitality sector outlets annually, 75 percent is avoidable.[3] Food waste represents misuse of the resources used to grow the food, which represents a lost economic value. As of 2009, food waste accounted for more than 25 percent of the "total global fresh-water consumption and approximately 300 million barrels of oil per year."[4] Considering the hospitality industry in particular, if the U.K. hospitality sector had reduced its food waste by only 5 percent by the end of 2015, it would have achieved savings of £250 million over two years.[5]

Since food waste decomposes to create the potent green-house gas methane,[6] it contributes to global warming. Thus, diverting it from landfills is a worthwhile effort. In fact, if global food waste was a country, and if countries were listed by the amount of greenhouse gas emissions they represent (in decreasing order), it would be third in the list after China and the United States.[7] Finally, on a global scale, about 795 million people are undernourished,[8] a number greater than the population of many large countries such as the United States and Brazil. Therefore, the large amount of food waste generated (and usually thrown away) by the hospitality industry is unjustifiable ethically.

Addressing food waste is a challenge, given restrictions on disposal and recycling. Even efforts to reduce waste through food donation have limitations created by the need to comply with food safety regulations. Rather than having to address post-consumer food waste, the best policy would be to minimize inappropriate food production in the first place. The FRESH metric described in this report is a step towards facilitating that minimization.

FRESH addresses the poor planning and preparation of food being served, although we note that food waste also arises from improper food storage, which we do not include in this metric. For instance, once again considering U.K. values, two-thirds of the 600,000 tons of food thrown away in 2009 could

have been eaten if the food had been better portioned, prepared, or stored.[9] In the hospitality sector, additional causes of food waste are poor stock rotation and inadequate portion control techniques.[10] Beyond that, more expansive food-service operations lead to greater waste, whether that be through serving a greater variety of dishes, greater amounts of food, or serving greater numbers of people, although in some cases this means that the waste per guest served decreases. Last but not least, a significant determinant of the amount of food waste generated in the hospitality sector is the accuracy of forecasted guest numbers. Many of these determinants are considered in the indicator described in this report.

The Need for a Food-waste Metric

In short, the industry can use a food-waste metric because no consistent measurement standard exists. More formally, there is a "need for addressing non-financial performance data collectively and uniformly within the hotel industry."[11] As stakeholders are becoming more interested in the sustainability of hospitality sector establishments, waste-oriented metrics are appealing. Unfortunately, however, "the hotel industry has no commonly accepted guideline for disclosing standardized sustainability information to allow for comparison among properties and companies."[12] Hotels and restaurants are increasingly obtaining and following sustainability certifications and practices that already are available, but these tend to vary significantly from one hotel chain to another or from one certification to another. For example, the Nordic Swan eco-label requires that unsorted waste generation be limited to no more than 1.5 kg per guest-night,[13] whereas Green Seal, for its bronze certification, specifies that the property should donate leftover food to a local shelter or food bank (subject to available programs and regulatory permits).[14] Moreover, at present, establishments are mainly segregating and measuring the waste they are generating (and therefore calculating diversion rates), while not paying much attention to documenting the food waste they are generating or to addressing how they are

[3] J. Parfitt, D. Eatherley, R. Hawkins, and G. Prowse, "Waste in the UK Hospitality and Food Service Sector," Waste and Resources Action Programme (WRAP), UK, Technical Report HFS001 - 00 6, Nov. 2013.

[4] K.D. Hall, J. Guo, M. Dore, and C.C. Chow, "The Progressive Increase of Food Waste in America and Its Environmental Impact," PLoS ONE, vol. 4, no. 11, pp. e7940, 2009. doi:10.1371/journal.pone.0007940

[5] J. Parfitt, D. Eatherley, R. Hawkins, and G. Prowse, "Waste in the UK Hospitality and Food Service Sector," Waste and Resources Action Programme (WRAP), UK, Technical Report HFS001 - 00 6, Nov. 2013.

[6] United States Environmental Protection Agency, "Turning Food Waste into Energy (EBMUD)," 2012. www.epa.gov/region9/waste/features/food-toenergy/. [Viewed: 09-Jan-2013].

[7] M. C. Lott, "UN says that if food waste was a country, it'd be the #3 global greenhouse gas emitter," 2013. http://blogs.scientificamerican.com/plugged-in/un-says-that-if-food-waste-was-a-country-ite28099d-be-the-3-global-greenhouse-gas-emitter/. [Viewed: 19-Apr-2016].

[8] FAO, Ed., Meeting the 2015 international hunger targets: taking stock of uneven progress. Rome: FAO, 2015

[9] Waste and Resources Action Programme (WRAP), "The composition of waste disposed of by the UK Hospitality industry," 2012. www.wrap.org.uk/content/composition-waste-disposed-uk-hospitality-industry-1. [Viewed: 29-Jan-2013].

[10] M. Mackenzie, C. Cheung, and R. Law, "The Response of Hotels to Increasing Food Costs due to Food Shortages," Asia Pac. J. Tour. Res. 16, pp. 395–416, 2011. doi:10.1080/10941665.2011.588869

[11] E. Ricaurte, "Developing a Sustainability Measurement Framework for Hotels: Toward an Industry-wide Reporting Structure," CHR Report, July 2011; Cornell Center for Hospitality Research.

[12] Ibid.

[13] P. Bohdanowicz, "Environmental awareness and initiatives in the Swedish and Polish hotel industries—survey results," Int. J. Hosp. Manag., 25, no. 4, pp. 662–682, Dec. 2006.

[14] M. Petruzzi, "Green Seal Bronze Certification Checklist for Lodging Properties," 2011. www.greenseal.org/GreenBusiness/Certification/Getcertified/CertificationChecklists.aspx.

processing this food waste. What is more, a recent study found that "top performance in diversion rates was not correlated with performance in waste generation."[15] Consequently, diversion rates may not necessarily be considered the most appropriate measure of waste performance.

The absence of a clear food sustainability metric is further amplified by the fact that guests want information on sustainability, and "one of the greatest challenges faced by hoteliers is to reduce the amount of information and data collected into a manageable number of key indicators."[16]

We developed the metric described in this report for the reasons described above. FRESH (for **F**ood-service Impact **R**ating for **E**nvironmentally **S**ustainable **H**ospitality Events) is an acronym for our dimensionless metric that can be used to evaluate the performance of any event in the hospitality sector with regard to its food-service sustainability. An event in this context refers to any food-service transaction, whether that be something simple like the lunch service in an all-day diner or something more elaborate such as a wedding reception. FRESH provides a way for managers to independently assess the sustainability of the events that they organize. In part, this allows a comparison of events and establishments all over the world. By combining the effect of many different variables into a single number, FRESH helps managers, authorities, and prospective guests and clients assess establishments' food-related sustainability.

The World Resources Institute is preparing a Food Loss and Waste Accounting and Reporting Standard which aims to "encourage consistency and transparency in quantifying and reporting" food waste and loss.[17] This standard is being designed to be applicable to all stages of the food supply chain and to all types of entities which can develop a food-waste and -loss inventory accordingly. Such a standard "ensures international consistency, enables comprehensiveness, facilitates comparability, and supports transparent disclosure" of food-waste quantities for the hospitality sector. [18] So we propose that such a standard be used to quantify those food-waste values which are used as part of calculating FRESH. The version of FRESH we present here is a revised version of the formula published in the *Journal of Cleaner Production*,[19] which we have modified according to feedback received from experts on the hospitality sector. For example, some of the names of the sub-indicators have been modified so that they are better representative of hospitality sector terminology.

Components of the FRESH Indicator

FRESH multiplies an event's normalized post-consumer food waste (PCFW), which is all the unconsumed food and leftovers generated per guest at the end of an event, by six sub-indicators, each of which reflects a dimension of the food-service process and which may promote or hinder its sustainability by influencing the amount of food waste generated. These components of FRESH are primarily calculated on a per-guest basis. Though one may need to include the amount of preparation waste to calculate FRESH, depending on the input data available from an establishment, FRESH assigns more importance to the PCFW. This is because, even though studies report that the amount of losses in food preparation may equal the losses in serving,[20] it may be argued that only certain types of preparation waste may be considered to be unavoidable.[21] However, most post-consumer waste is undisputably unavoidable. In addition, as a result of the food-waste data collection we have done at different hospitality sector events, it was clear to us that PCFW was a significant factor, and we have therefore constructed the FRESH equation accordingly.

FRESH is defined in equation 1 in terms of the names of its sub-indicators. The lower the FRESH value, the more sustainable the event is with regard to food-service and food-waste minimization and mitigation.

Equation 1

FRESH = [food-waste indicator] × [no-show indicator] × ["over-show" indicator] × [planning indicator] x [portion-size indicator] × [economies of scale indicator] × [post-event process indicator]

Each of the terms of Equation 1 is described below:

Equation 2

$$\text{Food-waste indicator} = \frac{\text{PCFW}}{\text{(actual number of guests that attended the event)}}$$

Food-waste indicator. This is a measure of the PCFW per guest actually generated at the event. Equation 2 shows how, as the amount of PCFW increases, the normalized PCFW also increases, which leads to a greater FRESH value (as per Equation 1) and the event is considered less sustainable.

15   Ricaurte, *op.cit.*

16 P. Sloan, W. Legrand, and J. S. Chen, *Sustainability in the Hospitality Industry: Principles of Sustainable Operations*. Routledge, 2009.

17 World Resources Institute, "Food Loss & Waste Standard-Pre-Publication Executive Summary," 2016. www.wri.org/sites/default/files/uploads/FLW_Standard_Executive_Summary_PrePublicationVersion_2016_April.pdf. [Viewed: 19- Apr-2016].

18 *Ibid.*

19 S.I. Pirani and H.A. Arafat, "Reduction of food waste generation in the hospitality industry," *J. Clean. Prod.*, Aug. 2015.

20 J. Marthinsen, P. Sundt, O. Kaysen, and K. Kirkevaag, *Prevention of food waste in restaurants, hotels, canteens and catering*. Copenhagen: Nordic Council of Ministers, 2012.

21 J. Parfitt, D. Eatherley, R. Hawkins, and G. Prowse, "Waste in the UK Hospitality and Food Service Sector," Waste and Resources Action Programme (WRAP), UK, Technical Report HFS001 - 00 6, Nov. 2013.

Equation 3

$$\text{No-show indicator} = \left[\max\left[\frac{(\text{expected number of guests - actual number of guests})}{\text{expected number of guests}}\right],0\right]+1$$

Equation 4

$$\text{Over-show indicator} = \left[\max\left[\frac{(\text{actual number of guests - expected number of guests})}{\text{expected number of guests}}\right],0\right]+1$$

No-show indicator. This is a representation of the number of guests who did not attend the event relative to the number of guests who were expected, as shown in Equation 3. A lower value for this indicator would mean that most of the guests expected at the event ended up attending it. This is positive from the sustainability perspective, yielding a lower FRESH value. We note that this indicator was called the show-up indicator in the original form of FRESH,[22] but we now separate it into two components: the no-show indicator and the over-show indicator.

Over-show indicator. This is a representation of the excess number of guests who attended the event relative to the number of guests who were expected, as shown in Equation 4. A lower value for this indicator would mean that there were few excess guests, yielding a lower FRESH value. Indeed, our data collection has shown how events that had a significant number of excess guests ended up having large amounts of food waste due to last-minute food preparation. As a result, for an event to be as sustainable as possible it is important to be able to predict guest numbers accurately. Either extreme of many fewer people showing up or many more people showing up, relative to predicted values, can have substantially wasteful consequences. While we weigh the effect of no-shows and over-shows equally in FRESH, weights could be assigned based on the challenges posed by no-shows and over-shows in specific environments.

Equation 5

$$\frac{\text{Planning}}{\text{indicator}} = \frac{\text{number of guests cooked for}}{\text{expected number of guests}}$$

Planning indicator. This fraction reflects the extra food amount which the kitchen staff of a hospitality establishment deliberately prepared. This indicator is calculated as shown in Equation 5.

The greater the difference between the expected number of guests and the number of guests cooked for, the greater the contribution of this indicator to the FRESH value (assuming the number of guests cooked for has a value greater than the expected number of guests, as is usually the case). This appropriately indicates a less sustainable event, since this greater dif-

ference leads to more PCFW. As we were informed during our data collection process, most establishments adopt the strategy of cooking for 10 to 15 percent more guests than expected, just in case a larger group of people shows up. Alternatively, other hotels cook just for the expected number of clients (or even fewer than that number in the case of slow-moving dishes). Other hotels ask their clients to provide two numbers, the "guaranteed" and the "expected" number of guests, and then the kitchen staff will cook food for 20 percent more than the guaranteed number of guests.

Equation 6

$$\frac{\text{Portion-size}}{\text{indicator}} = \frac{\text{planned portion-size ratio}}{\text{actual portion-size ratio}}$$

Where

Equation 7

$$\frac{\text{Planned portion-size ratio}}{\text{ratio}} = \frac{\text{amount of food prepared}}{\text{number of guests cooked for}}$$

Equation 8

$$\frac{\text{Actual portion-size ratio}}{\text{ratio}} = \frac{\text{amount of food eaten}}{\text{actual number of guests}}$$

Portion-size indicator. This is a ratio between the amount which the kitchen staff expected each guest would eat and the amount each guest actually ate, as is shown in Equation 6. Like the planning indicator, a large value for the portion-size indicator reflects poor planning on the part of the kitchen administration and so appropriately leads to a higher FRESH value.

Economies-of-scale indicator. On a total mass basis, an event catering to 1,000 guests with 10-percent food waste (i.e., 10% of the food prepared ended up as food waste) may be considered less sustainable than an event that caters to 20 guests and also has 10-percent food waste. This is due to economies of scale and is the theory behind including this indicator in the FRESH equation. Equation 9 shows how this term is calculated:

The exponent n potentially can have any value. We tested a range of values for n and assessed the effect on the economies-

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22   Pirani and Arafat, *op.cit.*.

Equation 9

$$\text{Economies-of-scale indicator} = \left[1 - \left(\cfrac{1 - \cfrac{\text{post-consumer food waste}}{\text{amount of food cooked}}}{\text{actual number of guests}} \right) \right]^n$$

Equation 10

$$\text{Post-event process indicator} = \left[1 - \left(\cfrac{\begin{array}{l} \text{food sent to landfill or incinerated} + (2 \cdot \text{ food composted}) + \\ (3 \cdot \text{ food used to generate energy} + (4 \cdot \text{ food fed to animals}) + \\ (5 \cdot \text{food donated} + (6 \cdot \text{ food saved}) \end{array}}{21 \cdot \text{ post consumer food waste}} \right) \right]$$

of-scale indicator for the events for which we were calculating FRESH. As the value of n increased, the value of the economies-of-scale indicator tended to converge (i.e., there was a smaller difference between successive values of the indicator at greater values of n). The value of this indicator was also tending toward zero at large values of n (e.g., 1,000). This made clear the importance of not having a value of n that was too large. Consequently, we decided to choose the value of 5 for n since it helped to sufficiently differentiate the numbers obtained for the economies-of-scale indicator for different events while not having a more significant effect on the overall FRESH value than was desired.

Post-event process indicator. This indicator is calculated using Equation 10. It helps to influence FRESH from the perspective of what is done with the food waste at the conclusion of the event.

Saving excess food for subsequent events is considered to be most environmentally favorable, followed by donating the food (either to charities or by giving it to the hotel staff), followed by using the food to feed animals, followed by using the food in waste-to-energy processes, followed by composting. Finally landfilling or incineration are the least environmentally favorable options. This preference is integrated into the equation via the coefficients for each of these categories. With regard to food waste that is disposed of through sewer effluent with the help of devices such as a digester or an extractor, this food waste would

also be considered in the least favorable category since it may be considered similar to food waste that is incinerated (i.e., it is being processed without any real benefits and takes energy for disposal). In Equation 10, the more favorable options have higher coefficients and this translates into a lower post-event process indicator value. In addition, this preference is in accordance with the food-waste management hierarchy which defines the different food-waste management options in order of most environmentally favorable to least favorable as follows: source reduction, feeding hungry people, feeding animals, industrial uses, composting, and then disposal whether in a landfill or by incineration.[23] The food-waste management hierarchy is a specific version of the general waste-management hierarchy which defines the different waste-management options in order of most environmentally favorable to least favorable, as follows: prevention, minimization, reuse, recycling, energy recovery, and disposal.[24] When more environmentally favorable options are adopted at the end of the event, the smaller value of the post-event process indicator helps reduce FRESH, reflecting a more environmentally sustainable event.

[23] Office of Solid Waste and Emergency Response (OSWER), "Food Recovery Hierarchy," United States Environmental Protection Agency (EPA), 2015.www.epa.g ov/sustainable-management-food/food-recovery-hierarchy. [Viewed: 13-March-2016].

[24] EHS Global Solutions, "The Waste Hierarchy," 2008. www.ehsgs. com/company-ethos.html.

Exhibit 1

FRESH values and sub-indicator values for the monitored events

No.	Event Monitored	Food waste indicator	No-show indicator	Over-show indicator	Planning indicator	Portion size indicator	Economies of scale indicator	Reuse indicator	FRESH
1	Wedding Buffet—Property A2	1.23167	1.25000	1.00000	1.10000	1.04548	0.98918	0.90624	1.58720
2	*A la carte*—Property B1	0.10968	1.00000	1.00000	1.12903	1.02863	0.86868	0.95238	0.10538
3	Breakfast Buffet—Property B2	0.07696	1.13182	1.00000	1.10000	0.91496	0.97762	0.91351	0.07830
4	Lunch Buffet—Property B1	0.77222	1.52632	1.00000	1.10526	1.96429	0.90183	0.92771	2.14089
5	Lunch Buffet—Property C1	0.44733	1.00000	1.53061	1.10204	2.14682	0.97861	0.95238	1.50977
6	*A la carte* Dinner—Property C2	0.07407	1.00000	1.00000	1.11111	1.35000	0.93978	0.95238	0.09945
7	Lunch Buffet—Property A3	0.50957	1.00000	1.88000	1.10000	2.91975	0.96927	0.89870	2.68017
8	Traditional* Lunch Buffet—Property D	1.22500	1.00000	1.00000	1.10000	1.63917	0.99079	0.90476	1.98001
9	Lunch Buffet—Property A4	0.92667	1.00000	1.00000	1.06667	2.19860	0.96126	0.93183	1.94659
10	Lunch Buffet—Educational Institution	0.28772	1.00000	1.58000	1.30000	1.54340	0.95114	0.86460	0.75008
11	Lunch Buffet—Property E	0.94698	1.00000	1.31429	1.14286	2.60625	0.95295	0.90419	3.19426
12	Dinner Buffet—Property F	0.65111	1.25000	1.00000	1.00000	1.77687	0.99532	0.86787	1.24921
13	Iftar** Buffet—Property A1	1.23125	1.04000	1.00000	1.10000	1.49807	0.94074	0.87116	1.72930
14	Iftar Buffet—Property A1 (With Vouchers)	0.96208	1.00000	1.06667	1.11111	2.01004	0.95123	0.81979	1.78728
15	Lunch Buffet—Property A1	1.58125	1.46667	1.00000	1.10000	0.91526	0.84506	0.92452	1.82421
16	Lunch Buffet—Property A1 (With Signs)	0.38071	1.00000	1.40000	1.20000	2.30140	0.92965	0.85714	1.17293

Notes: *Only local (Emirati) cuisine served. **Iftar is the meal which Muslims eat when breaking their fast at sunset during the month of Ramadan.

The FRESH Indicator in Use: Examples

FRESH values for the different events monitored as part of this study are shown in Exhibit 1, along with the values of the sub-indicators used to calculate FRESH. All these events occurred at hotels in Abu Dhabi, United Arab Emirates. Events 14 and 16 represent events where food-waste minimization strategies were tested, and are compared to the preceding Events 13 and 15 to see whether there has been any improvement. In Event 14 the strategy tested was using vouchers; guests were rewarded with vouchers they could use on their next visit if they wasted an insignificant amount of food as part of the buffet. In Event 16 the strategy tested was signs which encouraged people to waste less food, placed in and around the area where the food was served.

Using FRESH as an indicator, Exhibit 1 shows that the least sustainable events were the lunch buffets at Property A3 and Property E (due to the poor planning by the kitchen staff, as shown by the values of the portion size indicator). For the lunch buffet at Property A3, the high FRESH value was also due to the fact that, in this particular case, the number of guests who

actually came was almost double the number of expected guests, as shown by the high value of the over-show indicator. In this case, the event was penalized for more guests showing up than expected. Although it may be felt that this was not the fault of the establishment, that need not always be the case, depending on the type of event. For example, if a hotel is hosting a wedding reception for a certain client, then there is not much it can do if more guests show up than expected. In such a case, the hotel must prepare food at the last minute to cater to these extra guests. However, if the event is just a regular buffet where guests simply pay as they arrive (as was the case with the lunch buffet at Property A3), the event can have a maximum number of guests specified beforehand so that if more guests than the maximum limit arrive, the hotel staff can politely inform them that the buffet is closed for any additional guests.

Buffets need not be inherently wasteful. The breakfast buffet had the lowest FRESH value, for instance. The amount of food waste generated depends substantially on the types of food being served during the buffet and the no-show rate. In that connection, both *à la carte* events did well in terms of their

Exhibit 2

Peculiarities of the monitored events

Event Monitored	Reasons for Waste Observed
Iftar Buffet—Property A1	Some of the leftover food was given to staff, possibly due to the fact that it was a small establishment with fewer staff and with the different areas of the hotel devoted to food and beverage operations in close proximity to one another.
A la carte Meal–Property B1	The large plate waste in this *à la carte* event was justified in light of the nature of food that was being served, the large serving portions, and local culture, where it is considered inappropriate to finish all the food on one's plate. There was less preparation waste than the *à la carte* event at Property C1 possibly due to only serving Italian food.
Lunch Buffet–Property C1	At this event, a large amount of serving dish waste was generated despite the presence of live cooking stations due to the large variety of dishes served at the event.
A la carte Dinner—Property C2	As in the *à la carte* event at Property B1, the large amount of plate waste in this event was justified in light of the nature of food that was being served, the large serving portions, and local culture, where again it is considered inappropriate to finish all the food on one's plate. There was more preparation waste generated than at the *à la carte* event at Property B1 possibly due to the full international menu that was served.
Lunch Buffet—Property A3	A large amount of serving dish waste was generated due to last-minute preparation, as the number of guests attending exceeded the number cooked for. Many guests did not notice the larger plates they were supposed to use for the main course and instead filled all the food they needed in multiple smaller plates, so using smaller plates did not help reduce plate waste in this situation, possibly because an unlimited number of smaller plates was available.
Traditional Lunch Buffet—Property D	The significant amount of food waste from serving dishes generated at this event may be explained based on the type of food served. The main dish served during this event was lamb and rice, but the presentation of the dish consisted of large amounts of rice with non-proportional meat quantities on top of it. Moreover, this dish was served on large plates, and multiple guests were eating from each serving plate. As a result, the guests only ate some food from the outer edges of the circular dish which was otherwise completely filled with food. The meat was consumed first, along with a small portion of the rice, leaving the majority of rice behind to finally be disposed of. Consequently, much of the food went to waste despite the fact that the event had a full attendance rate. This may have been because the guests had had two coffee breaks before the lunch. What is more, the food was actually provided by an external caterer and so having multiple parties involved could have also facilitated the greater amount of waste.
Lunch Buffet—Educational Institution	At the end of this event, many of the cleaning and security staff dropped by to take the leftovers. This helped the event to perform well despite being a lunch buffet, but it also meant that guest numbers were somewhat inaccurate since the people who ate from the buffet were more than just the invitees. At the same time, the food that the cleaning and security staff took could not be measured separately as donated food, since they were taking the food from the same serving dishes.
Lunch Buffet—Property E	Like the lunch buffet at Property A3, there was a large amount of serving dish waste due to last-minute preparation of the fish, beef, and pasta dishes, since the number of guests attending exceeded the number cooked for.
Dinner Buffet—Property F	This event had a high percentage of plate waste, and this was because this was partially a plated event (only the main course was served in serving dishes which were placed on each table, thus the variety for the main dishes was also limited). In addition, the no-show rate was quite high, and this made the event quite wasteful despite the fact that a significant portion of the leftovers was donated.

FRESH values (since their no-show and over-show rates are always equal to one). Finally, we should note that in an ideal situation, there would not be any PCFW and so the value of FRESH would be zero.

For some of the events we monitored initially, we were able to obtain the value of the mass of ingredients and preparation waste from the kitchen staff, and we used these values to calculate the amount of food served. However, as our data collection proceeded, we realized that preparation waste was not

EXHIBIT 3

PCFW indicator versus FRESH

Event Monitored	PCFW (kg/guest)	FRESH	PCFW Rank	FRESH Rank	Difference in Rank
A la Carte Dinner—Property C2	0.07407	0.09945	1	2	1
Breakfast Buffet—Property B2	0.07696	0.07830	2	1	1
A la carte—Property B1	0.10968	0.10538	3	3	0
Lunch Buffet—Educational Institution	0.28772	0.75008	4	4	0
Lunch Buffet—Property A1 -With Signs	0.38071	1.17293	5	5	0
Lunch Buffet—Property C1	0.44733	1.50977	6	7	1
Lunch Buffet—Property A3	*0.50957*	*2.68017*	*7*	*15*	*8*
Dinner Buffet—Property F	0.65111	1.24921	8	6	2
Lunch Buffet—Property B1	0.77222	2.14089	9	14	5
Lunch Buffet—Property A4	0.92667	1.94659	10	12	2
Lunch Buffet—Property E	0.94698	3.19426	11	16	5
Iftar Buffet—Property A1 (With Vouchers)	0.96208	1.78728	12	10	2
Traditional Lunch Buffet—Property D	1.22500	1.98001	13	13	0
Iftar Buffet—Property A1	1.23125	1.72930	14	9	5
Wedding Buffet—Property A2	*1.23167*	*1.58720*	*15*	*8*	*7*
Lunch Buffet—Property A1	1.58125	1.82421	16	11	5

a significant waste component of the overall food waste generated. Additionally, we found it was more challenging to obtain ingredient amounts from the staff as compared to the mass of food cooked or served. Using the mass of food cooked or served as our base value for an event also helped to overcome the problem of the water content of food which was something that was not considered (though it should have been) when comparing the mass of ingredients to the amount of cooked food. As a result, the FRESH equation has also been designed so that it considers only the amount of food cooked and not the mass of ingredients or preparation waste.[25]

In many cases, the food waste generated at events was affected by various conditions that we discussed above. It is clear that a variety of circumstances affects the amount of food waste generated at an event, and so it is difficult to single out a particular aspect as being the reason for the food-waste generation rates observed. At the same time, anecdotes such as those mentioned in Exhibit 2 help provide a deeper understanding of the food-service process. Most important, FRESH, as a result of being a product of several sub-indicators, helps to neutralize the effects of what may be considered outlying scenarios.

[25] This is an improvement on the original version of FRESH where the economies of scale indicator was in terms of the mass of ingredients instead of the amount of food cooked. See: Pirani and Arafat, *op.cit.*

FRESH Insights

Although managers might simply evaluate events solely based on the normalized food waste values, we suggest that an indicator like FRESH provides insight into the sources of that waste. As is shown in Exhibit 3, we have been able to characterize the events we monitored with the help of FRESH and in terms of normalized PCFW values. It is clear that the rankings of the events can vary significantly depending on which calculations are used. This is because of the different sub-indicators in the FRESH equation. Using these sub-indicators one can evaluate an event and pinpoint exactly why an event might be awarded a poor FRESH value. Using that information managers and staff can determine exactly what issues they need to address to make their events more sustainable.

If we consider the two events in Exhibit 3 for which the difference in ranking is greatest (highlighted in **boldface**), we can see that the lunch buffet at Property A3 performed well in terms of the amount of PCFW per guest that was generated, but its performance in many of the other sub-indicators was quite poor, leading to a high FRESH value overall. The result was a FRESH ranking much lower than the PCFW ranking. For the wedding buffet at Property A3, in contrast, the effect was the opposite. It performed poorly in terms of PCFW, generating a large amount of PCFW per guest. However, the event

performed well for the other sub-indicators, scoring values lower than the average value for many of them, and this led to an overall low FRESH value, making the event's FRESH ranking considerably higher than its PCFW ranking. This is also clear from the values in Exhibit 1.

What is more, Exhibit 1 shows us how, when comparing Events 15 and 16, we can see how the sign strategy helped to make the event more sustainable overall, as is clear from the FRESH values. On the other hand, when comparing Events 13 and 14, the event that tested the waste minimization strategy was less sustainable overall. This is not due to increased PCFW values (which actually decreased due to implementing the strategy), but was primarily due to the high value of the portion-size indicator when we tested the voucher approach. As a result, this shows that while the onus for conservation was on the guests, the reality is that the kitchen staff should have planned better to improve the event's sustainability.

This analysis demonstrates that FRESH is a holistic indicator that allows you to rate events' sustainability and to compare them to one another. Moreover, it provides direction for how to make events more sustainable. The food waste indicator tells us how much waste we have generated at an event, and the other indicators tell us why the waste has been generated. As a result, a FRESH score, due to the other sub-indicators being considered, provides insights which a food-waste measurement on its own would not provide. In fact, PCFW, on its own, can show false good performance. This would occur, for example, if more food was prepared than necessary, but more people also showed up than had been planned for. In that situation, PCFW could look good, because of offsetting miscalculations. Because FRESH purposefully includes other factors, it gives a more balanced measure of waste.

The actual equation for FRESH can be used for any event, since the variables used are relevant for all events. That said, it is most suitable to compare events in similar locations and with similar infrastructure for food-waste processing technologies. Nevertheless, even if such events were compared and it was seen, for example, that all events in Location A perform better than those in Location B, it should lead to Location B's managers trying to understand what is lacking in their location and then improving the situation to make their location more sustainable. Thus, FRESH compares an event's sustainability to an ideal score, and it is as much about evaluation as it is about motivating change.

FRESH also provides specific information that allows analysis of local issues. Though the FRESH calculation does not actually consider different conditions, restrictions, or situations, the analysis of FRESH values can help to identify such issues as cultural norms or inappropriate service standards. Stakeholders evaluating the tourism and hospitality sector from a distance, such as government and investors, could use average values of FRESH to see whether performance has improved over time. Customers can use individual event values to see how local properties or restaurants compare with one another. Finally, managers could use FRESH to evaluate, analyze, and determine the roadmap they need to follow to reach their food-service sustainability targets. Indeed, we would like to propose that FRESH may be combined with sustainability certifications which may define how certain targets related to FRESH may be achieved by a property so that it can obtain more credit during the certification process.

Discussion and Conclusions

Measuring sustainability has been a challenging goal throughout the hospitality industry. One person who is pursuing hotel baselines is Eric Ricaurte, who offered the following observation: "Though academic studies on sustainability measurement, models, and frameworks exist, they do not necessarily address the need for comparisons and common measurement among properties on a global level in practical industry application."[26] FRESH seeks to fill this gap, providing an indicator that can provide a baseline value with which hospitality establishments can compare their events' food-service performance, while also providing target values to which hotel establishments can aspire.[27] While hotels have vastly different levels of resource use, depending on their chain scale, restaurants have more in common. "The metrics used to monitor, track, and communicate performance require clear definition," as well as "collaboration and practicality."[28] FRESH meets those prospective standards, since it has come about as a result of the food-waste data collection we have performed at various hospitality events.

In summary, we seek to unveil a useful and even exciting indicator to the hospitality sector in the hope that establishments all over the world will use it to evaluate their food-service performance. As part of a collaborative approach we encourage readers to send us any comments regarding the indicator and its calculation. One caveat is that FRESH addresses operations, but does not evaluate the guest experience at events in any way. Nevertheless, we anticipate that FRESH will make food waste measurement a more common practice in hospitality sector establishments, with a goal of reducing that waste. ■

26 Ricaurte, *op.cit.*

27 M. L. Diener, A. Parekh, and J. Pitera, "High Performance Hospitality: Sustainable Hotel Case Studies," University of Michigan, Mar. 2008.

28 *Ibid.*

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