CHAPTER 23

Enviro1ron1mentally Sustainable Design in Sports

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Overview: Kellison traces the history of concerted efforts to make large-scale sports venues and events more environmentally sustainable. He cites a number of examples of important pro-environment initiatives and a notable increase in new stadiums with sustainable designs, but cautions that “even the greenest sports facility can carry an environmental cost.” Kellison also comments on the value of sports as a platform to raise awareness of the need for good environmental stewardship.

In 2008, Nationals Park opened in Washington, DC. The home of the Washington Nationals, a major-league baseball team, the stadium became that same year the first professional sports facility to earn LEED (Leadership in Energy and Environmental Design) certification from the US Green Building Council, an organization that promotes sustainable building practices. The LEED rating system has since become the accepted standard for recognizing environmentally friendly sports facilities in North America (Kellison and Kim 2014). The ballpark’s LEED certification was achieved in part because of its location along major public transportation lines, its stormwater-management system, and its sourcing of recycled, local, or low-emitting construction materials (Henly, Hershkowitz, and Hoover 2012). More than seventy major sports facilities have earned LEED certification around the world, in countries including the United States, Canada, Brazil, Spain, and Australia (Center for Sport and Urban Policy 2018a).

The growing number of sustainable arenas, ballparks, and stadiums since 2008 might lead one to assume that the protection of the natural environment is now a mainstream issue within big-time sports, and that all sports organizations have adopted environmentally sustainable practices. In reality, far more major sports facilities have been constructed in the past decade without recognized pro-environmental designs (Kellison and McCullough 2017). Issues of cost, lack of technical expertise among an organization’s staff, and decision makers’ lack of awareness of environmental issues are some of the reasons...
why sustainable design in sports has not become widespread (see, e.g., Trendafilova, Kellison, and Spearman 2014). Additionally, engineering a building that can minimize the environmental impact of tens or hundreds of thousands of occupants requires advanced systems, human ingenuity, and forward-thinking leaders.

Despite the slow rate of adoption of sustainable design among sports organizations, a number of managers have embraced sustainability as a central tenet of their organizations, events, and facilities (Kellison and Hong 2015). These cases are the focus of this chapter, which describes the history of environmentally sustainable design in sports and possibilities for the future. It begins with a summary of when and where sustainable design emerged as an issue in sports. The discussion then turns to the different ways in which facilities may be designed in an environmentally friendly manner and current challenges to delivering a pro-environmental sporting experience. The chapter concludes with a vision for sustainable design in the future.

**THE EMERGENCE OF SUSTAINABILITY AS A CONCERN IN SPORTS**

The fundamental link between sports and the natural environment is demonstrated daily on the grassy field, frozen pond, whitewater river, mountain slope, or any of the other natural areas on which people of all ages rely to participate in sporting activities (Sato et al. 2017). As leisurely play and friendly competition grow into big-time sports, training facilities and competition venues built to support both elite athletes and large numbers of spectators can produce a significant environmental impact. As discussed further in the next section, long before professional sports organizations at large publicly recognized their important relationship with the land around them, organizers of the Olympic and Paralympic Games championed the need for sports organizations (including the venues in which their events took place) to be better stewards of the natural environment.

**ENVIRONMENTAL ACTIVISM AND THE GREENING OF THE OLYMPICS**

As the governing body of the Olympic and Paralympic Games, the International Olympic Committee (IOC) has ultimate authority on all aspects of the events, including selecting the location where the games will be held and defining the regulations to which a host city must adhere. In the 1990s the IOC adopted environmentalism as a mainstay of the Olympic Charter, the chief document
Chapter 23: Environmentally Sustainable Design in Sports

directing the organization and its events (Samuel and Stubbs 2013). The mandates of the Olympic Charter have become increasingly important as the Olympic and Paralympic Games have grown into highly lucrative mega events. Even before the commercial expansion of the games, however, the event’s environmental impact had already drawn the public’s attention. Much of the IOC’s focus on sustainability can be traced to a long history of environmental activism, especially concerning the location of permanent or temporary competition venues. For example, during preparation for the 1932 Winter Games in Lake Placid, New York, a planned bobsleigh run was relocated after a local activist group protested upon learning the original site would require the felling of 2,500 trees (Chappelet 2008). Environmental activism likely played an even more significant role in the case of the 1972 Winter Games. The IOC’s unlikely selection of Sapporo, Japan, as the host city was a result, at least in part, of environmental groups’ loud public opposition to the presumed favorite, Banff, in Alberta, Canada (Chappelet 2008).

As host cities continued to grapple with environmental concerns, the IOC was forced to examine its own responsibility to promote environmental stewardship following the 1992 Winter Games in Albertville, France. There, organizers were confronted by public concerns that the competition venues for bobsleigh and skiing were designed and constructed without much consideration for the natural environment. In one example of environmental groups’ frustration with the IOC and local organizers, demonstrators organized a march prior to the opening ceremony in which they carried “coffins as a representation of the environmental damages caused by the games” (Chappelet 2008, 1892). According to Hart Cantelon and Michael Letters, the impact of the Albertville Games was an “environmental disaster” that would not have occurred had “the IOC had in place a carefully considered policy for environmental protection” (2000, 300–301). As the environmental issues in Albertville were unfolding, the Lillehammer Olympic Organizing Committee (LOOC) was preparing to host the 1994 Winter Games in Norway. Hoping to avoid similar criticism, the LOOC began collaborating with environmental groups following an initial clash over the proposed location of a speed-skating rink in Åkersvika, which the environmentalists said was too close to a bird sanctuary. Though sustainability was not part of the host city’s original bid, the Lillehammer Games emerged as the first “green games,” exemplified by the LOOC’s formal establishment of five environmental goals (Lesjø 2000). One such goal was to ensure environmentally friendly arenas by using sustainably sourced materials, minimizing the facilities’ impact on the surrounding terrain, and planning for local use of facilities after the games were done (Official Report of the XVII Olympic Winter Games Lillehammer 1994b).

Lillehammer organizers also “hoped that the environmental work they initiated would be followed-up by the IOC” and that their example would lead the IOC “to give the Olympic Movement a third dimension, environment” (Official Report of the XVII Olympic Winter Games Lillehammer 1994a, 126). The environmental failure of Albertville and success of Lillehammer coincided with several key initiatives implemented by the IOC in the 1990s, including new requirements that host cities deliver the games in a manner that demonstrates environmental care and the adoption of the environment as the third pillar of Olympism (joining
the existing pillars of sports and culture). When developing a long-term legacy plan around the Olympic and Paralympic Games, local organizers and governing bodies are faced with unique challenges related to sustainability and the natural environment. To confront and resolve these challenges, the IOC developed a formal environmental management policy, part of which mandates that prospective host cities include comprehensive environmental legacy plans in their bid books. In response to these environmental guidelines, many Olympic host cities have endeavored not only to meet the IOC’s minimum standards but to use the games to demonstrate their long-term commitment to environmental stewardship (Kellison and Casper 2017). After the “green games” held in Sydney, Australia, in 2000, subsequent Olympic hosts have tried to build off their predecessors and provide more innovative sustainability-focused programming and facilities (Westerman 2010). The following list is a sample of facility-centered environmental initiatives:

- For the 2002 Winter Games in Salt Lake City, Utah, the vast majority of competition venues were existing buildings, largely eliminating the need to construct new venues for the sole purpose of the Olympics. For the three facilities constructed for the games, organizers committed to building them “specifically to be energy-efficient using minimal materials for construction” *(Official Report of the XIX Olympic Winter Games: Salt Lake 2002*, 195). The Utah Olympic Oval, for example, was designed to allow the roof to be lowered by twenty feet. This modification decreased the overall building volume by more than one million cubic feet, thereby reducing heating and cooling demand.

- Organizers of the 2004 Summer Games in Athens, Greece, implemented the Environmentally Sustainable Waste Management Programme of the Olympic and Paralympic Games in all competition and noncompetition venues, which resulted in the collection and recycling of 970 tons of plastic, 675 tons of paper, and almost 10 tons of used cooking oils *(Official Report of the XXVIII Olympiad: Athens 2004* 2005).

- More than 350 sustainability-focused programs were implemented in the venue construction stage of the 2008 Summer Games in Beijing, China. These programs focused on green energy production, reduction in overall energy consumption, and water conservation. In one example, the iconic National Stadium (or Bird’s Nest) used a solar photovoltaic system to power the stadium’s underground parking facilities *(Official Report of the Beijing 2008 Olympic Games* 2009).

- Environmental stewardship was a central focus of organizers for the 2010 Games in Vancouver, British Columbia. All new facilities constructed for the Games were designed to meet LEED Silver standards. Additionally, as in Salt Lake City, a number of existing buildings were used with minimal changes. One such venue, Canada Hockey Place (now known as Rogers Arena), a competition venue for men’s and women’s ice hockey, was already used for National Hockey League (NHL) games; the ice dimensions were narrower than those designed for international competition. Rather than reconfiguring Canada Hockey Place, the original dimensions were retained, resulting in “both financial savings and conservation of natural resources” *(Vancouver
2010: Sustainability Report 2010, 117). It also marked the first time Olympic ice hockey was played using NHL rink regulations.

- As part of its goal to deliver a “low carbon Games” in 2012, the London Organizing Committee of the Olympic and Paralympic Games committed to using “existing venues wherever practical, to build new permanent venues only where there was a strong legacy case and, finally, to use temporary structures for all other needs” (London 2012 Post-Games Sustainability Report 2012, 18). The centerpiece of this plan was the Olympic Stadium (now London Stadium), which was reconfigured from an 80,000-seat stadium during the Games to a 57,000-seat Premier League venue. However, the post-Games conversion of the stadium has brought with it much criticism over escalating costs and poor viewing sightlines (Kellison and McCullough 2017).

- Organizers of the 2014 Winter Games in Sochi, Russia, partnered with Coca-Cola to implement a zero-waste program. This partnership allowed for 97 percent of waste to be recycled directly at competition venues (Sochi 2014 Official Report 2015b).

- Coming off their hosting of the 2014 FIFA Men’s World Cup and following the example of previous host cities, organizers of the 2016 Summer Games in Rio de Janeiro, Brazil, pledged to build “only what [was] strictly needed, avoiding the so-called ‘white elephants,’ venues that have no commercial viability after the Games” (Embracing Change 2014, 3).

It is worth noting that although official post-Olympic Games reports from local organizing committees have touted their sustainability programs and facilities, other sources suggest that the games have continued to be fraught with environmental problems. For example, while the UN Environment Programme indicated that the “Beijing Olympics met or exceeded [organizers’] green goals” (Gronewold 2009), a second report described Beijing as “the most polluted games ever” (Jamieson 2009). Contrasting conclusions also were presented following the Sochi Games. Organizers there acknowledged that the “ambitious tasks [outlined in Sochi’s bid] required the implementation of . . . programmes on preserving the region’s natural diversity [and] the establishment of new environmental standards” (Sochi 2014 Official Report 2015a, 10), but Martin Müller’s analysis of Sochi’s execution of the games concluded that organizers fell short of the environmental advances they promised. Outlining the damage to the Mzymta River, near Sochi, he noted: “Organisers modelled the Olympic sustainability agenda on international best practice from previous editions of the event, which they considered to represent the state-of-the-art of sustainability. Yet, as the preparation for the Olympic Games proceeded apace, it became clear that the actual outcomes from this mobilisation of policies from elsewhere were going to belie the ambitions” (2014, 192).

Even before the 2016 Summer Games in Rio had closed, reports of environmental issues began to surface. After describing the host city’s failure to treat wastewater in Guanabara Bay and the Jacarepaguá Lagoon, James Young (2016) concluded: “Rio has broken its promise of an environment-friendly Olympics.” And while organizers codified their intention to build venues with post-Olympics occupancy in mind, in the months that followed the closing ceremony, it
quickly became clear that economic problems and mismanagement were derail-
ing Rio’s legacy planning. As one article put it, Rio was an “Olympic ghost town” because of unpaid bills and vacant competition venues (Wade 2017). The state of Rio’s Olympic venues was further detailed in a 2017 report for ESPN by Wayne Drehs and Mariana Lajolo, noting that many of them “sit largely abandoned, their decay and disrepair a constant reminder of what was meant to be. Even the iconic soccer stadium, the Maracaná, has been vandalized, and had its power shut off completely after amassing a $950,000 electric bill.” The Olympic park, “long hailed by Brazilian politicians and Olympic proponents as a path to upgrade one of Rio’s poorer neighborhoods, is shuttered.” Pools meant for community use were “abandoned,” dirty, and rodent-infested. After the games, according to the authors, “the city solicited bids for private companies to run the park, but no one bid, leaving Brazil’s Ministry of Sport with the task—and expense” of $14 million. Plans to turn the handball arena into public school buildings were scrapped, and the athletes’ village, a complex of thirty-one towers, rather than being turned into housing as planned, sat empty (Drehs and Lajolo 2017).

These cases illustrate the gaps that can develop between mega-event ideation and delivery. However, despite the complexity of deploying a successful pro-environmental program at an international mega event and the inevitability of challenges like these, future host cities continue to promote robust and innovative plans. In fact, Paris and Los Angeles, host cities of the 2024 and 2028 Olympic and Paralympic Games, respectively, announced a cooperative agreement in which the two organizing committees will engage in information sharing “in order to create a new gold standard of sustainability for major international sporting events” (Memorandum of Understanding on Olympic Cooperation 2017, para. 9).

SUSTAINABILITY IN PROFESSIONAL AND COLLEGIATE SPORTS

In a 2011 New York Times article, Ken Belson challenged the idea that there is no inherent link between sports and sustainability. Speaking in particular about US sports, he observed, “American sports are often an exercise in excess: fans consume large quantities of beer and hot dogs, stadiums with giant scoreboards and retractable roofs are surrounded by parking lots filled with thousands of cars. In many ways, they represent the broadest cross-section of consumer culture and America’s wasteful ways.” And yet, he continued, “the sports industry—from teams to leagues to stadium and track operators—is becoming more environmentally friendly” (Belson 2011, F6). Although only a handful of organizations were seriously promoting eco-friendly initiatives, it was also becoming clear that sustainably designed sports stadiums were not just passing trends.

Although some sports organizations were already employing sustainable practices such as installing energy efficient lighting (Balint 1986), conserving water (Brady 1991), recycling construction materials (Wilgoren 1991), and recycling in-game waste (Trumbull 1992), the earliest example of a professional sports stadium designed with a pro-environmental focus is Lincoln Financial Field, built in 2003 and the home of the National Football League’s (NFL)
Philadelphia Eagles. According to a report by the Natural Resources Defense Council (NRDC), “it was the first green renovation focused on a professional sports stadium” (Henly, Hershkowitz, and Hoover 2012, 18). The NRDC provided technical expertise for the stadium’s environmental design, and Lincoln Financial Field served as an exemplar of what green stadiums could provide: “This work set the stage for future sports facility greening templates. There was no precedent for this type of work, but the ecological impacts chosen as the project’s greening focus were obvious: energy use, paper products, water usage, waste generation, the use of chemicals for cleaning, and the health and ecological attributes of the food” (Henly, Hershkowitz, and Hoover 2012, 18). The NRDC was instrumental in the early development of sustainable stadium designs, and in the years following its work with the Philadelphia Eagles, the organization partnered with various leagues and events to promote the benefits of facility and event greening to team owners, stadium operators, and sports fans.

The sports and sustainability movement gained further legitimacy in 2010, when the NRDC partnered with six professional sports teams—the Seattle Mariners (Major League Baseball [MLB]), Seattle Seahawks (NFL), Seattle Sounders (Major League Soccer [MLS]), Seattle Storm (Women’s National Basketball Association), Portland Trail Blazers (National Basketball Association [NBA]), and Vancouver Canucks (NHL)—to form the Green Sports Alliance. Since its founding, it has swelled to an organization of nearly five hundred sports teams and facilities across fifteen leagues and fourteen countries (Green Sports Alliance 2018). In addition to promoting sports and sustainability throughout North America, the Green Sports Alliance paved the way for similar organizations to form around the world, including the British Association for Sustainable Sport (BASIS), Australasia’s Sports Environment Alliance (SEA), and Sport and Sustainability International (SandSI).

The initial wave of sustainable sports in North America coincided with an increase in stadium constructions across all major sports leagues (McCullough, Pfahl, and Nguyen 2016). Since 2005, more than fifty major stadium constructions or renovations have taken place across MLB, MLS, the NBA, the NFL, and the NHL (Center for Sport and Urban Policy 2018b). Each project provided team owners, local policy makers, and other decision makers with the chance to consider integrating large-scale sustainability-focused designs in the new stadium. The stadium construction boom, coupled with the growing popularity of the US Green Building Council’s LEED rating system in the late 2000s, led to an impressive number of sustainability “firsts” among sports stadium projects.

Many of these firsts occurred at the college level, including the first LEED-certified baseball stadium (Pennsylvania State University’s Medlar Park at Lubrano Park, in 2006), the first LEED-certified football stadium (University of Minnesota’s TCF Bank Stadium, in 2009), and the first LEED Platinum sports stadium (University of North Texas’s Apogee Stadium, in 2011) (Center for Sport and Urban Policy 2018a; Henly 2013).

The greening of college sports is distinct from that of professional sports. At the professional level, the prevailing conventional wisdom is that sports organizations can leverage their widespread appeal and popularity to increase fans’ awareness of environmental issues and at-home, pro-environmental behaviors.
(Kellison, Trendafilova, and McCullough 2015; McCullough and Cunningham 2010). While consumers can certainly exert pressure on management at the professional level, the decision to adopt eco-friendly practices largely comes from owners and local officials (Kellison and McCullough 2016). The rise of sustainability among collegiate athletic departments, on the other hand, more closely resembles that of sustainable practices in Olympic host cities impelled by the influence of activists and local citizens. For example, at the University of Colorado Boulder (Figure 1), a leader in sustainability and sports, “student support for more sustainable practices is the driving force behind greening efforts across the university” (Henly 2013, 22). Student-led initiatives are a key reason college athletic programs have become models of sustainable stadium design and operations in North American sports.

DESIGNING A GREEN SPORTS STADIUM

In 2017 an example of the stadium construction trend occurred in Atlanta, Georgia, which opened two new professional sports stadiums, Mercedes-Benz Stadium (football) and SunTrust Park (baseball); a third facility, State Farm Arena,
was undergoing renovations expected to be completed in time for the start of the 2018–2019 NBA season. The cost of these facilities was more than $2.3 billion, with the public’s share accounting for more than $640 million (Center for Sport and Urban Policy 2018b). State Farm Arena, LEED-certified since 2009, was quickly joined by the two new stadiums—Mercedes-Benz Stadium received a top LEED Platinum rating in November 2017 and SunTrust Park was certified LEED Silver in January 2018—and made Atlanta the first US city with three LEED-certified professional sports facilities (as noted in a 25 January 2018, Twitter post by the Center for Sport and Urban Policy). Adding the Georgia Institute of Technology’s Hank McCamish Pavilion, which earned a LEED Gold rating in 2014, Atlanta has four major LEED-certified sports facilities (Center for Sport and Urban Policy 2018a). These ratings reflect the fact that Atlanta’s sports stadiums all have pro-environmental designs, but each is also notable for distinct sustainable features, as summarized in the next section.

FEATURES OF SUSTAINABLE STADIUM DESIGN

Sustainable design begins long before a groundbreaking ceremony. The first consideration is the location of a sports facility, which can affect all other aspects of green building. Stadiums can promote smart growth by using previously developed spaces (thereby preserving open spaces and environmentally sensitive land), promoting alternative transportation, and developing effective stormwater management systems to protect surrounding neighborhoods from flooding. In some cases, developers of major construction projects like sports stadiums have partnered with the local government to redevelop land contaminated with hazardous waste or pollution. For example, before constructing Huntington Park, a minor-league ballpark in Columbus, Ohio, the builders completed brownfield reclamation of a former industrial site (Darbee and Recchie 2008).

As part of a location search, potential stadium sites undergo a comprehensive assessment that identifies the topography, hydrology, climate, vegetation, soil profile, and previous and current uses of the land. This process allows builders to minimize the effect of construction on erosion and sedimentation caused by the movement of heavy machinery, excavation, and grading. Building designers can also explore strategies to reduce what is called the heat island effect, the increase in surface and atmospheric temperature caused by buildings, roads, and other infrastructure (Environmental Protection Agency 2017). A big contributor to the heat island effect in indoor sports stadiums is the massive roof coverings. To reduce this effect, some designers have installed a green, or vegetated, roof. In addition to reducing heat absorption, green roofs last longer and improve building insulation and acoustics. Green roofs have been installed on indoor arenas such as the Barclays Center (Brooklyn, New York) and Target Center (Minneapolis, Minnesota) and even sections of outdoor stadiums like Levi’s Stadium (Santa Clara, California) and Nationals Park (Nonko 2015).

Acquiring and transporting the materials required for building a large sports stadium have significant impacts on the environment. Project managers are encouraged to build with environmentally preferable materials that are locally
sourced, can be recycled or salvaged, and have long life cycles. In 2016 the Forest Green Rovers, a club playing in the fourth tier of English football, announced plans to build a five-thousand-seat stadium constructed almost entirely of wood. This design represents a significant departure from traditional stadium constructions: “Unlike most buildings, around three quarters of the lifetime carbon impact of any stadium comes from its building materials, while the opposite is true for residential and business buildings, where three quarters of the lifetime carbon impact come from the operation of the building.” The plans specify the use of “ethically sourced wood,” which “has very low embodied carbon compared to alternatives such as concrete and steel” (Smale 2017). To mitigate the enhanced risk of fire, architects are “paying close attention to fire engineering standards” in the stadium’s design, including evacuation flow (Gardner 2017).

In addition to the building itself, sustainability-focused construction processes take into account construction waste (such as source reduction and recycling) and the decommissioning of other on-site structures. For example, as Mercedes-Benz Stadium was being constructed to replace the Georgia Dome, officials inventoried all items inside the Dome and marked most to sell or auction, donate, or reuse. Additionally, when the Dome was imploded, its debris was used as infill for a new thirteen-acre greenspace that included biking paths, a playground, and a sports field.

Inside a stadium, designers must account for the significant water demands that come from restrooms, food and beverage services, and irrigating the playing surface and surrounding landscaping (Bunds 2017). To reduce the need for outside sources of water, architects have recently begun integrating rainwater catchment systems in the design of stadium roofing structures; for example, in Dublin’s Aviva Stadium, the rainwater is harvested, stored in an enormous cistern, and used to irrigate the pitch (Aviva Stadium 2012). Even for indoor, artificial-turf stadiums, rainwater can be collected and stored to prevent the overwhelming of municipal drainage systems during storms (Mercedes-Benz Stadium 2018). To reduce water demands associated with large numbers of spectators, green stadiums can install low-flow water fixtures and waterless urinals. During minor renovations to Hard Rock Stadium, in Miami Gardens, Florida, in the mid-2000s, Falcon Waterfree Technologies retrofitted restroom drain systems with waterless urinals, which, according to the company, improved sanitation, saved 8.8 million gallons of water per year, and reduced annual maintenance costs by $22,000.

Once a stadium opens, building operators are responsible for the safety and comfort of all occupants, including athletes, staff, and guests. A facility’s indoor environmental quality is affected by lighting, acoustics, temperature, and air quality. Strategies to improve indoor air quality are to use materials and equipment that reduce exposure to harmful organic chemicals (e.g., volatile organic compounds), implement and enforce no-smoking policies, and give preference to energy-efficient Energy Star appliances when purchasing. Occupant comfort is also tied to a facility’s lighting and heating, ventilation, and air conditioning (HVAC) systems, the latter especially accounting for a significant portion of energy use in sports stadiums.
As green technology both improves and becomes less costly, sports organizations continue to adopt and promote sustainability-focused practices. Though not new technologies, solar arrays and wind turbines are becoming increasingly visible in and around professional and collegiate sports stadiums. Additionally, with more knowledgeable managers and improvements to municipal waste services, facility operators at several college and professional stadiums have instituted zero-waste programs, which refers to diverting materials from landfills through recycling and composting. For the 2016 season, the Ohio State Buckeyes (the athletic teams of The Ohio State University) achieved a diversion rate of 95.4 percent in a stadium that averaged more than 107,000 fans (Ohio State University 2016). That same year, Croke Park officials reported that the Dublin stadium “achieved its waste management goals of zero percent of waste going to landfill” (Croke Park 2016). Additionally, in 2018 the NFL, with corporate partners, launched its first zero-waste stadium legacy project for Super Bowl LII, called Rush2Recycle.

RATING SYSTEMS

As demonstrated throughout this chapter, the US Green Building Council’s LEED rating system figures prominently in the recognition of sustainably focused sports stadiums. The LEED system uses a 110-point scale, and buildings that meet required prerequisites and earn enough credits in the areas of location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation can be rated Certified, Silver, Gold, or Platinum (US Green Building Council 2018). In addition to six or more certified stadiums in each of the four most established sports leagues in North America (MLB, the NBA, the NFL, and the NHL), LEED-certified stadiums include the Maracana in Rio (formally Estádio Jornalista Mário Filho, used for the 1950 and 2014 FIFA Men’s World Cups), San Mamés Stadium in Bilbao, Spain (La Liga football), and Margaret Court Arena in Melbourne, Australia (Australian Open tennis) (Center for Sport and Urban Policy 2018a).

Outside of North America, other systems have been used to evaluate and recognize eco-friendly stadiums and events. The BREEAM assessment, devised by the Building Research Establishment (BRE) in 1990, has been used to certify more than 250,000 buildings. For new constructions, BREEAM rates buildings as Pass, Good, Very Good, Excellent, or Outstanding based on the following criteria: management, energy, water, waste, pollution, health and well-being, transport, materials, land use and ecology, and innovation (Building Research Establishment 2017). Facilities receiving BREEAM certificates include those used for the 2012 Olympic and Paralympic Games in London and the 2018 FIFA Men’s World Cup in Russia (Russian Green Building Council 2016; Paterson 2011).

While these rating systems recognize stadiums with green building designs, they do not tell the whole story. Several stadiums known for their significant environmental achievements have not obtained green building certification, including Safeco Field (Seattle, Washington) and Lincoln Financial
Field. Additionally, facilities with LEED, BREEAM, or other green building certification may have the necessary tools to achieve sustainability, but execution and management also play significant roles. Poor waste-management strategies, insufficient energy audits, or poor training of janitorial staff can derail the sustainability of a well-designed building. These examples indicate there is no surefire strategy to ensure that a sustainably designed stadium will produce any more environmental benefits than one that is not. Given the relative newness of sustainable design in sports and the lack of a standardized approach to guide decision making, the implementation of environmental strategies in sports will likely continue to grow, but haphazardly. The future of sustainable design in sports is discussed in the concluding section.

FUTURE CONSIDERATIONS IN SUSTAINABLE STADIUM DESIGN

When the Atlanta Braves opened SunTrust Park in an Atlanta suburb in 2017, they left behind their downtown stadium, Turner Field. The old ballpark was originally constructed for the 1996 Centennial Olympic Games and reopened a year later, reconfigured as a baseball stadium. When the Braves moved to the new stadium, after twenty seasons, it was unclear what would happen to Turner Field. Ultimately, the stadium and surrounding site were purchased by nearby Georgia State University and a development partner, with a pledge to revitalize the area by spurring educational, commercial, and residential activity. The first phase of the redevelopment was the reconfiguration of Turner Field, which reopened as Georgia State Stadium, the university’s football venue, less than nine months after the university took it over (Figure 2). Before its inaugural season at Georgia State Stadium, Georgia State played its home football games at the Georgia Dome, which opened in 1992 and was imploded after Mercedes-Benz Stadium opened in 2017.

In all of the excitement surrounding the LEED certification of Atlanta’s two newest professional sports stadiums, little attention was given to the environmental impact of building two stadiums, demolishing one barely twenty-five years old, and abandoning another less than twenty years old (Parker 2015). New stadiums provide designers and owners with a blank slate on which they can draw architecturally significant features; wider concourses with a diverse array of dining options; state-of-the-art lighting, sound, and multimedia systems; and exclusive club seating. While not a top priority for most decision makers, a new facility can also be designed in a way that softens its environmental impact. Still, for every new stadium receiving LEED or BREEAM certification, an enormous amount of energy must be expended to build it in the first place. And while new green stadiums deserve positive recognition, perhaps more deserving of celebration are the organizations that have retrofitted their existing facilities to be more environmentally friendly while preserving heritage of the site and community, including California Memorial Stadium in Berkeley, California, Soldier Field in Chicago, and Providence Park in Portland, Oregon; all opened in the 1920s, and all are LEED-certified (Center for Sport and Urban Policy 2018a; Pfleegor, Seifried, and Soebbing 2013; Schimmel 2001).
Looking forward, stadiums of the future will be more environmentally sustainable because of technological advances related to heating and cooling, water consumption, and energy efficiency. In a 2017 feature, *National Geographic* collaborated with the stadium-design firm Populous to create the “Stadium of Tomorrow.” The proposed stadium combined whimsical, futuristic concepts with some ideas that are already in place in the modern green stadium, including vegetable gardens that supply on-site restaurants, rainwater collectors, retractable roofs, wind turbines, solar panels, and public transport connectivity (Treat and Williams 2017). Until mandated by sports governing bodies, leagues, or local governments, however, these sustainable features are likely to be adopted slowly by a small, yet influential, number of individuals or groups advocating environmental stewardship.

**CONCLUSION**

As this chapter has shown, the earliest attempts to make large-scale sports venues and events more sustainable emerged with the modern Olympic Games, as
activists, local organizers, and eventually the IOC, advocated for more meaningful and intentional acts of environmental stewardship. In the early 2000s, a number of professional and collegiate sports organizations began following suit by championing pro-environmental initiatives. Their efforts have resulted in a surge in new stadiums with sustainable designs. However, given the negative impact of demolishing old stadiums and constructing new ones, it is clear that even the greenest sports facility can carry an environmental cost. Despite this challenge, sports remain a powerful platform to spread awareness of the necessity of environmental responsibility. Sometimes, a good vehicle for promoting that message is the stadium itself.

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Chapter 23: Environmentally Sustainable Design in Sports


