

# Tokyo 2020 Olympics sustainability: An elusive concept or reality?

International Review for the  
Sociology of Sport  
1–22

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DOI: 10.1177/10126902221110157

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## Abstract

The Olympic Games continue to be a creator of adverse environmental impacts for host communities. Given the role that the Olympic Games play in sustainability due to their size, the number of people attending, new construction and infrastructure, and the extensive exposure by the media, this study investigated the Tokyo 2020 Games by evaluating the efficacy of their ecological sustainability efforts. Methods for this study were framed by the conceptual model of Müller et al. Specifically, the model is grounded on the three general aspects of sustainability: ecological, social, and economic. Compared to all Olympic events from 1992 through 2020, results from the present research indicated that Tokyo 2020 Olympics may have been the most ecologically friendly Games. This ecological record is significant, but it may be an unrealistic benchmark, given that the lack of attendance due to the COVID-19 pandemic influenced much of the ecological sustainability scores.

## Keywords

olympic games, sustainability, environmental assessment, sport ecology

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## **Introduction**

The Olympic Games are considered the largest multi-sport event in the world (Wade, 2021). The size of the Olympic Games is calculated by the number of people that actively participate in the sports of the Summer Olympic and Paralympic Games, consisting primarily of athletes, coaches, medical teams, and media stakeholders (Marchant, 2021). Additionally, people who attend on-site to watch the Games and those who watch the Games from home (via telecommunications) are included in calculating the Olympic Games' size. Sponsors and media outlets are also considered part of the Games. Taken together, the number of facilities to accommodate the sport events, such as stadiums and arenas, lodging facilities, and concessions, reflect significantly on the impacts that the Olympic Games have on the pillars of sustainability, namely, environment, society, and economy (Müller et al., 2021; Wade, 2021).

Sustainability is a crucial objective of the Olympic Agenda 2020 managed by the International Olympic Committee (IOC) (Flyvbjerg et al., 2021). Broadly defined, 'sustainability' looks at the relationship between costs and benefits of implemented strategies to minimize the negative and maximize the positive consequences of hosting mega-events (Vanwynsberghe, 2015). Accordingly, the large size and impact of the Olympic Games play a significant role in encouraging society to become more sustainable (Flyvbjerg et al., 2021; Müller et al., 2021). More specifically, the plan for the IOC (as the governing body of the Olympics) regarding sustainability is to ensure that both the Olympic and Paralympic Games are the leader in sustainability initiatives (Müller et al., 2021). In 2021, the Tokyo 2020 Olympic Games were held after a year of postponement due to the coronavirus pandemic (Triantafyllidis, 2020). Consequently, Tokyo 2020 Olympic Games brought the world together in times of two crises: the coronavirus pandemic, which caused the delay and nearly the cancelation of the Games, and climate change, which forced athletes and spectators to suffer in 40°C heat (Müller et al., 2021; Triantafyllidis, 2020).

In addition, there is a need to view sustainability of the Tokyo 2020 Olympics through ecological, economic, and social lens. Therefore, this study aimed to: (1) evaluate sustainability efforts in Tokyo 2020 via the ecological aspects that capture new construction of facilities and venues, visitor's ecological footprint, and event size; (2) evaluate the social aspects, including the rule of law, social safety, and public approval; and (3) evaluate the economic aspects that focus on the financial exposure, long-term viability, and budget balance.

## **Literature review**

This section begins with an overview of the IOC and its position on sustainability. Next, we introduce some of the criticism the Olympic Movement has received regarding sustainability, and transition to a section discussing some sustainability assessment tools and strategies. Finally, we conclude by presenting the notion of legacy versus leverage in the context of the Olympic Games.

### *International Olympic committee and sustainability*

Despite the long history of the Olympic Games (starting from the Ancient Games to Modern day Games), the subject of sustainability in general and the environment, in

particular, are relatively new concepts within the Olympic Movement. However, early evidence exists that the Olympic Games organizers were concerned about the environment in the 1930s (Kietlinski, 2020). Similarly, Chappelet (2008) and Gold and Gold (2013) have discussed the controversy surrounding the Winter Olympic Games and the environment starting with the 1932 Games in Lake Placid. A local activist group (Association for the Protection of the Adirondacks) protested the clearing of 2500 trees to build the bobsled run. With the help of the New York state law, they were successful in their plight, and ultimately an alternate site for the venue was identified. Public outcry was also seen with Denver citizens and environmental supporters who held a referendum in 1974. Subsequently, these efforts turned down the IOC's bid award to host the 1976 Winter Games, citing concerns for the negative impact on the surrounding environment (Chappelet, 2008; Lenskyj, 1998). Furthermore, opposition due to the environmental risk associated with hosting the Games was seen in Toronto (1989–90) during bids for the 1996 Summer Olympic Games and in Rome (1997) for the 2004 Summer Olympics (Lenskyj, 1998).

The major turning point for this sustainability movement was the 1994 Winter Olympic Games in Lillehammer, Norway, when considerations were given to the natural environment (Chappelet, 2008). The negative impact on the environment was addressed by carefully planning the construction and management of the Olympic venues. In addition, the Organizing Committee initiated more than 20 sustainability projects to ensure that the Games were environmentally friendly. The success of the Games in Lillehammer decisively positioned the term ecology into the minds of the IOC (Cantelon and Letters, 2000). Furthermore, it offered an opportunity for the IOC to redeem its damaged environmental reputation (Pentifallo and VanWynsberghe, 2012). Thus, the 1994 Winter Olympics established a long-term legacy and were widely regarded as the first 'Green Games.' In response to these sustainability efforts, the IOC adopted the environment as the third pillar of Olympism (alongside sport and culture) the following year, 1995 (Cantelon and Letters, 2000; Holden et al., 2008; Weiler and Mohan, 2010), and in turn established a global environmental policy for the Olympic Movement, expecting future host communities to assure environmental protection during the bidding and hosting phases of the Olympic Games.

Amendments to the IOC's policy on environmental sustainability continued in the 21st century with the creation and adoption of Agenda 2020, which acts as a roadmap for the Olympic movement's future by providing a set of 40 comprehensive recommendations whose principal goal is to protect the Olympic values and fortify the role of sport in society (Ross and Leopkey, 2017). Although the IOC recommends that host cities address the environment, it is the ultimate responsibility of the host community to ensure a positive environmental legacy led by the Olympic Games Organizing Committee (Ross et al., 2019). Consequently, the Olympic Organizing Committees mimic previous successful Games' environmental plans and respond to pressures from the IOC and society when espousing environmental practices (Ross and Leopkey, 2017). In turn, Olympic Games bidding proposals are increasingly similar as pro-environmental behaviors are institutionalized within the greater Olympic Movement.

### *Criticism of the IOC's sustainability agenda*

Although it appears that the IOC has made some efforts to address environmental sustainability within the Olympics, they have a long history of receiving criticism for failing to substantially address the negative impact on the environment and enforce penalties when promises are not met. Notably, even the term 'sustainability' has been criticized for its 'malleable' use as a filler term for post-Games visions of regional transformation that is subject to multiple definitions (Gold and Gold, 2013; Holden et al., 2008). Furthermore, the concept of 'sustainability' lacks discussion of power dynamics and politics as illustrated by the perspective of ecological modernization (Wilson & Millington, 2013). As a result, scholars have been somewhat critical and skeptical toward the IOC's efforts to address the environment, encourage host cities to act, and monitor the success (or lack of such) in this area (Paquette et al., 2011). For example, Geeraert and Gauthier (2018) have criticized the IOC, pointing out that although the IOC has put a high emphasis on environmental sustainability for more than two decades, it has fallen short of its sustainability objectives leading to damaging ecological consequences. In addition, the system for overseeing and regulating sustainability goals (put in place by the IOC) is inadequate, with no provisions for penalties for those who do not comply and meet sustainability expectations and promises. The IOC recommends that third-party experts assist in the selection process and introduce sanctions imposed on the host city to address this criticism. However, it presents some challenges, such as potentially limiting the number of cities interested in hosting the Olympics and resulting in a smaller pool of bidding candidates (Schnitzer and Haizinger, 2019).

Similarly, other scholars (Ross et al., 2019) have examined major stakeholders associated with the Games and have discussed how the IOC employs a variety of coercive, framework, and voluntarism-oriented policies to encourage environmental sustainability practices among stakeholders. Unfortunately, many of the suggested tactics to take substantial and positive steps toward sustainability within the Olympics have limited enforcement mechanisms in place. It is possible that environmental goals are sacrificed to achieve goals related to profitability and successful event execution (Ross et al., 2019). As Del Fiacco and Orr (2019) have illustrated through a systematic review of the literature, environmentalism in the Olympic movement has sadly regressed despite the IOC's environmental policy changes. Furthermore, Weiler and Mohan (2010) examined the history of the Olympic Movement about environmental sustainability, concluding that it is difficult to unlock the Olympic Games' ability to utilize sport as a platform for sustainability, which is incredibly challenging without credible attempts by the IOC and the Organizing Committees to practice what they preach. Efforts should adopt mechanisms that create, track, and report key economic, environmental, and social outcomes.

Most recently, Müller et al. (2021) evaluated a total of 16 Winter and Summer Olympic Games and argued that sustainability rhetoric does not align with actual sustainability outcomes. Their findings illustrated that overall sustainability had declined dramatically over time, with Sochi 2014 and Rio 2016 performing poorly. Some possible short-term and temporary solutions could be to significantly reduce the size of the event, design a rotating schedule among the same host cities, and establish and enforce

independent sustainability standards. The key is to approach sustainability through a holistic lens and emphasize the collective action necessary to achieve long-lasting positive outcomes.

### *Assessment tools and strategies*

In this section we present a brief overview of some other approaches (in addition to the one by Müller and colleagues mentioned above) that have been utilized in an attempt to assess sustainability strategies. Dolf and Teehan (2015) have used a life cycle assessment-based approach to measure the carbon footprint of spectator and team travel to events to quantify some form of the environmental impact of sport. While a valid and useful form of environmental impact assessment, and with travel being the largest contributor to carbon emissions, it only measures one aspect of the entire impact of an event. Other scholars have conducted an assessment based on a cross-national data set, analyzing the experiences of homeless individuals in Vancouver and London (two Olympics host communities) (Kennelly and Watt, 2011). The authors concluded that the Olympics sustainability legacy specifically focused on the social aspect is rather questionable, by demonstrating the harmful impacts of the Games on marginalized populations. The strategy they used for assessing the Olympics legacy was mostly based on a qualitative approach through focus groups and interviews. While such an approach to sustainability assessment is surely appropriate and valuable for evaluating the social aspect of sustainability, it does not provide for a holistic assessment, including the economic and environmental components.

Another approach to assess sustainability was launched by the IOC in an effort to gather data on the overall impact of the Games. This approach is the Olympic Games Impact (OGI) study, which comprises of 126 indicators in all three areas of sustainability (economic, environmental, and socio-cultural). Although the OGI study as a tool to assess sustainability provides a standardized approach for evaluation, which can control for external factors (e.g. economic trends), it has been criticized by scholars with expertise in mega-events (Vanwynsberghe, 2015). Some of these critiques relate to concerns that the OGI study is not long enough to provide for longer-term effects. Others revolve around the issue of making conclusions based on quantitative data only, thus presenting challenges in the evaluation of the socio-cultural aspect. Overall, the OGI study does not present a strategy for an integrated way of measuring sustainability and lacks the comprehensive component, which is critical for the evaluation of mega-events. In other words, it is rather impossible to indicate whether the Games are sustainable or not.

To address some of the critiques the OGI study has received as a tool for assessment, the before-and-after-control-impact (BACI) method has also been utilized. This method is grounded on the approach of comparing the host community to a “control” location with very similar characteristics. The benefit of having such a strategy for sustainability assessment is that it allows us to identify a baseline against which future mega-events could be measured. Additionally, it provides the possibility to identify changes before and after the event. Moving forward, perhaps the focus on assessing sustainability within the Olympics should center on leveraging and not legacy, thus shifting the strategies that have been used in the past to evaluate sustainability to a more comprehensive

approach. In fact, it has been suggested that the concept of leveraging has the potential to provide a better tool for evaluating the Olympics since it takes into account the context of the host community (Vanwynsberghe et al., 2012).

### *Olympic legacy versus Olympic Leverage*

When addressing the concept of sustainability, it is imperative to discuss two related but at the same time distinct notions – legacy and leverage. Legacy in the sport context is broadly defined as “all the planned and unplanned, positive and negative, intangible and tangible structures created by and in connection with a sports event that remain for a longer period than the event itself” (Preuss, 2010, p. 211). The notion of green legacy in the Olympic Games is relatively new and was first addressed during the planning and organizing of the Atlanta 1996 Olympics. As a result, the host city felt compelled to highlight environmental sustainability efforts to leave a green legacy. Scholars have examined how green legacies are planned and managed, concluding that each city is unique. Therefore, the local culture, infrastructure, government, and social expectations are vital variables in successfully achieving a green legacy (Samuel and Stubbs, 2013). For example, Kellison and McCullough (2020) evaluated citizens’ environmental attitudes and behaviors in the Los Angeles area (Los Angeles will host the 2028 Games). The results illustrated that although citizens support environmental initiatives, they were unappraised of existing practices. Accordingly, it can be supported that gathering baseline data for future Olympic host cities is fundamental when the goal is to stage Games with a truly lasting and positive environmental legacy.

Furthermore, Boykoff and Macarenhas (2016) examined the legacy of sustainability in the Olympic Games through the lens of the Rio 2016 Olympics. Unfortunately, Rio did not contribute to the green legacy of the Olympics. Findings indicated that although Rio promised sustainable development in the area, there was a significant disconnect between the environmental sustainability promises and achievements. Similarly, Gold and Gold (2020) investigated the links between remediating land for the construction of Olympic venues and pursuing a legacy. They concluded that more comprehensive strategies are needed if the goal is to achieve long-term benefits to the host city and community. Concerns such as those described above raise the question of whether green legacy is an elusive concept or reality.

For the past 40 years, the common belief has been that significant scale events (e.g. the Olympics) provide substantial public investment. Therefore, these events should leave a positive legacy (Leopkey and Parent, 2012). However, Chalip (2018) argues that although many legacy models exist, they are somewhat rhetorical and rarely practical, making legacy a moving target and viewed as an elusive concept. Furthermore, the challenge with successfully achieving legacy comes from the fact that it is context-specific, defined by the local environment and characteristics of the host community.

Similarly, and specifically in the Olympics context, MacAloon (2008) has argued that claims about Olympic legacies are routine despite lacking persuasive supporting evidence. He compares the legacy debate to magical thinking, suggesting that strictly focusing on legacy is irrational reasoning. The IOC mandate to host cities and communities for achieving Olympic legacy serves the intended purpose by implying that the Organizing

Committees would ultimately work to support the IOC's interests. The fundamental flow with legacy is static and solely focused on outcomes rather than the resources necessary to obtain the expected results. In other words, it is what is left after the Games are over. Thus, it is illogical to assume that legacy automatically derives from events, especially mega-events and the Olympics.

Unlike legacy, leverage revolves around strategic processes, allowing it to be applied and discussed in different contexts (Chalip, 2018). Most scholarship on leverage has centered on economic and social development (Chalip, 2006; Dwyer et al., 2000; Smith, 2010), leaving environmental sustainability largely unexplored. However, if environmental sustainability is viewed as a component of social development, there is a potential for developing, exploring, and testing leveraging to support environmental sustainability. Strategic leveraging of the Olympic Games is a much more challenging enterprise than achieving legacy and typically more complex than what event planners are willing to undertake. Moving forward, if we seek to address sustainability, it would be critical to separate legacy from leverage. Legacy leaves us with the illusion of achieving benefits and claims that fail to withstand empirical scrutiny (Chalip, 2018). By focusing on leverage instead, we can strategically place and integrate the Olympics into the local community, which would lead to long-term benefits for the host city and for practical lessons that are more tangible than the deceptive notion of legacy. Environmental matters are severely understudied and inadequately understood in the context of leverage, especially with mega-events such as the Olympics.

## Conceptual model

As discussed earlier in the paper, there is a variety of models/methods that have been used to assess sustainability within the Olympics. However, none of these approaches fit well the study presented here. For example, we elected not to use Kennelly and Watt's (2011) approach as their method was qualitative in nature and addressed only the social aspect of sustainability. We also elected not to use the IOC's OGI study for the assessment of the Tokyo 2020 Olympics for two reasons: 1) the OGI study has been a subject to several methodological critiques (Vanwynsberghe, 2015), and 2) the OGI study was only completed for the Winter Olympics in Vancouver and abandoned in 2017 (Müller et al., 2021). Lastly, to use the BACI method we did not have a "control" location with similar characteristic to Tokyo due to the unique circumstances surrounding the Tokyo Olympics related to the COVID-19 pandemic.

The conceptual model framing this study is based on the recent work of Müller et al. (2021). This decision is based on the fact that the model provides a tool for a comprehensive assessment utilizing both quantitative and qualitative data. Furthermore, it provides for a standardized approach for evaluating sustainability and presents all three dimensions as mutually substitutable. The model is grounded on the three general aspects of sustainability: ecological, social, and economic. Additionally, each sustainability dimension consists of three indicators. Specifically, the ecological component is characterized by new construction, visitor footprint, and event size. The social is characterized by law, social safety, and public approval. Finally, the economic is characterized by financial exposure, long-term viability, and budget balance. All nine indicators meet two criteria:

1) they need to be valid, and 2) they need to be readily available. Each of the nine indicators evaluates a different facet of sustainability and is scored on a scale from 0 to 100, with 0 meaning 'least sustainable' and 100 meaning 'most sustainable'. The model also assigns equal weight to each of the three dimensions (economic, environmental, and social) to ensure that economic and environmental metrics are not calculated at the expense of the social component of sustainability. This type of scoring allowed the research team to develop a scorecard for measuring the overall sustainability performance of the Olympic Games.

It is important to note that the model is also based on quantitative and qualitative markers, allowing a more comprehensive evaluation approach. The model has already been applied to evaluate the sustainability performance of all Winter and Summer Games between 1992 and 2020, illustrating that the overall sustainability of the Olympics has declined over time. Thus, Müller and colleagues' model provides for conceptualizing sustainability in mega-events and the Olympics and an opportunity for scholars to evaluate the often-disputable claims of sustainability empirically. The most recent Olympics to be included in their study were the Tokyo Games, acknowledging the limitation that although some data for Tokyo were available, the study was completed before the Games took place in the summer of 2021. Consequently, there is an enhanced opportunity to re-evaluate the Tokyo 2020 Games and compare their sustainability performance with the results presented in Müller's work. They scored 40 points, indicating below the average sustainability efforts. Considering Müller's model in general and the context of the scholarship presented in the review of literature in particular, the research delivered in this paper evaluates the ecological, social, and economic dimensions of sustainability in the Olympics.

## **Purpose of study**

As indicated in the review of literature and subsequently in the above section, it is imperative to not only address sustainability in all three dimensions (economic, social, and environmental), but to also have a systematic process through which the Olympics sustainability performance is assessed. Although attempts have been made to evaluate sustainability, most have been somewhat limited by either single focusing on the social aspect or utilizing methods that are either qualitative or quantitative in nature. Furthermore, previous Games (both Summer and Winter) evaluations have been performed on a full scale Olympics, with thousands of participants and spectators attending. There is a need for an evaluation that is more comprehensive and incorporates both quantitative and qualitative metrics while assessing all three dimensions of sustainability.

Given the potentially significant negative environmental impact of the Olympic Games and especially the unique characteristics of the Tokyo 2020 Olympics (the first Games in the history of the Olympics not to have spectators), the purpose of this study was to evaluate the Tokyo 2020 Olympics sustainability efforts in all three aspects: ecological, economic, and social. Additionally, the goal was to compare Müller et al. (2021) predictions against more recent data related to the Tokyo 2020 Summer Games. Despite mixed feelings about not having spectators in the stands, optimism existed, and expectations were minimal for the Games' negative impact. Therefore, the central question for



this research was “Did Japan 2020 accomplish its ambitious promise of sustainable Games?” With the motto of “Be better, together – For the planet and the people,” public expectations were high. The Tokyo Organizing Committee for the Olympic Games (TOCOG)’s bid promised three pillars of a broad sustainability strategy with: minimal impact (via carbon neutrality), green urban plans, as well as social and economic sustainability through sport (TOCOG, 2013). This study addressed the following questions:

1. Did Tokyo meet its sustainability objectives across all three dimensions?
2. How did Tokyo perform in sustainability across all three dimensions viewed through the conceptual model of Müller et al. (2021)?

## Methods

The method utilized in this research followed the exact steps of the study conducted by Müller et al. (2021). Data collection, scoring, and analysis adhered to the protocol Müller and colleagues adopted in their paper. This decision and rationale were based on the research questions that framed this study. The process described below was used to collect data for sustainability’s ecological, social, and economic dimensions. Key terms used in the social search were public approval, social safety, the rule of law, population displacement, and rights infringement. For the economic search, key terms used were budget balance, financial exposure, long-term viability, cost overrun, the share of public funding, and after-use of venues.

The first step in the data collection process was to carefully review the raw data, parameters for scoring, pre-Games score, and sources provided by Müller et al. (2021) study. Next, the official Tokyo 2020 Olympic website was reviewed for a section on Sustainability. At the bottom of the home page, a separate sustainability page link was found in the “About the Games” section. The Tokyo 2020 Sustainability Pre-Game (main) report from April 2020 and the update to the Pre-Game report from July 2021 were available on the webpage. The entirety of the webpage and provided documents from the Organizing Committee were searched for information on the three ecological categories (new construction, visitor, footprint, and event size). Next, if data could not be found in the reports, the search feature on the sustainability page was used with ecological key terms (e.g. new construction, new competition venues, visitor footprint, number of tickets sold, event size, accreditations, volunteers, workers). Once the Tokyo 2020 website was searched, the sources used to extract the preliminary Tokyo 2020 data by Müller were reevaluated to assess if information had been updated. Searches for current academic journal articles were conducted using the same keywords. To complete the investigation, keywords were used in the Google search engine, to collect popular media sources (e.g. New York Times, Associated Press, Kyodo news). Popular press sources used in the Müller study were evaluated first. Raw data were entered into an Excel spreadsheet. Based on the steps taken in Müller’s data analysis and utilizing his conceptual model, raw data numbers were converted into correlating scores using the scoring criteria (see Table 1). Lastly, at the time of data collection (September 2021), there were no official final reports released and published by the

Tokyo OCOG or the IOC. All data were formulated from the pre-Game’s reports, academic publications, Müller’s study (2021), various sections on the official Tokyo 2020 website, and notable popular press. Data not provided exclusively from an official Olympic source was only used if verified by the combination of sources listed above. For example, projected and updated budget figures from the Organizing Committee served as a starting point for the economic parameters. The IOC reported in 2020 that delays due to the COVID-19 pandemic could add \$800 million to the cost of the Tokyo Olympics (Cervantes, 2021). A Google search found a news article from the Associated Press that pointed to a study by Flyvbjerg et al. (2021) from the University of Oxford that projected the total cost of the Tokyo Olympics to be over \$15 billion. The Wall Street Journal reported that Japanese government auditors listed the cost could be closer to \$20 billion (Cervantes, 2021). Based on the parameters of the Müller’s study, and using the conservative cost estimate still puts the budget overrun in the highest category (>80%), thus resulting in a score of zero for that category.

### Results

The sustainability dimension from Müller et al. (2021) presents the findings below and are summarized in Tables 1 and 2 and Figure 1.

Comprehensively, the Tokyo 2020 Summer Games outperformed their projections from Müller et al. (2021) model on sustainability (particularly in the ecological and economic dimensions). The projection was for a total sustainability score of 280 out of 900, with the actual Tokyo Games receiving a score of 480. However, this success might be misleading. Therefore, a closer examination of the three sustainability dimensions is required to understand the Tokyo 2020 Games impact fully.

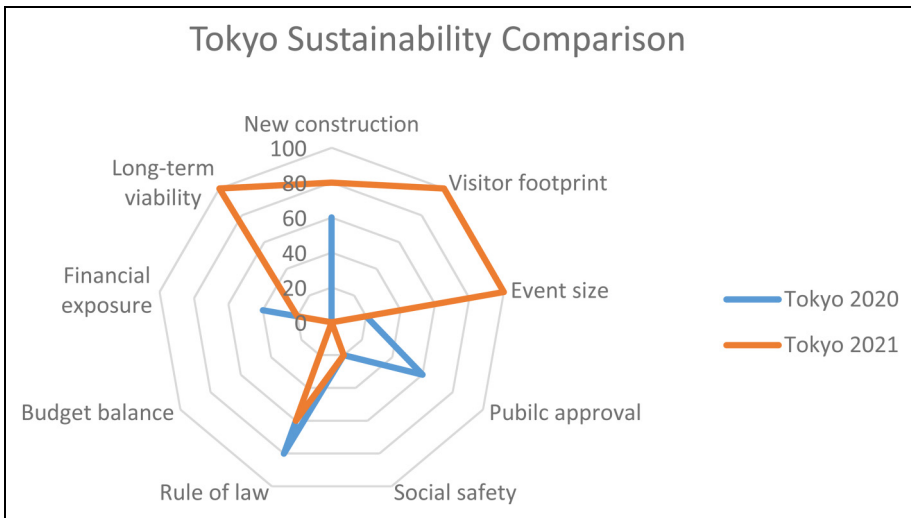


Figure 1. Tokyo 2020 projected versus actual sustainability score comparison.

**Table 1.** Indicators and scoring criteria (Müller et al., 2021).

Dimensions	Indicators	Proxy	Unit	Scoring Criteria
Ecological	New Construction	Share of new competition venues	Share of new-build sports venues among total number of sport venues	100 if $\leq 10\%$ ; 80 if $\leq 20\%$ ; 60 if $\leq 30\%$ ; 40 if $\leq 40\%$ , 20 if $\leq 50\%$ , 0 if $> 50\%$
	Visitor Footprint	Number of tickets sold	Tickets	Summer: 100 if $\leq 3m$ ; 80 if $\leq 4m$ ; 60 if $\leq 5m$ ; 40 if $\leq 6m$ ; 20 if $\leq 7m$ ; 0 if $> 7m$
	Event Size	Number of accreditations	Persons	Summer: 100 if $\leq 150k$ ; 80 if $\leq 200k$ ; 60 if $\leq 250k$ ; 40 if $\leq 300k$ ; 20 if $\leq 350k$ ; 0 if $> 350k$
Social	Public Approval	Public approval of event	Share of respondents in polls that supports hosting the event	100 if $\geq 90\%$ ; 80 if $\geq 80\%$ ; 60 if $\geq 70\%$ ; 40 if $\geq 60\%$ ; 20 if $\geq 50\%$ ; 0 if $< 50\%$
	Social Safety	Displacement of population	Number of people directly displaced by the preparation for the event	100 if no displacement or relocation; 80 if temporary displacement (often homeless people during the Games); 60 if permanent displacement of less than 100; 40 if permanent displacement of more than 100 but less than 500 people; 20 if permanent displacement of more than 500 but less than 1000 people; 0 if permanent displacement of more than 1000 people
	Rule of Law	Infringement or curtailment of rights	Extent and severity of changes in the legislation due to the event	100 if no change or inconsequential changes that do not benefit event owner; 80 if minor, event-related changes that do not infringe human rights and freedoms but benefit event owner (e.g. tax exemptions, immigration facilitation); 60 if one minor, event-related change that also infringes human rights and freedoms (e.g. limiting free speech in a circumscribed way); 40 if several minor, event-related changes that also infringe human rights and freedoms; 20 if one major change in at least one legal code that infringes significantly human rights and freedoms (e.g. facilitation of expropriation); 0 if several

(Continued)

Table I. (continued)

Dimensions	Indicators	Proxy	Unit	Scoring Criteria
Economic	Budget Balance	Cost overrun	Percent of bid budget	major changes in multiple legal codes that infringe significantly human rights and freedoms 100 if $\leq 10\%$ ; 80 if $\leq 20\%$ ; 60 if $\leq 40\%$ ; 40 if $\leq 60\%$ , 20 if $\leq 80\%$ , 0 if $> 80\%$
	Financial Exposure	Share of public funding	Percent of final sports-related costs	100 if $\leq 15\%$ ; 80 if $\leq 30\%$ ; 60 if $\leq 45\%$ ; 40 if $\leq 60\%$ , 20 if $\leq 75\%$ , 0 if $> 75\%$
	Long-term Viability	After-use of venues	Number of venues with high degree of capacity utilization after the event, out of a basket of 6 venues	100 if all venues used with high degree of capacity utilization; 80 if 5 out of 6 venues used with high degree of capacity utilization 60 if at least 4 out of 6 venues used with high degree of capacity utilization; 40 if at least 3 out of 6 venues used with high degree of capacity utilization; 20 if at least 2 out of 6 venues used with high degree of capacity utilization; 0 if 1 or 0 out of 6 venues used with high degree of capacity utilization All temporary venues that are dismantled after the event are counted as long-term viable. Retrofitting and remodeling are permitted. The score is based on after-use as of end of 2019.

**Table 2.** Sustainability score results.

Dimension	Indicator	Müller et al. (2021) Tokyo 2020 prediction	Tokyo 2021 post hoc score
Ecological	New construction	60	80
	Visitor footprint	0	100
	Event size	20	100
	Subtotal	80	280
Social	Public approval	60	0
	Social safety	20	20
	Rule of Law	80	60
	Subtotal	160	80
Economic	Budget balance	Missing (0 used)	0
	Financial exposure	40	20
	Long-term viability	Missing (0 used)	100
	Subtotal	40	120
Total		280	480

### *Ecological dimension*

**New construction.** New construction was evaluated by measuring the share of newly built sport venues as a percentage of the Games' total number of sport venues. Müller et al. (2021) projection for the Tokyo 2020 Games was 20.5% new construction out of a total of 39 venues, which yields a score of 60 (Müller et al., 2021). However, according to a report from the Tokyo OCOG, the number of newly constructed venues was 43, which lowers the new construction rate to 18.6% and yields a score of 80 (TOCOG, 2020). The scores were based on the criteria of 80 for a percentage of new construction more significant than 10% and less than or equal to 20%. Therefore, Tokyo 2020 venue construction was largely not impacted by the delay in the event or the COVID pandemic.

**Visitor footprint.** The number of tickets sold estimated the footprint of visitors. In the original projections, it was estimated that close to 9 million tickets were to be sold to the various events at the Tokyo 2020 Games. However, due to the COVID-19 pandemic preventing spectator attendance, it is estimated that fewer than 273,000 spectators may have been present for a rate of 3.5% of the projected attendance (Nakamura, 2021). Therefore, the score for the original project was 0 due to ticket sales exceeding 7 million, but the actual event yielded a score of 100 due to fewer than 3 million spectators attending. Therefore, lack of spectators may be considered responsible for a considerable gain to the visitor footprint score.

**Event size.** Event size was estimated based on the number of accredited attendees (e.g. athletes, coaches, team members, officials, staff, and other dignitaries). The original projection was to expect 300,000 accredited attendees (Marchant, 2021), but COVID-19 pandemic safety measures limited the size of the event to just under 80,000 attendees

(TOCOG, 2021). The projected score was 20 since the number of accredited attendees was expected to fall between 300,000 and 350,000 attendees, while the actual score became 100 due to the event having fewer than 150,000 attendees. Again, the decreased size of the event led to significant gains in the scores.

*Overall ecological dimension.* Original projections for the Tokyo 2020 Games by Müller et al. (2021) were scored at a collective 80, while the actual event yielded a much higher collective score of 280. Compared to all the other Olympic events considered by Müller et al. (2021) from 1992 through 2020, the Tokyo 2020 Olympics were the most ecologically friendly Games, with the score far surpassing the previous high score of 220 from the Barcelona 1992 Summer Games and Albertville 1992 Winter Games. In both instances, the Barcelona and Albertville Games scored 100s in visitor footprint and event size, matching Tokyo's scores. However, Tokyo differentiates itself from these two Games with a high score of 80 for new construction. This high ecological score is primarily attributed to the lack of spectators and decreased size of official attendees. Due to the timing of the COVID-19 pandemic, new venue construction would have been almost complete, and there would have been no feasible means to cease construction of new venues to improve the score for the ecological dimension and overall sustainability score. If the Tokyo Games were to advance as projected (assuming the COVID-19 pandemic never came to be), then the Tokyo ecological score would have been tied for the lowest score of the events considered by Müller et al. (2021) along with the Beijing 2008 Summer Games and Sochi 2014 Winter Games.

### *Social dimension*

*Public approval.* Public approval was measured by polls surveying public support for hosting the Olympic Games. The original projection was for 70% public approval for the event, which received a score of 60 for greater than or equal to 70% public approval (Müller et al., 2021). Unfortunately, the actual event received far less public support, with less than 20% of the general public approving of hosting the Olympic Games during the COVID-19 pandemic (Dunbar, 2020; Inoue, 2021). This dropped the score from 60 to 0 for receiving less than half of the public's approval.

*Social safety.* The number of people directly displaced by the Olympic Games event preparation was the proxy for social safety. Projections for social safety scores from Müller et al. (2021) suggested approximately 550 people would be displaced by the Tokyo Olympic Games, which earned a score of 20. In this case, the projection was somewhat accurate even in the context of the pandemic-delayed event. Approximately 231–300 households were displaced, for an estimated total of 554–720 individuals displaced (McDougall & Ross, 2021; TOCOG, 2020). Despite being slightly higher than the original projection, this keeps the same score of 20 in the sustainability score metric.

*Rule of law.* This final indicator of the social dimension considers the infringement or curtailment of rights measured by the extent and severity of changes in legislation tied to the Games' demands. The original projections for the Tokyo 2020 Games yielded a high

score of 80 due to limited changes in legislation. The only changes projected were minor changes that did not infringe upon human rights or freedoms: strict anti-doping laws and additional public holidays for the residents (Müller et al., 2021). Protections for human rights were already guaranteed under pre-existing laws. The actual Games received a slightly lower score of 60 due to the introduction of laws largely meant to curb the spread of the COVID-19 pandemic: infringement upon residents' rights due to the influx of foreign individuals for the Games were introduced, tracking visitors' movements via GPS, and requiring businesses to close early to limit the spread of the virus (Takahashi & Vasquez, 2021; Wamsley, 2021).

*Overall social dimension.* The overall social dimension score for the Tokyo 2020 Olympic Games was 80 compared to the projection of 160. Similar to the ecological dimension, the changes in the scores are largely due to the COVID-19 pandemic. Most of the drop in the social dimension score results from the massive loss of public approval for the event due to the pandemic, which is a unique circumstance to this edition of the Games compared to the others Müller et al. (2021) reviewed. The Tokyo Summer Games were not projected to have the highest score for the social dimension, but they were just 20 points shy of matching the high score held by Barcelona 1992, Atlanta 1996, Sydney 2000, and Pyeongchang 2018. Instead, the actual score of 80 matches the lowest social dimension score from Müller et al. (2021) for the Rio de Janeiro 2016 Games, Albertville 1992 Winter Games, and Sochi 2014 Winter Games.

### *Economic dimension*

*Budget balance.* Cost overruns were the proxy for budget balance and were measured by comparing the actual budget to the proposed budget in the bid for the event. Data for the original budget balance were not available. They were effectively assigned a score of 0 (Müller et al., 2021), but this may potentially have been because the event had not yet taken place. The actual Tokyo 2020 Summer Games overran the bid budget by upwards of 400% (Carp, 2020; Cervantes, 2021), which means it kept the score of 0 for budget balance.

*Financial exposure.* Financial exposure is meant to estimate the share of public funding for the Games and was measured via the percentage of the final sports-related costs that the public had to pay. The projections from Müller et al. (2021) put the Tokyo 2020 Olympics share of public funding at 56.6% for a sustainability score of 40. As of December 2021, the exact figure of the public financial burden is not yet known, but early reports have suggested that taxpayers will be responsible for most of the costs, with estimates as high as 75% in some cases (Wade, 2021; Yee Hee Lee & Denyer, 2021). This will drop the sustainability score to 20 if this turns out to be the actual public financial burden for the Tokyo Summer Games.

*Long-term viability.* This indicator considered the potential use of venues after completing the Olympic Games event. In particular, it was measured by taking a basket of six venues from the whole of the event and counting the number of those six venues with a high

degree of capacity utilization beyond the event itself. Data for the original projection from Müller et al. (2021) were missing, but the event had not yet taken place to determine an accurate score. For their analysis, an assumed score of zero was assigned. Post Tokyo 2020, all venues will have a high degree of capacity utilization, with a total of six out of six venues meeting the benchmark (TOCOG, 2020). This earned the Tokyo 2020 Olympics a score of 100 for long-term viability. In the years to post Tokyo 2020, this particular score may need to be readjusted if venues decrease utilization.

*Overall economic dimension.* The original projection for the economic dimension score was 40 based on the findings from Müller et al. (2021), but the actual Tokyo 2020 Summer Games economic score was higher than the projection: 120. Most of this gain in the score comes from the long-term viability of the venues. However, as indicated in the analysis of this score, this may need to be readjusted in the future. It is potentially too early to fully project the long-term viability of the Tokyo 2020 Olympics venues. The projected score of 40 would have been the lowest of all economic sustainability scores from 1992 through 2020, but the rise to a score of 120 places Tokyo 2020 firmly in the middle of the pack of these Games (Müller et al., 2021). Again, the long-term viability indicator score is highly influenced both high and low, which may be subject to change in the future.

## Discussion

Considering the Tokyo 2020 Summer Games scores, there are many points of discussion to address both theoretically and practically. Comparison of the results to other events, the further testing of the research method from Müller et al. (2021), implications of the COVID-19 pandemic, contribution to sport ecology research and legacy, and limitations will be explored in detail in the section that follows.

This study further examined Müller et al. ' (2021) sustainability model by following up on its predictions for the Tokyo 2020 Summer Games with events' actual counts. The projections, in some cases, were far off from the actual size of the event, but this is mainly due to the COVID-19 pandemic delaying and then fundamentally altering the event by limiting spectators, limiting accredited attendees, and decreasing public approval. About the ecological dimension, it should be no surprise that the model yields a much higher score due to the limitations on spectators and accredited attendees. Both scores had shifted from 0 (visitor footprint) and 20 (event size) to 100s for both indicators, while new construction only slightly improved from 60 to 80 since the construction of the venues had already taken place and could not be reversed in response to the pandemic. This illustrates how the ecological dimension of the model from Müller et al. (2021) is highly sensitive to attendance and event size changes. While travel does account for a significant portion of a carbon footprint (Intergovernmental Panel on Climate Change, 2014), it does not account for even half of the carbon footprint of human activity. This model can provide a snapshot examination of the ecological impact of the Tokyo 2020 Olympic Games. Still, much of the ecological impact may not be felt until years or decades later. This is an area for the future expansion of this model. This was a limitation that Müller et al. (2021) noted in their research that the definition of "sustainability" is



entirely subjective. It seems that subjectivity remains in the eyes of the researcher. This also affirms other previous criticism of ‘sustainability’ as too malleable as a term and concept (Gold and Gold, 2013; Holden et al., 2008). Alternatively, the social and economic dimensions were not highly impacted by the COVID-19 pandemic other than the loss of public approval for hosting the event. The large changes in scores in the economic dimension could be explained by the lack of data more than by changes to the event itself due to the pandemic.

While the results were influenced by the lack of spectators, lack of accredited attendees, and the loss of public approval, the Tokyo 2020 Games provide unique opportunity to have studied the Olympics from the ecological dimension precisely because of the COVID-19 pandemic and attendance restrictions. Previous editions of the Games have not had the limitations that Tokyo 2020 had. In several decades, there may not be another edition of the Games with these limitations again. This allowed the Tokyo 2020 Games to break the trend of the Summer Games having a larger ecological footprint than the Winter Games due to the limitations they were presented with (Müller et al., 2021). Yet, while Japan had ambitious sustainability goals for the Tokyo 2020 Games, it seems that their ecological success was the cause of a mere accident. It appears that Geeraert and Gauthier’s (2018) criticism of how the IOC has fallen short of its sustainability objectives may be warranted. Had the COVID-19 pandemic not occurred, the Tokyo 2020 Games would have remained one of the Games’ lowest-scoring editions in the ecological dimension (in addition to low projected scores in the social and low actual scores in the economic dimensions). Perhaps awarding Tokyo the title of “most ecologically friendly Olympic Games since 1992” might be somewhat disingenuous? It would be unrealistic to view Tokyo 2020 as a benchmark to compare future editions of the Games against since they will allow spectators, all accredited attendees, to travel and will most likely not have the limitations placed on them that Tokyo 2020 had to endure.

For a positive contribution, this research adds to the growing body of research in sport ecology and environmental sustainability in the Olympic Games by highlighting that travel is a significant contributor to the carbon footprint of the Olympic Games. This confirms past research on the impact of travel from Chard and Mallen (2012), Dolf and Teehan (2015), as well as Wicker (2018). To decrease their carbon footprints, all future editions (e.g. Beijing 2022 Winter Games, Paris 2024 Summer Games, etc.) should encourage spectator and accredited attendee travel through more environmentally responsible means. Of course, responsibility for travel impacts may fall onto the IOC and event organizers or the travel industry itself. Still, undoubtedly this needs to be addressed in future editions of the Games to reduce the overall carbon contribution of these events – especially considering the Intergovernmental Panel on Climate Change’s 1.5°C global average temperature rise goal.

Moving forward, the long-term viability indicator, legacy, and actual ecological impacts of the Tokyo 2020 Games may not be fully understood for years to come. Similarly, the political and power dynamics associated with ecological modernization are not assessed as well as underdeveloped (c.f., Wilson & Millington, 2013). With all the long-term legacies of the Olympic Games, we know that they are moving targets (Chalip, 2018). The responsibility should be focused on ensuring these positive

ecological legacies (and other legacies) remain with the host communities themselves since the organizing committees dissolve and the IOC moves on (Ross et al., 2019). This is something that Müller et al. (2021) note in their research. While the Rio 2016 Summer Games were overpromised and under-delivered concerning sustainability (Boykoff and Mascarenhas, 2016), it remains to be seen if this will be true for Tokyo. With certainty, we can establish that Tokyo is off to a better start on long-term ecological sustainability simply due to the limitations of the event. Still, the accurate measurement of ecological sustainability will need to be revisited multiple times over the next several decades. Follow-up research utilizing a model other than that from Müller et al. (2021) will need to be used since this model does not account for those long-term legacies nor does it account for political and power dynamics associated with the perspective of ecological modernization.

Lastly, we must reiterate the limitations of this research, as explained in the methods. At the time data were collected to evaluate the sustainability of the Tokyo 2020 Summer Games, final reports from the Tokyo organizing committee had not been published. Alternatively, missing data were pulled from the official Olympic Organizing Committee Pre-Games reports, press releases, updates, and webpage content on the official Tokyo 2020 website, academic journals, and popular press articles. Despite these limitation, data were verified by multiple sources. The researchers acknowledge that the final reports (specifically economic) from the Tokyo Organizing Committee would provide the most accurate data, however, given the timeline of the research, best efforts were made to verify and attain accurate data through various sources used in Müller et al.'s (2021) research and other sources mentioned above. Following the previous discussion point of revisiting the long-term ecological impact and long-term viability of infrastructure, future research should include the official final reports from the Organizing Committee as they become available.

## **Conclusion**

The purpose of this study was to evaluate whether the Tokyo 2020 Olympic Games met their sustainability objectives and specifically to compare the Games sustainability performance (ecological, social, and economic dimension) to the prediction presented in Müller et al.'s study (2021). The research contributes to the conceptual model of Müller et al., but more generally to sport ecology by expanding the scope and depth of scholarship in this area. Subsequently, this contributes to the legitimacy of sport ecology. The findings also expand the literature on environmental sustainability, particularly in the context of the Olympics. Furthermore, the significance of this work is in its applicability outside the scope of the Olympic Games. Although the Olympics are the ultimate sporting event, it is not the only mega-event, and lessons learned from the Olympics can easily be transferred and adapted to other large-scale events.

Our work is also valuable to future Olympic host cities as well as scholars conducting work on the intersection of sport and sustainability. More specifically, work in the area of sport mega-events and mega-events in general, and the impact of such events on urban development. It provides a holistic approach to empirically evaluate and conceptualize sustainability within the Olympics. Previous work in this area, and specifically in the

context of the Olympics, has had some limitations from an assessment point of view. For example, some scholarship has only evaluated the social aspect of the Games (Kennelly and Watt, 2011), or has based the evaluation on a comparison to a similar host community setting (BACI method). While our work does assess the 2020 Olympic Games and in this sense is similar to previous work, at the same time it is different as it provides a comprehensive evaluation based on both quantitative and qualitative metrics. Additionally, it diverges from other scholarship in presenting an assessment of a rather unusual and unique setting, in which spectators were not allowed at the stands. This in turn, delivers lessons that may raise questions of re-evaluating the Olympic movement as a whole and values of Olympism in particular. From a policy standpoint, this work sets the stage for revising existing policies and answering the question of how realistic it is to host Games that are sustainable. Furthermore, we hope that our work would trigger global discussions about possibly scaling down the size of the Olympics, which has been suggested before, and focus more on how to leverage the event within the context and characteristics of the local community.

Event management and the sustainability aspect of mega-events must ensure that the main objective is not to simply achieve a green legacy but rather to utilize the local characteristics of the host community and strive to leverage the event. As Chalip (2018) emphasized, such an objective is more challenging and requires careful strategic planning. Suppose sustainability is to be viewed as a reality and not an illusion. In that case, efforts need to integrate the Olympics and other mega-events into the local community. For example, in preparation for the Paris 2024 Summer Games, the Organizing Committee plans to host the first major sporting event to positively impact the climate by carefully and strategically incorporating urban development into the Olympic project. Paris has committed to using existing or temporary facilities whenever possible and avoiding new construction while focusing on urban heritage planning and preservation. The goal is for the Paris Games to showcase a new pathway for hosts to embed the Games within an existing city, maintaining the unique local culture, infrastructure, and governmental and social elements. In general, sustainable mega-events and the Olympics can be achieved only if the events are embedded in a carefully planned long-term strategy. In other words, there is a potential for the Olympic Games to become a risky endeavor if they do not support the host regions and local community's long-term strategy.


### **Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### **Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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