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### Building sport's green houses: Issues in sustainable facility management

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## **Building Sport's Green Houses: Issues in Sustainable Facility Management**

There is little doubt that sport arenas, ballparks, and stadiums are deeply tied to their cities. The allocation of millions, and sometimes billions, of public dollars toward the construction or renovation of sport facilities implies that policymakers, local residents, and athletic teams attribute significant value to these venues (Long 2013). Much of this supposed worth is financial: the sport facility provides a home for a high-profile professional team or event, which may consequently produce greater tax revenues, create jobs, and stimulate urban renewal (Kellison & Mondello 2012). However, other perceived benefits of mega sport facilities are largely symbolic. As one of the most recognizable structures in a cityscape, a stadium may induce civic pride or invoke positive feelings of nostalgia among local residents (Horne 2011; Seifried & Meyer 2010). Furthermore, in a business in which teams' star players can be traded in an instant, the facility is a stable and familiar face of the sport organization.

Given the symbolism ascribed to sport facilities by fans, elected officials, ordinary citizens, historians, urban planners, and sportswriters, it should come as no surprise that sport organizations have begun using their facilities as symbols in their broad strategic communications. These messages are delivered in unique ways across all levels of sport: a small town might finance new green spaces to signal its pledge to curbing childhood obesity; a local park might institute a public smoking ban to encourage healthier living; and—central to this chapter—a team might incorporate pro-environmental elements into the design of a new facility in order to demonstrate its commitment to environmental stewardship.

This chapter explores the integration of pro-environmental design in the planning, construction, operation, and maintenance of sport facilities. In the first section, I highlight recent technological advances and strategic initiatives in sport facility management. One of the most

popular trends—third-party accreditation—is further detailed in the second section. Third, I identify the key concerns of those contemplating sustainable design. This chapter concludes with a discussion of future directions in sustainable facility management.

## **TRENDS IN FACILITY DESIGN**

In the US, buildings are responsible for 14 per cent of the nation’s potable water consumption, 30 per cent of waste output, 40 per cent of raw materials use, 38 per cent of carbon dioxide emissions, 24–to–50 per cent of energy use, and 72 per cent of electricity consumption (U.S. Green Building Council 2011). Given their expansive designs and the vast number of spectators they serve, sport facilities are expected to account for a significant portion of natural resource consumption. For instance, it was widely reported in 2013 that AT&T Stadium, home of the Dallas Cowboys, consumed more electricity on game days than the entire country of Liberia (Lefebvre 2013). Due in part to mounting pressure to operate their businesses in more environmentally conscientious ways, many sport organizations have begun looking at innovative means to manage their facilities in order to showcase their staunch support of pro-environmental initiatives.

The U.S. Green Building Council (USGBC), the organization responsible for the popular Leadership in Energy and Environmental Design rating system (LEED, discussed later in this chapter), outlines six broad categories in which organizations can reduce their environmental impacts. As summarized in Table 17.1 and discussed further below, these categories represent building and design considerations as well as operations and maintenance. Furthermore, they can be applied to both new constructions and existing facilities.

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## **Sustainable Sites**

A key consideration of sustainable design is made before the first foundations are poured. During the site-selection process, designers, planners, and team officials must think about myriad environmental factors, including location and linkages, neighborhood patterns and design, access to transportation, stormwater management, and the heat island effect (USGBC 2011). Ideal development sites should encourage *smart growth* (“an approach that protects open space and farmland by emphasizing development with housing and transportation choices near jobs, shops, and schools”; USGBC 2011: 51), sufficiently respond to stormwater management without compromising the quality of surface and ground water, and minimize the increased air temperature that often accompanies urban spaces.

Historically, owners of big-time sport teams have not always been amenable to thinking seriously about the environmental impact of their site selections. Particularly during the “cookie-cutter” period of the 1960s and 1970s, the suburbs were a popular choice for a new stadium because of their proximity to the city’s highway system and the abundance of space to build parking lots (Chapin 2000). In the past 20 years, however, many big-time sport facility constructions have returned to urban centers with the hopes of catalyzing economic activity, repopulating downtown residences, and revitalizing city centers (Santo 2010). Still, given the sprawling footprints of arenas, ballparks, and stadiums, selecting a sustainable site can be incredibly challenging for facility designers. In other words, landlocked urban cores afford few site choices for huge sport facilities.

Interestingly, the fact that many city building sites are landlocked has actually encouraged pro-environmental design in sport venues. For example, a number of new facilities have been built on *brownfields*, or land “which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant” (Environmental Protection Agency

2011). In these cases, the land must be decontaminated before it can be developed, and thus, projects built on brownfields “go beyond just reducing their effects on the environment and enhance the community” (USGBC 2011: 51). Brownfield redevelopments have been choices for sport developments of all types. With dramatic views of the Manhattan skyline, a golf course was built over once abandoned and polluted land in Bayonne, New Jersey, providing a new recreational space for local residents (Holusha 2000). Similarly, Nationwide Arena in Columbus, Ohio, and Nationals Park in Washington, DC, were both constructed on brownfields (John Glenn School of Public Affairs 2008; Lambert 2008), as was London’s Olympic Stadium and much of the surrounding park (International Olympic Committee 2013).

Another challenge in sustainable site selection is responding to transportation needs. This problem is especially pronounced when designing large public assembly facilities like arenas, ballparks, and stadiums. The environmental impact of traffic can be tempered by locating the facility near public transportation hubs, encouraging the use of other forms of transportation like bicycling, and incentivizing travel by alternative-fuel and high-occupancy vehicles (e.g., by offering preferred or no-fee parking). Given the enormous amount of traffic large sporting events can generate, transportation planning is of central importance to facility and event planners. For example, in preparation for the 2012 Olympic and Paralympic Games, the city of London spent an estimated £6.5 billion upgrading its transportation infrastructure (Hervey & Chennaoui 2012). Elsewhere, during the 2013 World Series, Dodger Stadium officials waived parking fees for vehicles with four or more passengers, while Los Angeles’ transit authority provided free stadium shuttles to anyone with game tickets (Nelson & Dilbeck 2013).

### **Water Efficiency**

In many cities, sport facilities have been at the center of water-management controversies. Faulty water pipes at Lucas Oil Stadium in Indianapolis resulted in an increase in monthly water usage from 2.5 million gallons to nearly 14 million gallons; this increase subsequently raised the facility's water bill by 240 per cent, which the city was responsible for paying (Milz 2011). All across the globe, water-shortage crises have had wide-ranging implications for facility managers. For example, in Zimbabwe, football matches were canceled when the under-watered field was deemed too dangerous for play (Zililo 2013). Furthermore, questions have been raised regarding Rio de Janeiro's readiness to host the 2014 FIFA World Cup and 2016 Olympic and Paralympic Games amid major water shortages in the city (Barchfield 2013).

Given the wide array of amenities offered in major sport facilities, managers face unique challenges due to the high demand for water and other resources. As part of a comprehensive water-conservation strategy, facility managers must consider ways to reduce both indoor and outdoor water use. Restaurants and food-preparation areas, public restrooms, locker room and shower facilities, heating and cooling systems, the maintenance of playing surfaces (e.g., irrigating fields or resurfacing ice), and landscaping not only place large demands on municipal water supplies, but they also produce significant amounts of wastewater that require proper processing by the city. In regions where water conservation is such a priority that field irrigation is restricted, artificial field turf can be installed (Clarey 2010). For existing facilities, outdated or inefficient systems have led some managers to devise creative ways to reduce water consumption: for instance, a 2007 drought in the southeastern United States led University of Georgia facility managers to post signs in the public restrooms requesting that patrons avoid flushing the toilets "if it's yellow" (Associated Press 2007). Other pro-environmental strategies

for improving water efficiency have existed for some time, including the use of water-flow restrictors and automatic sensors on sinks, the installation of waterless urinals, landscaping with plants that require little watering, and harvesting stormwater to meet irrigation needs.

A number of sport facilities have adopted innovative techniques to improve water efficiency. In Manitoba, ice rink managers piloted a program in which greywater—spent water from sinks and showers—was reused in their ice resurfacing machines (Canadian Press 2011). At Target Field in Minneapolis, the Twins partnered with water-management company Pentair to install an advanced underground water collection, filtration, storage, and recycling system capable of irrigating the field for four hours at a rate of 125 gallons per minute (Pentair n.d.). Water collection is also a priority for large facilities such as Suncorp Stadium in Queensland, where managers take advantage of their oversized roof to capture rainwater for reuse (Suncorp Stadium 2010).

### **Energy and Atmosphere**

Along with concerns about water use, much of the attention on green stadium building has focused on ways to reduce reliance on nonrenewable resources and eliminate the emission of harmful pollutants into the earth's atmosphere. Systems that harness energy from renewable sources such as sunlight and wind are most recognizable, but facility designers and operators may also minimize their environmental impact in other ways. For example, a team might adopt a policy to purchase only appliances with satisfactory efficiency ratings, such as those meeting ENERGY STAR standards. Additionally, facilities with passive designs can benefit from so-called free energy, such as natural light and wind. ANZ Stadium, constructed for the 2000 Olympics and Paralympics in Sydney, utilized a passive ventilation system that cooled the facility by drawing "air out from the grandstand through thermal stacks" (BHP Steel 2003: 2).

Routine equipment maintenance and regular energy audits are also important elements of energy efficiency; regardless of how well a system is designed, unmaintained or improperly operated equipment can negate pro-environmental effects.

The return of professional sport stadiums to their cities' downtown areas has also provided opportunities for city planners to build more sustainable urban communities. A host of cities have sought to use new arenas, ballparks, or stadiums as anchors of downtown revitalization projects or sports district developments, including Baltimore (Hamilton & Kahn 1997), Cleveland (Austrian & Rosentraub 1997), and San Diego (Chapin 2002). As noted by the USGBC (2011), "Community planning can support building configurations that minimize solar gain in summer and maximize it in winter" (65). When a sport facility is part of a larger master plan, designers can think about issues such as building orientation and transportation accessibility in order to exploit free energy and compel visitors to arrive using means other than single-occupant vehicles.

Perhaps the most visible cue that a sport organization is committed to reducing its environmental impact is the display of renewable energy systems such as solar panels and wind turbines. Smaller scale projects—such as the single wind turbine erected above Cleveland's Progressive Field—serve as much to raise fan awareness as they do to reduce nonrenewable energy consumption (Kellison & Kim 2014). The three wind turbines built outside Apogee Stadium at the University of North Texas (UNT) are estimated to reduce energy consumption at the school's athletic facilities by a mere six per cent. Yet, they serve as symbols of the university's environmental commitment and reminders of Apogee Stadium's status as one of the most eco-friendly sport facilities in the world (North Texas Athletics 2012). More sophisticated projects include:



- Lincoln Financial Field (home of the National Football League’s Philadelphia Eagles), where wind turbines and solar panels are capable of producing six times the amount of energy consumed during Eagles games (Bauers 2013);
- the National Football League’s San Francisco 49ers’ partnership with NRG Energy to create the NRG Solar Terrace at Levi’s Stadium (Levi’s Stadium 2013); and
- National Stadium in Kaohsiung, Taiwan, a 55,000-seat facility covered in 8,844 photovoltaic panels capable of generating enough energy to power almost 80 per cent of the stadium’s surrounding neighborhoods (Jordana 2013).

<<< “NATIONALSTADIUM” IMAGE NEAR HERE >>>

### **Materials and Resources**

Facility managers must be cognizant of the environmental impacts of their decisions at all stages of the building process. Beginning at the design phase, contractors should consider using green building materials when possible. Construction materials should be sourced locally, thereby reducing the need to transport materials over long distances. These materials should also be durable; made from *rapidly renewable materials* (which “can naturally be replenished in a short period of time”; USGBC 2011: 73) or from recycled material; and be capable of being repurposed at the end of the building’s life cycle. Since 1990, the Nike Reuse-a-Shoe program has processed worn shoes into scrap material used to construct courts, tracks, and field turf in over 450,000 locations worldwide (Nike 2013). For London’s Olympic Stadium, recycled aggregate was used in almost 40 per cent of the concrete used; additionally, some of the 50 million tons of guns, ammunition, and knives collected by Scotland Yard were melted into scrap and used for the stadium’s steel supports (IOC 2012; Meinhold 2010).

Waste management is another important component of sustainable facility planning and operations. During the construction stage, planners should develop strategies to repurpose building equipment and surplus materials no longer needed at the site. At many existing facilities, teams have begun instituting comprehensive recycling programs in order to manage the waste created during events. For example, officials at The Ohio State University recently launched their *Zero Waste at Ohio Stadium* initiative, endeavoring to divert more than 90 per cent of the waste created on Saturday game-days through recycling and composting (The Ohio State University 2012).

Many teams have also been able to capitalize on fan appeal and the reverence often given to arenas, ballparks, and stadiums at the end of a facility's life span (Trumpbour 2006). Prior to facility demolition, teams often hold public sales for memorabilia and equipment, auctioning off a wide variety of keepsakes, including stadium seats; corridor signage; basketball nets and hockey goals; photographs; locker room doors; trainers' tables; lockers; benches; kitchen appliances; athletic equipment; flooring and field turf; dirt and sod; lawnmowers and other maintenance vehicles; medical equipment; trash cans; hot dog rollers and popcorn makers; and ceiling banners. In addition to the pro-environmental impact of diverting these items away from landfills, teams can benefit by avoiding the costs associated with equipment removal and by earning extra capital from the sale of obsolete—yet historic and sentimental—items.

### **Indoor Environmental Quality**

The places where individuals work and patronize are worthy of facility managers' attention, as issues related to air quality, lighting, thermal conditions, and ergonomics can impact the health and well-being of building occupants (USGBC 2011). Managers for buildings of all types employ a number of strategies to improve indoor environmental quality, including

improving air movement, installing entryway floor coverings, prohibiting smoking, using eco-friendly cleaning and pest-control products, and investing in ergonomic office furniture.

The complicated designs of sport facilities—enormous public-assembly centers with hundreds of supporting and auxiliary spaces—and the wide range of events that a sport facility might host demand a holistic approach to managing indoor environmental quality. For indoor sport facilities, an efficient ventilation system is especially important given the fumes created by the use of pyrotechnics at concerts, shows, and games. For outdoor facilities situated in mixed-use neighborhoods, designers have been charged with curbing the light and noise pollution accompanying evening sporting events.

Efforts to address some of these challenges have simultaneously improved occupant comfort, provided facility owners with utility savings, and produced environmental benefits. For instance, improved lighting technology has not only decreased the amounts of wattage and bulbs needed to light an outdoor field, but also has reduced spill light in adjacent neighborhoods. After switching to LED lighting in 2012, Montreal's Bell Centre realized an estimated C\$125,000 in annual savings (Belson 2013). Additionally, to improve air quality, some ice-rink managers have sought to eliminate exhaust fumes caused by propane-powered ice resurfacers by switching to electric-powered alternatives (Caldwell 2009).

### **Innovation in Design and Operations**

Many teams have devised creative design and operations strategies that do not fall under any of aforementioned categories. These innovations range in cost and scope. For instance, a sophisticated solar array at Kaufmann Field in Kansas City is being used to power the stadium's refrigeration system, thereby producing sun-cooled beer (Kaegel 2012). At many stadiums, that

beer is being poured into compostable cups made from corn-based materials (e.g., Phoenix Coyotes n.d.).

On a larger scale, some sport-facility architects have begun rethinking the design process altogether:

- The London Olympic and Paralympic Games were hailed for building temporary facilities to house sports like basketball and for its post-Games plan to downsize Olympic Stadium (Oliver, O'Mahony, & Palmer 2012).
- The recent partnership between the National Football League's New York Jets and New York Giants to share MetLife Stadium not only saved money for the teams and government, but it also eliminated the harmful environmental impact of constructing two new stadiums (Bagli 2005).
- Of the 37 athletic venues proposed for the 2020 Olympic and Paralympic Games in Tokyo, 15 will be existing facilities (Martin 2013).

<<< "LONDON" IMAGE NEAR HERE >>>

As discussed in previous chapters (see in particular Chapters 12–15), sport organizations are increasingly engaging in marketing campaigns designed to raise awareness of the teams' own corporate pro-environmental strategies and to grow public interest in environmental issues. As part of their educational outreach, teams have highlighted their facilities' eco-friendly designs to captive audiences at sporting events and during stadium tours. As a reflection of their comprehensive commitment to green planning and operations, many teams have pursued and attained third-party certification of their facilities' pro-environmental designs. This accreditation process is discussed in further detail in the following section.

## **GREEN BUILDING CERTIFICATION**

Managers of new or existing eco-friendly facilities may seek further validation of their sustainable initiatives after the construction or renovation process has been completed. A small—but growing—number of collegiate and professional sport facilities have met the design and operations standards of third-party organizations like the USGBC. Not originally designed with mega sport facilities in mind, these certification systems have challenged facility managers to think about innovative ways to meet tough environmental metrics.

### **Leadership in Energy and Environmental Design**

In North America, the USGBC's Leadership in Energy and Environmental Design (LEED) rating system is the most recognized third-party accreditor of green building (Chamberlain 2008). Worldwide, over 50,000 projects have received some form of LEED certification, with nearly 45,000 of these in North America (USGBC 2013). The LEED rating system consists of prerequisites and credits—or points—awarded for meeting standards in the following general categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design, and Regional Priority (USGBC 2009). Based on the total number of credits received, a project may qualify for one of four classifications: Certified, Silver, Gold, or Platinum (in order of least number of credits required to greatest number of credits required).

While the LEED rating system can be applied to a number of project types including schools, healthcare, and neighborhood development, sport facilities typically fall into one of two rating categories: (1) New Construction and Major Renovations or (2) Existing Buildings (EB). In 2008, Nationals Park, home to Major League Baseball's Washington Nationals, became the first LEED-certified sport facility across the major American sporting leagues: Major League Baseball, Major League Soccer, the National Basketball Association, the National Hockey

League, and the Women's National Basketball Association. Since then, over 15 facilities in those leagues have received various levels of LEED certification, ranging from EB certification of Chicago's Soldier Field (built in 1924) to Gold certification of major-league facilities in Pittsburgh, Orlando, and Miami. College athletic facilities have also actively pursued LEED certification, including UNT's Apogee Stadium, which was designated LEED Platinum in 2011 (North Texas Athletics 2012).

<<< "APOGEE" IMAGE AROUND HERE >>>

### **International Variants**

Rating systems similar to LEED exist outside North America. The most recognized, the British-based Building Research Establishment Environmental Assessment Methodology (BREEAM), was developed in 1990 and has certified over 250,000 buildings worldwide (BREEAM 2013). Smaller-scale rating schemes exist in a number of other countries, including Germany (i.e., the German Sustainable Building Council's *Deutsche Gesellschaft für Nachhaltiges Bauen e.V.*) and Japan (i.e., Comprehensive Assessment System for Built Environment Efficiency). Like LEED, these rating systems have been used to designate sport facilities as green. In April 2013, Thyagaraj Stadium (Delhi) received a gold rating by the Indian Green Building Council (Economic Times 2013). Additionally, Aviva Stadium (Dublin) and the Millennium Stadium (Cardiff) both met the British Standard for Sustainability Management Systems for Events (BS 8901; British Standards Institution 2013).

While not an accreditation system, the International Organization for Standardization (ISO) provides a number of benchmarks intended to improve efficiency and minimize environmental impacts. Several of these standards have direct relevance to sport organizations, including ISO 14001 for environmental management and ISO 20121:2012 for event

sustainability management. Metrics from both ISO 14001 and ISO 20121:2012 have been met by several professional teams (e.g., Manchester United's Old Trafford) and events (e.g., 2012 Olympic and Paralympic Games) (Lambert 2013).

## **Governance**

As early adopters of the pro-environmental movement, many of the sport organizations highlighted in this chapter introduced their sustainable initiatives without pressure from league-wide guidelines or government mandates. Furthermore, the establishment of partnerships between like-minded organizations has provided a vehicle through which leaders in sport and environmental design can engage in meaningful discourse about trends, technology, and challenges to green building. For example, the Green Sports Alliance launched in 2011 “to help sports teams, venues and leagues enhance their environmental performance” (Green Sports Alliance 2013a). What began as a small grassroots organization of six professional teams and five sport venues has since grown into an international network of over 190 professional and collegiate teams and venues (Green Sports Alliance 2013b). Each year, the organization holds an international summit at which members can learn about environmental best practices, engage in roundtable discussions, collaborate with other industry leaders, and tour eco-friendly facilities. The overnight growth of the Green Sports Alliance illustrates the current trendiness of sustainable practices in sport.

Of course, there are big differences between starting a recycling program and constructing a LEED-certified facility. As momentum for the green movement in sport continues to strengthen, governing bodies may elect to adopt formal environmental policies catering specifically to issues of sport-facility design. Already, some American counties and cities have offered tax breaks to facility owners for their inclusion of green stadium elements. Further, some

policymakers have introduced legislation requiring that stadium proposals include plans for pro-environmental features before being considered for taxpayer support (Pfahl 2013). On the other hand, over 60 per cent of new professional sport stadiums from 2006–2013 were constructed without the integration of major sustainable designs, and some lawmakers have pursued statewide bans on certain forms of pro-environmental certifications for government construction projects (Badger 2013). Clearly, consensus has yet to be achieved among civic leaders regarding the cost-effectiveness of sustainable arenas, ballparks, and stadiums.

Among governing bodies and sport leagues, environmental agendas are on the rise. Both FIFA and the International Olympic Committee (IOC) have insisted that cities bidding to host the organizations' flagship events make environmental-impact minimization a focus in their facility proposals (FIFA n.d.; Swan 2012). Due to their authority over selecting sites for their mega events, both FIFA and the IOC have substantial influence on whether World Cup and Olympic facilities are designed with sustainability in mind. Conversely, while broad initiatives like the NHL's Gallons for Goals and the MLB Greening Program may signal league-wide support of environmental causes, professional sport leagues have decidedly less control over their clubs' facility designs. Thus, given that teams are highly autonomous during the facility planning process, decisions to incorporate green designs into new venues are likely to rest on ownership and local government. So, what leads some facility owners to implement wholesale sustainable practices while others decline to invest in green technology? When deciding whether to pursue a sustainable facility design, a number of incentives and barriers are considered, as discussed in further detail below.

## **CHALLENGES TO SUSTAINABLE DESIGN**



The environmental, economic, and social benefits of sustainable design represent compelling reasons to engage in pro-environmental behavior (see Chapter 10). Owners of green sport facilities may realize positive publicity, new sponsorship opportunities, tax credits, reduced utility costs, longer facility lifecycles, and long-term savings (Nyikos, Thal, Hicks, & Leach 2012). Colleges and universities can expect to realize these benefits with greater confidence since there is no possibility that their teams will be sold. Short-term owners might also benefit when selling a team because of the value associated with a green building's technology and anticipated long-term savings. Despite these incentives, some decision-makers have been reluctant to adopt large-scale sustainable designs.

Upfront costs—both perceived and actual—are likely the top concern for decision-makers. In numerous studies, researchers have found *perceived cost premiums* in excess of 10 per cent to be the biggest deterrent to green building (cf. Mapp, Nobe, & Dunbar 2011). A recent analysis of LEED vs. non-LEED buildings by Nyikos *et al.* (2012) found actual cost premiums for LEED buildings averaged 4.1 per cent. Despite the added cost of LEED-certified facilities, that same study found the long-term savings of green buildings to be significant: energy costs in LEED-certified buildings were 31 per cent lower, while operating costs were US\$.70 per square foot less than their non-LEED equivalents. While much of this higher cost is related to equipment, construction, and operations, a portion of the premium cost is related to obtaining formal accreditation. For example, the cost of LEED certification is calculated by the building's gross square footage, which can be quite high for sport arenas, ballparks, and stadiums. Mapp *et al.* (2011) estimated the direct cost for LEED certification to be less than two per cent of the total project cost. Based on the average costs of MLB, NBA, NFL, and NHL venues from 2000–2013, this cost amounts to nearly \$8 million per facility (Long 2013).

A second complication of embracing environmental measures is the historic lack of technological systems designed specifically for sport facilities. The sheer expansiveness of arenas, ballparks, and stadiums somewhat contradicts many sustainable design principles like utilizing smaller spaces with smaller footprints, limiting field irrigation, and repurposing and retrofitting existing facilities. As the growing number of pro-environmental sport facilities indicates, however, engineers have developed increasingly sophisticated ways to accommodate both environmental and guest-amenity needs. In fact, both Populous and AEG—two of the most well-known international sport-facility-design firms—have pledged commitments to environmental stewardship (AEG 2012; Populous 2013).

In addition to the historical engineering challenges, those sport facilities designed with the intent of receiving third-party accreditation have faced issues when trying to meet criteria of certification systems that were not specifically written for arenas, ballparks, and stadiums. For example, in order to receive certain LEED credits for Site Selection, the USGBC advises facility planners to *limit* parking (e.g., adding no new parking) so as to “spark interest in alternative transportation issues” (USGBC 2011: 54). While this strategy might be effective for smaller scale projects, discouraging travel to a sport facility might have several drawbacks for collegiate and professional teams. First, teams would have to develop unconventional alternatives to handle the large volume of out-of-town guests arriving just for the event. Second, teams and cities would lose a large portion of parking revenue. Third, a loss of surface parking would threaten traditions like tailgating parties, possibly resulting in disenchanting fans (Holden 2013; La Gorce 2013). None of these factors negates the positive environmental impact of encouraging spectators to utilize public transit and seek other transportation alternatives, but each does raise economic and logistic questions for event planners.

Each of the three challenges discussed above is directly related to the relative newness of sustainable design in sport. Early adopters of green building have limited experience and information to deal with uncertainty about the construction and operating costs, sluggish technological innovation, and the complexity of applying conventional accreditation standards. Yet, interest and action in sustainable sport facility design continues to spread around the globe, with little sign of slowing.

### **FUTURE DIRECTIONS**

In many ways, large sport facilities are antithetical to green building. On game days, they create huge strains on local resources. They often draw tens of thousands of people to a single site, thereby increasing traffic that contributes significantly to air pollution. Facilities like football stadiums are used infrequently, while others constructed for international mega events like the Olympic and Paralympic Games may be abandoned altogether (cf. Pack & Hustwit 2013). But recent technological advances and the commitment to environmental stewardship by a growing number of sport organizations are highlighting the belief that sustainable sport is a worthwhile endeavor.

Looking forward, a number of facility planners have created ambitious designs for future sustainable stadiums. When it was announced that the 2022 FIFA World Cup bid was awarded to Qatar, some critics called into question the conventional wisdom of hosting an outdoor sport in such a dry and hot climate. In response to this concern, several architecture firms have released conceptual plans to keep the facilities cool. For instance, building designer Tangram Gulf proposed an innovative air conditioning system for the stadium in Doha; instead of an electric-powered system, the stadium would be cooled by channeling desert winds (Grozdanic 2013). Another proposed solution to the Qatar heat is the use of artificial clouds, floating carbon

structures that would shade spectators from the sun (BBC 2011); a similar system is part of a new proposed stadium in Croatia (Schwartz 2010). Plans for China's Dalian Shide Stadium call for green walls made of living plants that change color with the seasons, a feature unseen in any stadium before:

[The design] represents a new direction in sports architecture by moving away from the creation of a building based on pure form. The organic architecture of the building challenges the typical stadium typology to become more than an impressive skin wrapped around an ordinary seating bowl. (Jordana 2009)

Like the other innovations discussed, Dalian Shide Stadium's planned living walls challenge traditional elements of building design by blurring the divide between steel-and-concrete sport venues and the natural environment.

Long a drain on their natural surroundings, today's mega sport facilities are being built with the environment in mind. Sustainable site selection, water efficiency, energy use, materials sourcing, and indoor environmental quality each challenge facility planners to think about new ways to positively contribute to the ecosystem. Due in part to the success of rating systems like LEED and BREEAM, sport-venue designers are answering calls to be more environmentally sensitive. Additionally, through engineering marvels like passive air conditioning systems, artificial clouds, and living walls, sport facility planners are demonstrating the possibility of arenas, ballparks, and stadiums in new frontiers once thought of as unsuitable for big-time spectator sports.

Perhaps most important to keep in mind is that sustainable design in sport is still in its infancy. The addition of solar panels on stadium roofs, the adoption of LEED standards by college and professional teams, the sudden growth of the Green Sports Alliance, and the support

of green initiatives by professional leagues are all developments of the past 10 years. There remains considerable uncertainty about some aspects of sustainable sport facilities, including their actual costs and benefits, the effectiveness of their green technology, and the public goodwill they generate. Despite these concerns, the exponential growth of green building in sport suggests that managers will continue to think about ways to temper their facilities' environmental impacts.

## References

- AEG (2012) *AEG's 2012 environmental sustainability report*. Online. Available HTTP: <[http://www.aegworldwide.com/media/swf/2012\\_sustainability\\_report/index.html](http://www.aegworldwide.com/media/swf/2012_sustainability_report/index.html)> (accessed 20 November 2013).
- Associated Press (2007) 'Football fans told not to flush', *Associated Press*, 03 November. Online. Available HTTP: <<http://abclocal.go.com/wpvi/story?section=news/bizarre&id=5741675>> (accessed 16 November 2013).
- Austrian, Z. and Rosentraub, M.S. (1997) 'Cleveland's gateway to the future', in R.G. Noll and A. Zimbalist (eds.) *Sports, jobs and taxes: the economic impact of sports teams and stadiums*, Washington, DC: The Brookings Institution Press.
- Badger, E. (2013) 'Why are some states trying to ban LEED green building standards?', *The Atlantic Cities*, 28 August. Online. Available HTTP: <<http://www.theatlanticcities.com/design/2013/08/why-are-some-states-trying-ban-leed-green-building-standards/6691>> (accessed 19 November 2013).
- Bagli, C.V. (2005) 'Three winners in stadium deal: Giants, Jets and governor', *The New York Times*, 01 October. Online. Available HTTP: <<http://www.nytimes.com/2005/10/01/nyregion/01stadium.html>> (accessed 18 November 2013).
- Barchfield, J. (2013) 'Brazil: water shortage dries Rio de Janeiro taps', *Associated Press*, 29 October. Online. Available HTTP: <<http://finance.yahoo.com/news/brazil-water-shortage-dries-rio-201934326.html>> (accessed 16 November 2013).

- Bauers, S. (2013) 'Philadelphia Eagles green: Lincoln Financial Field generating energy with solar panels, turbines', *Philadelphia Inquirer*, 16 April. Online. Available HTTP: <[http://articles.philly.com/2013-04-16/entertainment/38558948\\_1\\_don-smolenski-turbines-desean-jackson](http://articles.philly.com/2013-04-16/entertainment/38558948_1_don-smolenski-turbines-desean-jackson)> (accessed 17 November 2013).
- BBC (2011) 'Artificial clouds could help cool 2022 Qatar World Cup,' 24 March. Online. Available HTTP: <<http://news.bbc.co.uk/sport2/hi/football/9435035.stm>> (accessed 20 November 2013).
- Belson, K. (2013) 'Sports beginning to see the energy-efficient light', *The New York Times*, 08 October. Online. Available HTTP: <[http://www.nytimes.com/2013/10/09/business/energy-environment/sports-beginning-to-see-the-energy-efficient-light.html?\\_r=0](http://www.nytimes.com/2013/10/09/business/energy-environment/sports-beginning-to-see-the-energy-efficient-light.html?_r=0)> (accessed 17 November 2013).
- BHP Steel (2003) *Olympic case study: Stadium Australia*. Online. Available HTTP: <[http://www.bluescopesteel.com.au/files/Stadium\\_Australia.pdf](http://www.bluescopesteel.com.au/files/Stadium_Australia.pdf)> (accessed 17 November 2013).
- BREEAM (2013) 'BREEAM in numbers'. Online. Available HTTP: <<http://www.breeam.org/page.jsp?id=559>> (accessed 18 November 2013).
- British Standards Institution (2013) 'Standards'. Online. Available HTTP: <<http://www.bsigroup.com/en-GB/standards>> (accessed 18 November 2013).
- Caldwell, D. (2009) 'At 2010 Games, the ice rinks will be greener', *The New York Times*, 29 January. Online. Available HTTP: <<http://www.nytimes.com/2009/02/01/automobiles/01ICE.html?em>> (accessed 17 November 2013).

- Canadian Press (2011) 'Recycled shower water eyed for ice rinks', *Canadian Press*, 07 July. Online. Available HTTP: <<http://www.cbc.ca/news/canada/manitoba/recycled-shower-water-eyed-for-ice-rinks-1.1029082>> (accessed 16 November 2013).
- Chamberlain, L. (2008) 'Serving architects, consultants in everything green become mainstays', *The New York Times*, 26 August. Online. Available HTTP: <<http://www.nytimes.com/2008/08/27/business/27green.html?pagewanted=all&gwh=FD4BEC722440FA7ADD471BEBC488760E>> (accessed 18 November 2013).
- Chapin, T. (2000) 'The political economy of sports facility location: an end-of-the-century review and assessment', *Marquette Sports Law Review*, 10: 361-382.
- (2002) 'Beyond the entrepreneurial city: municipal capital in San Diego', *Journal of Urban Affairs*, 24: 565-581.
- Clarey, C. (2010) 'A surge in artificial turf', *The New York Times*, 21 October. Online. Available HTTP: <<http://www.nytimes.com/2010/10/22/sports/soccer/22iht-ARENA.html?pagewanted=all>> (accessed 16 November 2013).
- Economic Times (2013) 'Delhi's Thyagaraj Stadium is country's first green stadium', *India Times*, 16 August. Online. Available HTTP: <[http://articles.economictimes.indiatimes.com/2013-08-16/news/41417815\\_1\\_first-green-stadium-thyagaraj-stadium-south-delhi](http://articles.economictimes.indiatimes.com/2013-08-16/news/41417815_1_first-green-stadium-thyagaraj-stadium-south-delhi)> (accessed 18 November 2013).
- Environmental Protection Agency (2010) 'Brownfields definition'. Online. Available HTTP: <<http://www.epa.gov/brownfields/overview/glossary.htm>> (accessed 15 November 2013).



FIFA (n.d.) 'FIFA and the environment'. Online. Available HTTP:

<<http://www.fifa.com/aboutfifa/socialresponsibility/environmental.html>> (accessed 19 November 2013).

Green Sports Alliance (2013a) 'About the Green Sports Alliance'. Online. Available HTTP:

<<http://greensportsalliance.org/about/>> (accessed 19 November 2013).

— (2013b) 'Members benefits'. Online. Available HTTP:

<<http://greensportsalliance.org/members-benefits/>> (accessed 19 November 2013).

Grozdanic, L. (2013) 'Tangram's Qatar World Cup stadium sculpts the desert wind to provide passive cooling', *Inhabitat*, 13 May. Online. Available HTTP:

<<http://inhabitat.com/tangrams-fifa-world-cup-2022-stadium-in-qatar-sculpts-the-desert-wind-to-create-passive-cooling-systems>> (accessed 16 November 2013).

Hamilton, B.W. and Kahn, P. (1997) 'Baltimore's Camden Yards ballparks', in R.G. Noll and A. Zimbalist (eds.) *Sports, jobs and taxes: the economic impact of sports teams and stadiums*, Washington, DC: The Brookings Institution Press.

Hervey, L. and Chennaoui, O. (2012) 'Sky investigation: Olympics bill tops £12bn', *Sky News*, 26 January. Online. Available HTTP: <<http://news.sky.com/story/920409/sky-investigation-olympics-bill-tops-12bn>> (accessed 15 November 2013).

Holden, E. (2013) 'Mets fans upset by tailgate beer crackdown at Citi Field,' *Yahoo! News*, 2 May. Online. Available HTTP: <<http://news.yahoo.com/mets-fans-upset-tailgate-beer-crackdown-citi-field-165700488.html>> (accessed 22 November 2013).

Holusha, J. (2000) 'Commercial property; turning brownfields into fairways and greens', *The New York Times*, 29 October. Online. Available HTTP:

<<http://www.nytimes.com/2000/10/29/realestate/commercial-property-turning->

brownfields-into-fairways-and-greens.html?pagewanted=all&src=pm> (accessed 15 November 2013).

Horne, J. (2011) 'Architects, stadia and sport spectacles: notes on the role of architects in the building of sport stadia and making of world-class cities', *International Journal for the Sociology of Sport*, 46: 205-227.

International Olympic Committee (2012) 'Flexible and sustainable: London's Olympic Stadium sets new standards', 08 January. Online. Available HTTP: <<http://www.olympic.org/news/flexible-and-sustainable-london-s-olympic-stadium-sets-new-standards/170181>> (accessed 17 November 2013).

— (2013) 'London 2012's sustainable legacy lives on', 31 July. Online. Available HTTP: <<http://www.olympic.org/news/london-2012-s-sustainability-legacy-lives-on/205777>> (accessed 15 November 2013).

John Glenn School of Public Affairs (2008) *Assessment of the gross economic impact of the Columbus Blue Jackets and Nationwide Arena on the Greater Columbus Area*. Online. Available HTTP: <[http://glennschool.osu.edu/faculty/greenbaum\\_pdf/Phase1\\_report.pdf](http://glennschool.osu.edu/faculty/greenbaum_pdf/Phase1_report.pdf)> (accessed 16 November 2013).

Jordana, S. (2009) 'Dalian Shide stadium / NBBJ', *Arch Daily*, 15 September. Online. Available HTTP: <<http://www.archdaily.com/35207/dalian-shide-stadium-nbbj/>> (accessed 20 November 2013).

— (2013) 'Taiwan solar powered stadium / Toyo Ito', *Arch Daily*, 17 March. Online. Available HTTP: <<http://www.archdaily.com/22520/taiwan-solar-powered-stadium-toyo-ito/>> (accessed 17 November 2013).

Kaegel, D. (2012) 'Solar panels to help power Kauffman Stadium', *MLB.com*, 31 January.

Online. Available HTTP:

<[http://kansascity.royals.mlb.com/news/article.jsp?ymd=20120131&content\\_id=26525142&vkey=news\\_kc&c\\_id=kc](http://kansascity.royals.mlb.com/news/article.jsp?ymd=20120131&content_id=26525142&vkey=news_kc&c_id=kc)> (accessed 18 November 2013).

Kellison, T.B. and Kim, Y.K. (in press) 'Marketing pro-environmental venues in professional sport: planting seeds of change among existing and prospective consumers', *Journal of Sport Management*, 28.

Kellison, T.B. and Mondello, M.J. (2012) 'Organisational perception management in sport: the use of corporate pro-environmental behaviour for desired facility referenda outcomes', *Sport Management Review*, 15: 500-512.

La Gorce, T. (2013) 'New Jersey: tailgate parties far beyond burgers and dogs,' *The New York Times*, 24 October. Online. Available HTTP:

<<http://www.nytimes.com/2013/10/27/nyregion/tailgate-parties-far-beyond-burgers-and-dogs.html>> (accessed 22 November 2013).

Lambert, G. (2013) 'Event sustainability management – ISO 20121 passes 2012 Olympic Games test', *ISO*, 09 January. Online. Available HTTP:

<[http://www.iso.org/iso/home/news\\_index/news\\_archive/news.htm?refid=Ref1690](http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1690)> (accessed 18 November 2013).

Lambert, L. (2008) 'DC turns brownfield into 'green' ballpark', *Boston Globe*, 29 March.

Online. Available HTTP:

<[http://www.boston.com/news/nation/articles/2008/03/29/dc\\_turns\\_brownfield\\_into\\_green\\_ballpark](http://www.boston.com/news/nation/articles/2008/03/29/dc_turns_brownfield_into_green_ballpark)> (accessed 16 November 2013).

- Lefebvre, B. (2013) 'What uses more electricity: Liberia, or Cowboys Stadium on game day?', *The Wall Street Journal*, 13 September. Available HTTP: <<http://blogs.wsj.com/corporate-intelligence/2013/09/13/what-uses-more-electricity-liberia-or-cowboys-stadium-on-game-day>> (accessed 15 November 2013).
- Levi's Stadium (2013) 'NRG Energy installs 49th solar frame to complete Levi Stadium suite tower roof', 29 October. Online. Available HTTP: <<http://levisstadium.com/headlines/nrg-energy-installs-49th-solar-frame-complete-levi's-stadium-suite-tower-roof>> (accessed 17 November 2013).
- Long, J.G. (2013) *Public/private partnerships for major league sports facilities*, New York: Routledge.
- Mapp, C., Nobe, M.C. and Dunbar, B. (2011) 'The cost of LEED – an analysis of the construction costs of LEED and non-LEED banks', *Journal of Sustainable Real Estate*, 3: 254-273.
- Martin, A. (2013) 'Tokyo promises to meld technology, tradition with 2020 Olympics', *The Wall Street Journal*, 08 September. Online. Available HTTP: <<http://online.wsj.com/news/articles/SB10001424127887323623304579062090411749578>> (accessed 18 November 2013).
- Meinhold, B. (2010) 'London's Olympic Stadium to be made out of recycled guns and knives!', *Inhabitat*, 20 January. Online. Available HTTP: <<http://inhabitat.com/confiscated-weapons-used-to-build-londons-olympic-stadium>> (accessed 17 November 2013).
- Milz, M. (2011) 'Lucas Oil Stadium's water bills skyrocket', *WTHR*, 15 March. Available HTTP: <<http://www.wthr.com/story/14258003/lucas-oil-stadiums-water-bills-skyrocket>> (accessed 16 November 2013).

- Nelson, L.J. and Dilbeck, S. (2013) 'Cardinals game: carpool incentive for Dodgers Stadium debuts Monday', *Los Angeles Times*, 14 October. Online. Available HTTP: <<http://www.latimes.com/local/lanow/la-me-ln-new-carpool-incentive-for-dodger-stadium-debuts-monday-20131014,0,1423637.story>> (accessed 15 November 2013).
- Nike (2013) 'Reuse-a-Shoe'. Online. Available HTTP: <[http://www.nike.com/us/en\\_us/c/better-world/stories/2013/05/reuse-a-shoe](http://www.nike.com/us/en_us/c/better-world/stories/2013/05/reuse-a-shoe)> (accessed 17 November 2013).
- North Texas Athletics (2012) 'Apogee Stadium wind turbines. Online. Available HTTP: <<http://www.meangreenmap.com/turbines.html>> (accessed 17 November 2013).
- Nyikos, D.M., Thal, A.E., Hicks, M.J. and Leach, S.E. (2012) 'To LEED or not to LEED: analysis of cost premiums associated with sustainable facility design', *Engineering Management Journal*, 24: 50-62.
- Oliver, M., O'Mahony, J. and Palmer, D. (2012) 'London 2012 Olympics: venue guide', *The Telegraph*, 23 July. Online. Available HTTP: <<http://www.telegraph.co.uk/sport/olympics/7908313/London-2012-Olympics-venue-guide.html>> (accessed 18 November 2013).
- Pack, J. and Hustwit, G. (2013) *The Olympic city*, s.l.: John Pack and Gary Hustwit.
- Pentair (n.d.) 'Helping the Twins hit a 'green' grand slam. Online. Available HTTP: <<http://www.pentair.com/case-studies/case-study-2.html>> (accessed 16 November 2013).
- Pfahl, M. (2013) 'The environmental awakening in sport', *Solutions*, 4: 67-76.
- Phoenix Coyotes (n.d.) 'Going green'. Online. Available HTTP: <<http://coyotes.nhl.com/club/page.htm?id=32755>> (accessed 18 November 2013).
- Populous (2013) *Sustainability*. Online. Available HTTP: <<http://populous.com/expertise/sustainability>> (accessed 20 November 2013).

- Santo, C.A. (2010) 'Economic impact of sport stadiums, teams, and events', in C.A. Santo and G.C.S. Mildner (eds.) *Sport and public policy: social, political, and economic perspectives*, Champaign, IL: Human Kinetics.
- Schwartz, A. (2010) 'Blue Volcano: a futuristic cloud-covered stadium for Croatia', *Fast Company*, 5 January. Online. Available HTTP: <http://www.fastcompany.com/1506266/blue-volcano-futuristic-cloud-covered-stadium-croatia> (accessed 20 November 2013).
- Seifried, C.S. and Meyer, K. (2010) 'Nostalgia-related aspects of professional sport facilities: a facility audit of Major League Baseball and National Football League strategies to evoke the past', *International Journal of Sport Management, Recreation & Tourism*, 5: 51-76.
- Suncorp Stadium (2010) 'Environment'. Online. Available HTTP: [http://www.suncorpstadium.com.au/The\\_Stadium/Environment.aspx](http://www.suncorpstadium.com.au/The_Stadium/Environment.aspx) (accessed 16 November 2013).
- Swan, R. (2012) 'Sustainability isn't just management-speak, it's about making the Games happen', *Inside the Games*, 23 July. Online. Available HTTP: <http://www.insidethegames.biz/sustainability/16817-sustainability-isnt-just-management-speak-its-about-making-the-games-happen> (accessed 19 November 2013).
- The Ohio State University. (2012) *Zero waste at Ohio Stadium: achieving zero in 2012*. Online. Available HTTP: [http://footprint.osu.edu/assets/files/zerowaste/ZeroWaste\\_2012\\_Overview\\_WEB%20full%20quality.pdf](http://footprint.osu.edu/assets/files/zerowaste/ZeroWaste_2012_Overview_WEB%20full%20quality.pdf) (accessed 17 November 2013).
- Trumbour, R.C. (2006) *The new cathedrals: politics and media in the history of stadium construction*, Syracuse, NY: Syracuse University Press.

U.S. Green Building Council (2009) *Green building design and construction*, Washington, DC:

U.S. Green Building Council.

—— (2011) *Green building and LEED core concepts*, 2nd edn, Washington, DC: U.S. Green Building Council.

—— (2013) ‘Infographic: LEED in the world’. Online. Available HTTP: <<http://www.usgbc.org/articles/infographic-leed-world>> (accessed 18 November 2013).

Zililo, R. (2013) ‘Water shortage hits city stadia’, *Chronicle*, October 22. Online. Available HTTP: <<http://www.chronicle.co.zw/water-shortage-hits-city-stadia>> (accessed 16 November 2013).

Table 17.1 Strategies in Sustainable Sport Facility Design and Operations

<b>Strategy</b>	<b>Example</b>
<i>Sustainable sites</i>	
Brownfield location	Nationwide Arena (Columbus, OH)
Accessibility of public transportation	London Olympic Park
Carpooling incentives	Dodger Stadium (Los Angeles, CA)
<i>Water efficiency</i>	
Water conservation in restrooms	Sanford Stadium (Athens, GA)
Greywater reuse	Dakota Community Centre (Winnipeg, MB)
Rainwater harvesting	Suncorp Stadium (Queensland, Australia)
<i>Energy and atmosphere</i>	
Passive ventilation	ANZ Stadium (Sydney, Australia)
Neighborhood planning	Oriole Park at Camden Yards (Baltimore, MD)
Installation of wind turbines	Lincoln Financial Field (Philadelphia, PA)
Installation of solar panels	National Stadium (Kaohsiung, Taiwan)
<i>Materials and resources</i>	
Recycled building materials	Nike Reuse-a-Shoe
Recycling programs	Ohio Stadium (Columbus, OH)
<i>Indoor environmental quality</i>	
LED lighting/reduced spill light	Bell Centre (Montreal, QC)
<i>Innovation in design and operations</i>	
Compostable cups	Jobing.com Arena (Phoenix, AZ)
Temporary facilities and seating	London Olympic Park
Shared or dual-purpose facilities	MetLife Stadium (East Rutherford, NJ)
Repurposing existing venues	2020 Olympic Games (Tokyo, Japan)
<i>Green building certification</i>	LEED, BREEAM