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Sport Events and Emissions Reporting: An Analysis of the Council for Responsible Sport Standard in Running Events

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Abstract: The use of fossil fuels has pushed the world towards crucial ecological tipping points and a climate crisis. The rapid decarbonization of all sectors is necessary to limit the worst impacts of this. Within the sports and sport-tourism sectors, event organizers and policymakers are increasingly interested in assessing the environmental impacts of events and identifying the types of strategies needed to reduce their carbon footprint. This paper responds to calls for studies to examine and compare the environmental impacts of multiple sport events and contribute towards providing an enhanced understanding of key factors influencing the scale of those impacts. It focuses on assessing the carbon footprints of 28 mass participation running events in North America. The paper uses a methodology developed by the Council for Responsible Sport as part of its Responsible Sport Standard for Events accreditation process. The results highlight that variations existed between the events in terms of their reporting of GHG emissions. The average event generated 3363 $MtCO_2e$ (0.23 $MtCO_2e$ per capita), with Scope 3 emissions accounting for 99.9% of the total emissions, and 98.9% being attributable to participant travel. This demonstrates how the Council's methodology can assist event organizers by providing valuable insights into the carbon footprint of their events and its potential value as an environmental management tool. The paper also discusses some of the challenges faced by event organizers in measuring the carbon footprint of their event, suggests strategies for reducing event emissions, and provides recommendations for strengthening the Council's methodology and its contribution to global sustainability efforts.

Keywords: environmental impacts; carbon footprint; mass participation sport events; sustainable sport tourism; sustainable travel

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1. Introduction

Human activities energized by fossil fuels have pushed the world towards crucial ecological tipping points and a climate crisis [1]. Before the mid-century, the rapid decarbonization of all sectors is needed to limit the worst impacts resulting from climate change [2]. In addition, there is a need for all business sectors to reduce their carbon emissions and combat climate change [3], including tourism [4–6] and sport [7,8].

The sports and sport-tourism sectors, primarily in high-income countries, are part of global tourism's 8% share of the worldwide greenhouse gas (GHG) emissions causing climate change [9]. There is a need for sport tourism to assess its environmental impact, identify ways of reducing this, and contribute positively to global sustainability efforts [10]. This imperative is particularly relevant given the potential for major events to reduce the environmental impact of international tourism and inspire pro-environmental behavior [11,12]. Research on sports and the sport tourism sectors has tended to focus on assessing the environmental impacts of individual sport events [13–16]. Furthermore, studies have also used different impact evaluation methods and the scope of these studies has have varied, making it difficult to assess and compare the environmental impacts across multiple sport events.

The empirical research presented in this paper responds to calls for studies to examine the environmental impact of multiple sport events using a single assessment method. This paper applies a methodology developed by the Council for Responsible Sport (CRS)—as part of its Responsible Sport Standard for Events accreditation process—to assess the carbon footprints of 28 one-day running races (e.g., marathons, half marathons, and 10K events). These events were staged in North America between 2014 and 2019 and attracted local and international participants. More specifically, this research focuses on answering the following questions: How much GHG emissions are generated by mass participation events, and what energy use activities have the greatest impact? Are there differences between events in terms of GHG emissions? And What key factors are influencing the scale of event-related emissions? In doing so, the paper reflects on the value of the CRS methodology as an approach that can enhance organizers' understanding of their event's environmental impact and provide direction for organizers in reducing these event impacts.

This paper is structured as follows. It begins by providing an introduction to environmental impact assessments, the challenges of conducting these assessments in a sport event context, and the unique elements of running events specifically. Section 2 provides background on the CRS and its methodology for assessing events' carbon footprints and assumptions relating to calculations. Section 3 analyzes and compares the GHG emissions results across all race events and identifies those activities with the greatest impact. The concluding section discusses the strengths and challenges surrounding the CSR's methodology as an approach for assessing the GHG emissions of mass participation sport events, and its potential value as an environmental management tool for event organizers. Suggestions for further research are also provided.

1.1. Assessing the Environmental Impact of Major Events

Researchers have extensively explored the environmental impacts of sport events extensively for more than a decade. Sport organizations and events offer different factors contributing to their overall carbon emissions compared to other business sectors [8]. The sport sector is unique because it relies on various industries to provide services and products, including transportation, food and beverage, and apparel [15]. To this end, researchers have, so far, focused primarily on examining the environmental impacts of individual sport participants [17] and individual sport events [11,14,15,18]. However, Mallen et al. [19] found that comprehensive evaluations of sport events and their environmental impacts are rare as they generally focus on ad hoc assessments rather than assessments using a standard methodology. This can restrict practitioners to using readily available data rather than developing a plan to gather data more comprehensively and intentionally to address specific metrics and assess an event's carbon footprint. The current post hoc approach necessitates structure and the formalization of processes to assess the environmental impacts of sport events.

However, there are inconsistencies in the assessment of sport organizations and their environmental impacts. The lack of standards or benchmarks can harm the legitimacy of environmental sustainability efforts [20]. This issue is exacerbated when sport organizations and events cannot invest in environmental sustainability programming, resulting in much less reporting. Professional and collegiate sport organizations in North America do not regularly communicate or report on their environmental sustainability efforts and performance [21,22]. Moreover, sport organizations and events use different methodologies, whether Ecological Footprint Analyses, environmental input-output analyses, carbon footprints, or life cycle analyses [7,14].

1.1.1. Challenges with Environmental Impact Assessments across Sport

One of the greatest challenges that researchers have encountered is comparing the environmental impacts of major events due to the different methodologies being used. Sport organizations and events often have different operational components to minimize or increase their environmental impacts. For example, Triantafyllidis et al. [17] noted the increased travel impacts of college off-campus sporting events compared to on-campus events. Similarly, the travel impacts of a major event with more robust mass transit options could also greatly minimize its environmental impact by decreasing attendee dependence on individual cars [17,23–25].

Similarly, sport organizations and events may benefit from the sustainable infrastructure of the host cities. For example, sport organizations and facilities in Seattle, Washington, benefit from the renewable energy provided by Seattle City Lights. This electric company provides 95% of its energy from renewable sources (i.e., hydroelectric) and offsets the remaining 5% of fossil fuel-based energy. This enables sport organizations and events to minimize their Scope 2 emissions. However, while these organizations benefit from their circumstances, other sport organizations and events may only purchase fossil fuel-based energy, which can increase their Scope 2 emissions.

As previously discussed, it is difficult to compare the environmental consequences of sport events directly based on differing evaluative methodologies. This divide in approaches remains debated [13]. However, researchers have moved towards also assessing the environmental impact of events per capita [11,13–15,26]. This approach considers the gross impact of an event and divides it by the total number of attendees or participants. While not perfect, this perspective allows for more fair and direct comparisons between events [27]. Despite these challenges, this study aims to assess and compare events of different scales (i.e., small and large participant-based events) and evaluate any differences from a per capita perspective. This evaluation will allow us to assess the influence of various activities on the events' carbon footprints and, more specifically, identify the extent to which specific activities contributed to the overall environmental impacts of these mass participation events.

1.1.2. Running Events

Running events attract a substantial number of participants in the United States. For example, running events attracted nearly 50 million people in 2019 [28]. Furthermore, the number of participants taking part in running events in a single year is between the total attendees at National Football League (17 million) [29] and Major League Baseball games (64.48 million) [30]. Therefore, it is imperative to assess the environmental impacts of race events and identify the key factors influencing the scale of their environmental impacts.

Beyond national attendance and participation levels, running events and operations are quite different from professional spectator sport events. Their use of facilities and energy is less than spectator sports that often use the same venue(s) multiple times throughout a season. Running events are typically held annually, with limited resource consumption and a small number of full-time staff. However, the resource consumption of such events escalates as the number of temporary event staff increases, and additional space is needed to store material inventory [31]. As a result, we would expect the environmental impact of these events to differ from that of spectator events [7,13–15]. Considering the different resource demands and environmental impacts of spectator and participant events, it is important to ensure that consistent categories or standards are used to evaluate and compare the impacts of participant-based events. The Council for Responsible Sport (CRS) has established itself as an authority by developing Responsible Sport Standards to evaluate the carbon footprint of sport events, specializing in running events.

1.2. Council for Responsible Sport and Standards for Events and Organizations

The CRS was incorporated in 2008 as a Delaware not-for-profit charitable organization based in the United States with 'a vision of a world where responsible sport is the norm'. Its mission is to develop standards to support and accelerate socially and environmentally responsible large sporting events. Additionally, the CRS supports event organizers through guidance via standards of good practice, assessment, and monitoring through its custom web-based application called 'ReScore,' and credibility via the independent certification of event organizers' implementation of Responsible Sport Standards.

The CRS's standards and certification programs were developed in response to the widespread lack of accountability and requirements in measuring, reporting, and verifying sporting events' social and environmental impacts, particularly large-scale events (e.g., professional level spectator and participatory sport events). Since 2008, the CRS has certified groups and events that have demonstrated their adherence to its two standards (Responsible Sport Standards for Events and Responsible Sport Standards for Organizations) which provide a comprehensive framework for sport organizations to address their social and environmental responsibilities.

Events pursuing certification are required to document evidence and report on their activities across five 'pillars of responsible sport' (planning and communications; procurement; resource management; access and equity; and community legacy) to an independent third-party verifier and the CRS. An on-site verification visit is also used to confirm the claims, statements, and reporting by the applicant event. Applicant events earn points toward certification by adequately demonstrating their adherence to or implementing individual criteria within each of the five categories. There are four levels of certification (certified, silver, gold, and Evergreen), which last two years before a new review and verification are needed to maintain this certification standing.

To date, 175 events have earned a Responsible Sport Certified status. Some of the largest events to have earned this certification include the Waste Management Phoenix Open PGA Tour golf tournament (2013–2014 Gold; 2015–2018 Evergreen); the NCAA Division I Men's Basketball Championships (2016 Certified; 2017 Evergreen; 2019 Silver); the Major League Baseball All-Star Game (2018 Certified; 2019 Silver; 2021 Gold); and the Bank of America Chicago Marathon (2010–2015 Certified; 2016–2019 Evergreen).

2. Materials and Methods

Calculating the Carbon Footprint of Mass Participation Events

This section of the paper describes the methodology developed by the CRS as part of its most recent Responsible Sport Standards for Events that is used by event organizers when estimating their carbon footprint [32]. Section 3 of the Standard focuses specifically on 'Resource Management'. Event organizers can earn credits for initiatives in six areas (waste, water, calculating carbon footprints, alternative and renewable energy, carbon offsetting, energy, and carbon management). Calculating the carbon footprint associated with staging an event is a mandatory requirement for certification. An additional point for accreditation can be earned if the carbon footprint of event-related travel is also calculated.

Table 1 provides a summary of the activities that are considered by event applicants when measuring and reporting their carbon footprint. It is important to note that, although the Standard guides organizations as to which activities can be included in their reporting for accreditation, there was variation between the events in terms of (a) activities they included as part of their final report and (b) the methodologies used by the organizers when estimating their GHG emissions. These differences relate to organizational capacity, staff expertise, and the accessibility and comprehensiveness of data.

Table 1. Activities included in calculating direct and indirect event related CO_2e emissions.

Emission Category	Activities Included
Scope 1—CO_2e emissions generated directly by event organizers	(1) Non-renewable fuels used (includes operation of vehicles used by event staff and fuel used for site specific energy generation, e.g., generators).
Scope 2—CO_2e emissions generated indirectly by event organizers	(2) Purchased energy (includes electricity for lighting, e.g., expos and bib/packet distribution centers; generators; food, and drink preparation).
Scope 3—CO_2e emissions event organizers are indirectly responsible for	(3) Participant local travel (4) Participant long distance travel (5) Event operations (includes purchased goods and product and service providers) (6) Disposal of waste to landfill (7) Disposal of sewage waste.

For the 28 events included in this study (Table 2), the race organizers predominantly used the emission factors published by the United States Environmental Protection Agency

(US EPA) when calculating the GHG emissions generated from their direct and indirect energy use [33]. Emissions generated by participant travel to/from an event were most often calculated using a Travel Emissions Calculator (Travel Emissions Calculator available at: https://pdd.eugene-or.gov/GreenBuilding/TravelEmissionsCalculator) (accessed on 1 January 2022), a free online tool recommended by the CRS and developed with the City of Eugene (OR, USA). The calculator estimates the return distances traveled by the participants using home postcode/zip codes, International Country Codes, and the event zip code. The distances traveled by the participants are then combined with US EPA emission factors per vehicle miles (i.e., kg CO_2/vehicle-mile). The calculator has two in-built assumptions; distances of up to 300 miles (i.e., local travel) are undertaken by car, and distances of more than 300 miles (i.e., long distance travel) are undertaken by airplane. For most events, the participant figures were based on the number of registered participants. However, it is acknowledged that in some cases, the number of participants may have been overestimated as some may have chosen not to attend the event.

Table 2. Summary of Carbon Dioxide equivalent emissions in million tons ($MtCO_2e$) for all 28 events.

Event	Location	Year	Number of Event Participants	Scope 1 Emissions (%)	Scope 2 Emissions (%)	Scope 3 Emissions (%)	Total Emissions per Event (Scope 1, 2, and 3) ($MtCO_2e$)	Total Emissions per Capita ($MtCO_2e$)
A [1,6,7]	Morristown, NJ, USA	2014	2500	0.0	0.10	99.9	87	0.03
B [1,6,7]	Boston, MA, USA	2014	6000	0.0	0.17	99.8	514	0.09
C [1,6,7]	Houston, TX, USA	2014	8000	0.0	0.40	99.6	1174	0.15
D [1,6,7]	Toronto, Canada	2014	8000	0.0	0.37	99.6	409	0.05
E [1,6,7]	Cape Elizabeth, ME, USA	2014	8000	0.0	0.00	100.0	497	0.06
F [1,6,7]	Kansas City, MO, USA	2014	8000	0.0	1.18	98.8	144	0.02
G [1,6,7]	Hartford, CT, USA	2014	10,000	0.0	0.19	99.8	415	0.04
H [1,6,7]	Eugene, OR, USA	2014	10,000	0.0	0.01	100.0	15,109	1.51
I [1,6,7]	Akron, OH, USA	2014	11,000	0.0	0.21	99.8	559	0.05
J [1,6,7]	Mexico City, Mexico	2014	12,000	0.0	0.65	99.3	536	0.04
K [1,6,7]	Vancouver, BC, Canada	2015	8000	0.0	0.00	100.0	453	0.06
L [1,6,7]	Cincinnati, OH, USA	2015	9000	0.0	0.67	99.3	3044	0.34
M [1,5,6,7]	Los Angeles, CA, USA	2015	13,000	0.0	0.18	99.8	4624	0.36
N [1,6,7]	Austin, TX, USA	2016	13,000	0.0	0.05	100.0	3036	0.23
O [6,7]	Eugene, OR, USA	2018	5311	0.32	0.05	99.6	847	0.16
P [1,6]	Monterrey, Mexico	2018	9417	0.0	0.25	99.8	848	0.09
Q [1,3,4,6,7]	Orlando, FL, USA	2018	3500	0.0	42.44	57.6	1	0.00
R [6,7]	Cape Elizabeth, ME, USA	2019	6416	0.05	0.00	100.0	773	0.12
S [7]	Sacramento, CA, USA	2019	11,736	0.46	0.17	99.4	2464	0.21
T [1,5,6,7]	Dayton, OH, USA	2019	10,000	0.0	1.05	98.9	549	0.05
U [7]	Capitola, CA, USA	2019	16,000	0.03	0.00	100.0	639	0.04
V [1,5,6,7]	Chicago, IL, USA	2014	37,000	0.0	0.06	99.9	15,547	0.42
J [1,6]	Mexico City, Mexico	2018	32,645	0.0	1.61	98.4	665	0.02
W [1,3,4,6,7]	Arlington, VA, USA	2019	26,060	0.0	46.07	53.9	17	0.00
J [1,6]	Mexico City, Mexico	2019	31,564	0.0	1.66	98.3	646	0.02
X [1,6]	Los Angeles, CA, USA	2019	25,000	0.0	0.00	100.0	6244	0.25
V [6,7]	Chicago, IL, USA	2019	46,203	0.001	0.02	100.0	31,678	0.69
Y [1,6,7]	Houston, TX, USA	2019	23,746	0.0	0.24	99.8	2634	0.11

Activities not reported by events: [1] non-renewable fuels used; [3] local travel; [4] long distance travel; [5] event operations; [6] waste to landfill; and [7] sewage waste.

3. Results

Table 2 summarizes the 28 running events included in this study, their geographical locations, the number of participants, and the year they reported their CO_2e emissions. To ensure anonymity, the events were assigned an alphabet letter (i.e., A, B, and C). Twenty-two events were small-scale (i.e., less than 20,000 participants), and six events were large-scale (i.e., more than 20,000s participants). In addition, two events (J and V) reported their emission results in two years. Across all the events, the average number of participants per event was 14,682; the small events averaged 8994 participants, and the large events averaged 31,745 participants.

Before discussing the results from this study, two important issues should be noted. First, not all the events reported their CO_2e emissions for every activity listed in Table 1.

As shown in Table 2, the activities reported least by the event organizers were (1) the non-renewable fuels used (staff travel, and fuel used to generate energy onsite), (6) the energy used to dispose of waste to landfill, and (7) the disposal of sewage waste. Second, based on the information provided by the CRS, variations existed between the events in terms of the comprehensiveness of the data reported for accreditation. For these reasons, the CO_2e emissions reported by some event organizers may have been underestimated. Emission results presented in this paper are presented in metric tons of carbon dioxide equivalent ($MtCO_2$e); they were rounded up to the nearest tenth when the total was larger than 1 $MtCO_2$e and the nearest hundredth when the total was less than 1 $MtCO_2$e.

Overall, the 28 events included in our analysis generated a total of 94,152 $MtCO_2$e emissions (3363 $MtCO_2$e per average event) (Table 3). The average emissions per capita was 0.23 $MtCO_2$e, which is equivalent to almost 50% of the CO_2e emissions produced by an average US citizen per day in 2018 [34].

Table 3. Summary of Scope 1, 2 and 3 event emissions.

	Emissions [all 28 Events] ($MtCO_2$e)	Emissions per Average Event ($MtCO_2$e)	Emissions per Large Event (Mean) ($MtCO_2$e)	Emissions per Small Event (Mean) ($MtCO_2$e)
Number of participants	411,098	14,176	31,745	8994
Scope 1	15.0	0.5	0.06	0.69
Scope 2	109.3	3.90	7.20	2.80
Scope 3	94,027	3358	8197	1745
Total	94,152	3363	8204	1749
Total (per capita)	0.23	0.23	0.26	0.19

Table 2 provides a breakdown of the CO_2e emissions for all 28 events and shows that the total emissions generated by the events ranged from 1 to 31,678 $MtCO_2$e. The total emissions for small events ranged from 1 to 15,109 $MtCO_2$e, with an average of 1749 $MtCO_2$e. For large events, the total emissions ranged from 17 to 31,678 $MtCO_2$e, with an average of 8204 $MtCO_2$e. Overall, events with more participants tended to have greater total emissions.

To allow for a more fair and direct comparison across events, it is important to consider the event emissions per capita. As shown in Table 3, the events generated an average of 0.23 $MTCO_2$e (or 230 kg CO_2e) per capita. Small events averaged 0.19 $MtCO_2$e per capita compared to large events with 0.26 $MtCO_2$e per capita. The events with the largest emissions per capita were 'H' (2014), a small-scale event with 1.51 $MtCO_2$e per capita, and 'V' (2014 and 2019), both large-scale events with 0.42 $MtCO_2$e, and 0.69 $MtCO_2$e per capita, respectively.

The activities included within Scope 3 (i.e., event operations, waste disposal and participant travel) accounted for the largest percentage of emissions across all the events (99.9%). Excluding events 'Q' and 'W,' which did not report travel-related emissions as part of their reports for accreditation, Scope 3 emissions accounted for 98.4% to 100% of the total CO_2e emissions for all the other events. Scope 2 activities (i.e., purchased energy) accounted for the second-largest percentage of emissions (0.1%). However, in the case of events 'O, R, S, and U', the emissions for Scope 1 activities were greater. This may have been due to the organizers having more comprehensive data on staff vehicle journeys or on-site fuel use.

Scope 3

A breakdown of the CO_2e emissions for Scope 3 activities (i.e., emissions that event organizers were indirectly responsible for—participant travel, event operations, and waste management) is provided in Table 4. Events 'Q ' and 'W' did not provide participant travel-related emissions as part of their Standards report for accreditation and were excluded from this part of the analysis. As a result, the average Scope 3 emissions per event were 0.20 $MtCO_2e$ per capita. For small events, the average emissions were 0.18 $MtCO_2e$ per capita and for large events, they were 0.25 $MtCO_2e$ per capita. Participant travel (short and long distances) accounted for the largest proportion of Scope 3 emissions—98.9% across all the events. Conversely, the emissions generated from event operations and waste disposal (landfill and sewage) accounted for a relatively small proportion, 1.2%, and 2.2%, respectively.

Table 4. Summary of Scope 3 emissions for all events (including event-related travel).

Event	Year	Local Distance Emissions (%)	Long Distance Emissions (%)	Event Operations Emissions (%)	Waste Management Emissions (%)	Scope 3 Total Emissions Per Capita ($MtCO_2e$)
A [1,6,7]	2014	43.8	54.2	2.0	0.0	0.03
B [1,6,7]	2014	42.3	56.9	0.8	0.0	0.09
C [1,6,7]	2014	48.8	46.3	4.8	0.0	0.15
D [1,6,7]	2014	51.4	47.7	1.0	0.0	0.05
E [1,6,7]	2014	40.5	58.4	1.2	0.0	0.06
F [1,6,7]	2014	35.2	64.1	0.7	0.0	0.02
G [1,6,7]	2014	67.6	32.1	0.2	0.0	0.04
H [1,6,7]	2014	0.3	99.7	0.0	0.0	1.51
I [1,6,7]	2014	45.9	53.9	0.2	0.0	0.05
J [1,6,7]	2014	97.6	0.9	1.4	0.0	0.04
K [1,6,7]	2015	7.5	91.4	1.1	0.0	0.06
L [1,6,7]	2015	37.2	62.0	0.8	0.0	0.34
M [1,5,6,7]	2015	15.5	84.5	0.0	0.0	0.36
N [1,6,7]	2016	16.6	82.8	0.6	0.0	0.23
O [6,7]	2018	25.6	74.4	0.0	0.0	0.16
P [1,6]	2018	71.0	25.8	0.6	2.6	0.09
R [6,7]	2019	29.1	65.2	5.7	0.0	0.12
S [7]	2019	11.6	87.8	0.6	0.1	0.21
T [1,5,6,7]	2019	22.5	77.5	0.0	0.0	0.05
U [7]	2019	79.5	8.0	12.4	0.2	0.04
V [1,5,6,7]	2014	5.3	94.7	0.0	0.0	0.42
J [1,6]	2018	17.0	81.7	1.3	0.1	0.02
J [1,6]	2019	16.9	81.3	1.8	0.02	0.02
X [1,6]	2019	5.5	86.3	8.0	0.1	0.25
V [6,7]	2019	1.8	96.7	1.5	0.0	0.69
Y [1,6,7]	2019	23.6	76.3	0.1	0.0	0.11
Average per event		0.03	0.16	0.002	0.1	0.2
% of total		15.3	83.7	1.2	2.2	

Activities not reported by events: 1 non-renewable fuels used; 5 event operations; 6 waste to landfill; and 7 sewage waste.

Focusing specifically on participant travel, long-distance travel accounted for 84.2% of the total CO_2e emissions for an average event and local travel for 15.8%. The emissions attributable to local travel were found to be similar for small and large-scale events, accounting for 320 $MtCO_2e$ per average small event and 433 $MtCO_2e$ per average large event. This finding suggests that, when opting to participate in mass participation events, choosing local events and traveling by more sustainable forms of transport are the most effective ways for participants and events to reduce their carbon footprint. However, the difference in long-distance travel emissions for large events was 6.4 times greater than that for small events (8961.6 $MtCO_2e$ compared to 1444.6 $MtCO_2e$). This highlights that the scale of the emissions generated by large events is being driven by a large proportion of participants traveling longer distances using less sustainable forms of transport.

4. Discussion

This paper has examined the carbon footprints of mass participation sport events. Specifically, the data for 28 running events (generated as part of the CRS's accreditation process) were used to compare and identify the activities that generated the largest impacts. Previous researchers have called for a more uniform and comprehensive analyses in GHG reporting to enable comparisons and tracking from event to event and year to year [14,19]. As a result, there are now more reporting standards in the sport industry, such as the CRS's standards designed to create uniformity.

This study is amongst one of the first to examine the carbon footprints of multiple sport events using a predetermined standard. However, due to differences in organizational capacity, staff expertise and access to energy use data, the comprehensiveness of the data reporting varied across events. Despite this challenge, the CRS's standard does allow for comparisons of CO_2e emissions across events, enhances the understanding of factors driving the scale of event emissions, and can assist in identifying the types of strategies needed to reduce these impacts.

This study has highlighted the relatively small contribution made by Scopes 1 and 2 activities to the overall CO_2e emissions of mass participation sport events (0.01%). Scopes 1 and 2 impacts are activities that an organization or event have the most direct control over. Based on the race events included in this study, it is encouraging that they had limited carbon emissions within their direct control. However, this small contribution does highlight the difference between mass participation running events and spectator sporting events. For example, previous studies have found that Scopes 1 and 2 contributed from 2.8% to 12.6% of the total CO_2e emissions of a spectator sport event (i.e., NCAA March Madness) [15] and between 20.4% to 27.7% of a college football game [35]. Our findings also indicate the importance of examining spectator and participant-based sport tourism events differently, specifically Scopes 1 and 2.

Although the significance of Scopes 1 and 2 activities is relatively small compared to Scope 3, there are ways in which events can continue to reduce these impacts—for example, clearly stating their intent to collect energy data upon agreement with an event, expo, or convention center. In addition, event organizers can seek to ensure the utility will provide a final total of the kilowatt-hours used during the occupancy period related to the event. If a venue shows hesitation, they could ask for details as to why and whether they could provide an estimate. Finally, event organizers can opt into a utility clean energy program.

Event organizers have less direct control over Scope 3 activities, which can make it more difficult to reduce their impacts. Our study found that Scope 3 activities accounted for between 98.4% and 100% of the events' total CO_2e emissions, and participant travel accounted for 98.9% across all the events. The significant impact of travel is in line with previous studies that have examined the environmental impacts of sport participants [36]. Specifically, Castaingnède and colleagues [36] found that non-transatlantic travel contributed 1%, and transatlantic travel contributed 83% to French marathon runners' annual training and competition carbon emissions.

Some emission sources are more easily avoided by events, and others are not. Therefore, event organizers should adopt an 'emit less, offset the rest' approach to lower the carbon footprints of road races and mass participation events. To eliminate their contribution to climate change, event organizers should strive to achieve carbon neutrality, ideally within the next decade, due to the urgency communicated in the most recent assessment by the International Panel on Climate Change. Organizers could use the CRS's freely available GHG tracking and estimation tool or a similar alternative to simplify the process of estimating their Scope 1, 2 and 3 CO_2e emissions. Once calculations are performed, and emissions are estimated, organizers can identify the decisions within their control, reducing emissions from event operations and implementing those.

The collection of comprehensive emissions data to fulfill the CRS accreditation process can be invaluable for event organizers. First, it can enhance organizers' understanding of the environmental consequences linked to their events. Second, it provides them with an important baseline to examine the impacts of different activities and identify those with the greatest impact. Third, this can assist them in developing specific strategies aimed at reducing the carbon footprint of their event in the short term (e.g., through offsets) and long term, such as creating campaigns designed to encourage participants to adopt more sustainable consumption behaviors (e.g., transportation and accommodation).

More specifically, event organizers can use their GHG emissions per capita and estimate the cost of offsetting their event's entire emissions and incorporate this cost into the event registration fee. Typically, running events in the United States are associated with non-profits, and organizers could consider including/offering carbon offsets as part of the race entry fee at a minimal cost. For example, carbon offsets in the United States range from USD 1 to 50, but average between USD 3 and 6 per ton, and small-scale events could offset their event by charging individual runners from USD 0.57 to 1.14. The costliest offset at USD 50 would cost runners USD 9.50. Large-scale events and those with more international participants would incur higher charges, though still relatively minimal—the average event would cost runners from USD 0.78 to 2.34, with a maximum of USD 13. However, it should be noted that there is a growing debate around the quality of carbon offset programs, what are meaningful offset programs, and what is an appropriate price [37].

In the short term, event organizers could promote their events as being carbon neutral by including offsetting in the race entry fee. However, challenges still exist in terms of encouraging sustainable behaviors among participants, particularly in terms of sustainable travel options [11,38]. Supposing event organizers can shift their focus to longer term solutions, in this case, they can use the insights provided by their carbon footprint data to develop strategic plans to reduce their event's Scope 3 emissions.

Specifically, campaigns could be created to encourage participants to select more sustainable modes of transport when traveling to an event. Such examples have been demonstrated to work in other sport tourism contexts [38]. Event organizers can also focus on creating exclusive partnerships with certified, environmentally friendly hotels to reduce the impacts of participants' stays in overnight accommodation. Finally, event organizers can also identify ways to reduce the amount of waste ending up in landfills by featuring only recyclable or compostable items. As noted, running events have different capacities, which may limit their purchasing power and coordination to implement more sustainable initiatives designed to reduce the carbon footprint of their event. However, as the CRS develops its standards and programming, the organizations can also find ways to assist these events organizers with suppliers and broader campaigns ideas to reduce the carbon emissions of events.

4.1. Limitations

Although the CRS approach can assist event organizers in providing a more comprehensive assessment of their event's environmental impacts, it is not without challenges. The practice of carbon accounting and performing emissions inventories is complicated and, without training, can lead to poor quality data and an underestimate of an events' carbon footprint. To this end, event organizers are limited in capturing all categories, making direct comparisons difficult.

However, collecting an event's GHG emission data is significant, as the sport sector is severely lacking in environmental reporting. Obtaining and reporting on environmental data has been shown to improve environmental performance despite the quality of the data. Poor-quality data are referred to as grey data. Researchers have argued this is typically the quality of the data that managers use initially when developing strategic plans. As an organization becomes more aware, it places greater emphasis on and targets a specific subject; data collection is refined, resulting in higher quality data to assess organizational efforts and refine strategic planning [39]. This progression is also noted in sport through the diffusion of innovation within and outside of sport organizations and events to advance the environmental practices within the sport sector [40].

The reporting of participant travel, the largest contributing factor to an event's carbon footprint, was vague. Further standardization in the CRS's methodology would help to ensure cleaner data. For example, few events provided a breakdown of participant travel by transport type (e.g., car or airplane). Others designated participants traveling from the host city or state as 'local travel' and those traveling from elsewhere as 'long distance'. In addition, events can leverage their data to calculate and report their environmental impacts based on participant registration data (e.g., addresses and zip codes).

Furthermore, another difficulty with participant travel calculations was the lack of participant zip code accuracy. The CRS encourages event organizers to use the City of Eugene's emission tracker tool, which requires participants' zip codes. Unfortunately, some events submitted zip code data sets with a sizeable amount of data (>10%) unrecognizable to the tool (primarily due to four-digit zip code entries). In those cases, individual participant data were omitted, resulting in underestimating the actual participant travel-related emissions. Accurately recording participant zip codes is a simple fix to this problem.

4.2. Future Research

Based on the mentioned limitations, there are future opportunities for research. First, future studies should consider comparing the carbon footprints of similar events held in different geographical locations, and whether host cities with better public transport connections and infrastructure encourages low carbon travel decisions and leads to lower carbon footprints. Second, researchers can focus on participant and spectator profiles. Prior research has predominantly focused on the environmental impacts of participants or spectators, but not both. Examining the profiles of participants and spectators, especially in a large-scale running event, is important to account for the impacts from both segments, and may indicate differences in their impacts when attending such events and how these segments may differ in their receptivity to an event's sustainability prompts and campaigns. This additional consideration will advance the CRS's assessment, delineating the data from event participants and spectators. Third, researchers and the CRS can focus on and design metrics to evaluate the travel choices of participants and spectators. This research can further refine the emissions from transportation. In addition, this line of research can explore the influence on transportation choices. Finally, examining the influences on transportation choices will also allow researchers to find the effectiveness of various incentives (e.g., free public transit and reduced individual emissions) to encouraging the use of more sustainable transportation options. This understanding will allow researchers and practitioners to design, test, and evaluate campaigns for promoting more environmentally responsible transportation choices and the best ways to engage specific market segments of participants and spectators.

5. Conclusions

Variation existed between the events in terms of the activities and associated GHG emissions reported by the event organizers. As a result, there are questions concerning the comprehensiveness and accuracy of the data, and the underreporting of emissions by the event applicants. The CRS Standard could be strengthened in several ways. First, all activities, including event-related travel, should be considered as mandatory and reported by all event applicants as part of the accreditation process. Second, the analysis and reporting of event-related travel should be more comprehensive and include other modes (e.g., rail, bus, coach, and active travel). Finally, the methodology for estimating the GHG emissions and conversion factors used in the calculations should be standardized. These developments would enhance the transparency and comprehensiveness of event carbon footprint assessments and allow for clearer comparisons across events and the identification of the key factors driving impacts. Given the significance of event-related travel, comprehensive reporting on participant/spectator travel would also provide organizers with a better understanding of their travel choices and the types of strategies and incentives needed to encourage low-carbon travel.

With human-caused climate change beginning to change our everyday lives, all sectors need to act. There is an opportunity for sport events to lead by example to raise awareness because of the popularity of sports and sports media platforms [40–42]. In addition, the sporting sector can serve as a convening ground for cross-sector collaboration, highlighting innovations through sponsorship assets [42]. Doing so may catalyze faster action to reduce emissions and stem the worst effects of the changing climate. This can only be achieved by engaging the participant and fan bases, teams, athletes, and the organizations that sponsor them. Furthermore, running races can reduce their emissions and set an industry-leading example by purchasing renewable energy for their event operations and incorporating the amount to offset runner emissions into the cost of their event registration. As a result, net-zero events are attainable now, resulting in a fractional increases in operational expenses and participants.

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