

**SUSTAINABLE SPORTS FACILITIES:
ENVIRONMENTALLY AWARE DESIGN AND OPERATION IN THE SPORTS
INDUSTRY**

Piroska BÉKI - Beáta DOBAY - Beatrix FARAGÓ

Abstract

The design and operation of sustainable sports facilities are key to reducing the environmental footprint of the sports industry and promoting sustainable development. The study examines the certification systems for environmentally friendly sports facilities and the certification of nearly zero-energy buildings. The research aims to analyze the sustainability practices of two specific sports facilities – the Mercedes-Benz Stadium and the Johan Cruijff Arena – with a particular focus on energy saving, water management, and waste management. The study's secondary methodological research examined the sustainability performance of the facilities using multi-criteria assessment systems. The results highlight the role of photovoltaic systems, rainwater harvesting systems, and energy-efficient lighting and heating and cooling in the environmentally friendly operation of sports.

Keywords:

sports facilities, sustainability, environmental protection, sports economy, sports management

JEL code: Q56, L83, Q01

INTRODUCTION

The design and operation of sustainable sports facilities is an important step in reducing the environmental footprint of the sports industry and moving towards a sustainable future. Green building certification, the implementation of sustainable practices, water conservation, energy saving, and pollution reduction are all key factors in this process. Further research and development offer the industry the opportunity to achieve sustainability goals and further reduce environmental impacts. Green building certification is an important step in the development of sustainable sports facilities. Such certification systems, such as LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Method), allow the assessment and certification of the environmental performance of buildings. Certification of nearly zero-energy buildings is also being discussed, emphasizing a multi-criteria approach (Fedorcak-Cisak 2019). To address these challenges, a green sports building rating system has been proposed that focuses on sustainable use (Wang 2020). These ratings help architects and designers integrate energy efficiency, water management, material use, and other sustainability considerations into the design and development of sports facilities.

The applicability of sustainable sports facilities is also an important factor in reducing environmental impacts. This includes design and operational practices that minimize environmental impacts and maximize resource efficiency. For example, integrating smart energy systems, solar panels, and rainwater harvesting systems can be a significant step towards sustainability.

This study analyzed the Mercedes Benz Stadium, and the Johan Cruyff Arena based on the previously mentioned aspects. Our results clearly demonstrate the two stadiums' sustainability aspirations and environmentally friendly management. Signs of sustainability are mainly represented by photovoltaic systems; in both cases, great attention is paid to energy

management, water management, and waste management. Water conservation and energy saving are key factors in the design and operation of sustainable sports facilities. Rainwater harvesting systems, water-saving equipment, irrigation systems, and energy-efficient lighting and heating and cooling systems all contribute to reducing water and energy consumption. Reducing environmental pollution is also an important objective of sustainable sports facilities. This includes measures such as waste reduction, waste recycling, environmentally friendly cleaning products, and the optimization of transport infrastructure.

Literature analysis

The reason for the existence of large-scale sports facilities is explained by globalization, tourism, and, with it, sports tourism. Globalization brought with it the rapid development of mass communication, which gave the opportunity to broadcast sports events from different parts of the world, thus significantly increasing the interest in sports and sports events (Lasztovicza, Béki, 2016). The interest in various sports events grew rapidly with the wide appearance of the media, creating a supply that was still unsatisfactory at that time, thus establishing the concept of sports tourism. Globalization enabled the flourishing of sports tourism, which triggered a huge demand for passive sports tourism (following events mainly on-site), and the sports sector saw the untapped potential to meet these needs in modern sports complexes. One of the challenges of sports events is waste management, for which the 4R model is applied. The 4Rs, which stand for waste reduction, reuse, recycling, and repairability, appear as a new element. (Figure 1)

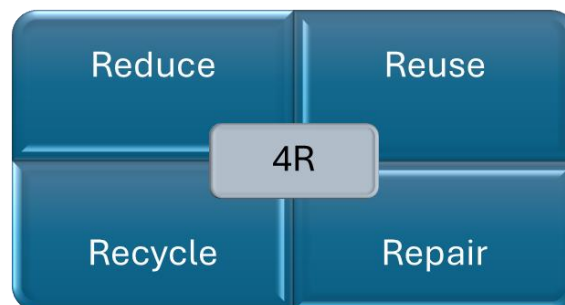


Figure 1. 4R model in waste management
Source: Faragó, 2024

Sustainability and sport

Sustainable development is extremely broad, encompassing many interpretations and layers. According to Daly, sustainable development, sustainability – or more recently sustainable development, sustainable transition – is “the achievement of continuous social well-being without growing beyond ecological carrying capacity” (Gyulai, 2012, p. 2). We have divided sustainability into three dimensions. The relationship between the social, environmental, and economic subsystems that constitute the three pillars of sustainability is usually represented by sets. According to the model, the intersection of any two sets yields an important sustainability objective. However, we can only speak of sustainability in the case of an optimum determined by the narrow common intersection of the three sets. (Figure 2)



Figure 2. The relationship between the three pillars of sustainable development
Source: vitafutura.hu

According to the UN definition, sustainability in sports is characterized by the increasing contribution of sport to sustainable development, peace, tolerance, and respect, and the contribution to the rights of women, children, individuals, and communities, health education, and the creation of an inclusive society (UN Agenda 2030 program, 2015). When we talk about the relationship between sport and the environment, there are several aspects in which sustainability can be examined. These can include the sustainability of sports events or sports facilities, fan behavior, or the impact of the given sport itself on the environment. At the same time, in many aspects related to social sustainability – health preservation, community building, attitude formation, and social mobility – sports could be a particularly good communication medium, which is worth using more consciously. Sport can be a tool in the palette of sustainability that is quite strong both socially and economically. Sport can affect the above-mentioned dimensions (social, economic, environmental) and seriously impact them. As a social synthesizer, sport is a powerful tool in itself, as it is for everyone, social inequalities are eliminated, and sport belongs to everyone. In addition, it has a social, community-building power and is a culture-developing activity. Due to the Olympic movement and other international competition events, it offers global networking opportunities. In addition to popularizing sports, various sporting events and world competitions increase the desire to play sports, thereby contributing to a healthy lifestyle.

In the context of economic sustainability and sport, we examine the relationship between the economy, society, and the environment. (Figure 3)



Figure 3. Strong sustainability model
Source: ageoftransition.org/eco-mutuality

Economic sustainability is perhaps the smallest set of the three dimensions if the goal is strong sustainability. If our environment and society function optimally, a kind of end product can be the stability and sustainability of the economy. This works similarly in the world of sports; of course, economic security is a condition for social satisfaction. Several studies have examined the connections between economic sustainability and the sport. Bang-hua (2005) and Moskovljević (2021) both emphasize the need for sustainable development strategies in competitive sports, focusing on athlete culture and scientific support. Tziralis (2008, 2006) and Weiler (2010) examine the sustainability impacts of the Olympic Games, highlighting the need for economic and environmental aspects in investment projects.

The UN Brundtland Report (1987) states: “Sustainable development is a development process that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Meadows (1993) defines a sustainable society as “a society that is able to survive for generations, that is foresightful, flexible and wise enough not to undermine its own physical or social life support system.”

The sport also directly impacts our natural environment, as it uses natural resources (Ráthonyi-Ódor and Ráthonyi, 2020). An example of this is football matches. In recent decades, football has been played in increasingly modern stadiums, the construction, maintenance, and operation of which require various renewable and non-renewable natural resources, so it can be stated that sport (e.g., football) uses natural resources.

If we want sports to be more sustainable, it is important to create sports programs and sports facilities that harmonize with nature. This is vital because when organizing a sports event and building, maintaining, and operating a sports facility, there are several factors that burden the environment. Such factors include land use, raw materials, energy use, and environmental pollution (Ujj, Dikács, 2004).

Since the sports sector has been increasingly emphasizing environmental awareness in the past decade or two, it is trying to mitigate the above factors and follow the principle of sustainability (Ráthonyi-Ódor, Ráthonyi, 2016). One of the biggest problems from the sustainability perspective is the enormous energy consumption of sports facilities. It is well known that the largest stadiums and sports complexes are multifunctional facilities, and various shops and canteens can also be found in them. Maintaining and operating these – in addition to sports fields and projectors – requires much energy. In order to protect our non-renewable resources, we must pay special attention to the sustainability of the operation of facilities serving as centers of sport and entertainment, with the participation of the sports sector.

The principles of sustainability can be divided into three parts, the first of which is that what we put into the environment should not exceed the capacity of the environment to absorb/process it.

The next: What we extract from the environment should not exceed the capacity of the environment to regenerate it. The third factor: The use rate of non-renewable resources should not exceed the rate at which we can replace them with renewable resources” (Daly, 1994).

According to this definition, the materials released into the environment during the operation and maintenance of a sustainable sports facility do not exceed its processing or absorption capacity, and the materials used or extracted from the environment during its construction, operation, and maintenance do not exceed its regenerative capacity. Also, the number of non-renewable resources used during its operation and maintenance does not exceed the rate at which they can be replaced by renewable resources. Two of these criteria must be met in order for the sports facility to be considered sustainable. Meeting these criteria is not easy, which is why most sports facilities strive to reduce harmful emissions significantly and to ensure that a significant part of their energy consumption comes from renewable resources, such as solar panels. If we examine the corporate aspect of sports, sports also appear in corporate responsibility, CSR (corporate social responsibility). According to the European Commission’s 2011 definition, CSR is “the responsibility of businesses for their impact on society.” (EC, 2011, p. 6) CSR aims to achieve the direction of long-term maintenance of value preservation and value creation. In this way, CSR follows the values of sustainability. CSR is not separated from sport among companies, and sport appears in social engagement. The social engagement of sport is less a part of the corporate strategy, and CSR appears more in support outside the corporate concept. Typically, only larger companies have a social responsibility concept, which they also communicate to society. (Faragó, 2017) In the operation of sports facilities, the operator appears as a company. Thus, the sustainability of the sports facility can even be treated as part of corporate CSR.

GOOD PRACTICE IN THE SUSTAINABILITY OF SPORTS FACILITIES

The study presents two good practices for the sustainability of sports facilities. First, the basic sustainability characteristics of the Johan Crujff ArenA are presented.

The Johan Crujff ArenA, formerly known as the Amsterdam ArenA, is one of the most prominent sports facilities in the Netherlands, which opened in 1996. The stadium’s historical roots can be traced back to the 1986 Olympic bid, but actual construction began in 1993. The building has a capacity of 50,000 people and an innovative, retractable roof. The 50 million euro renovation, which began in 2015, aimed to improve sustainability, meet modern requirements and present a green stadium for the EURO 2020 sports event. As part of this, LED technology was used in the lighting, and additional photovoltaic systems and rainwater harvesting were installed. (Michał, 2015)

As a first step in the sustainability measures, energy management was transformed. The stadium has more than 4,000 solar panels and a wind energy system, which covers 8% of its annual energy needs, while the rest is provided by purchasing green electricity. An energy storage system with a 3 MW/2.8 MWh capacity is also in operation by recycling Nissan LEAF batteries. (NRGreport, 2018) The spread of electric vehicles and the recycling of used batteries is also a major problem factor that this system can handle. Recycling eliminates environmental pollution. The production of used batteries is environmentally polluting, emitting carbon dioxide and greenhouse gases. (Hannan et al., 2018) The energy is used to operate the stadium and support the nearby environment's electricity supply, thus reducing the carbon footprint. (Warmerdam et al., 2020)

Another sustainability aspect was considered to be water management. The stadium has rainwater collection systems that contribute to reducing water consumption, especially in meeting irrigation and cooling needs.

An additional advantage of the sports facility is that it has a building management system that monitors energy consumption, and thus the amount of energy saved can be continuously controlled. The system optimized the energy consumption of the sports facility. (Raan, 2014) Their carbon dioxide emissions have been decreasing yearly, halving in 4 years. A tenth has reduced Arena's natural gas consumption in 5 years, as the heating and cooling system is used in an alternative way, and several innovative systems have been introduced, such as a solar panel system, green electricity purchase, and wind energy.

The stadium aims to achieve net positive sustainability by 2030, in which the environmental contribution exceeds consumption. (Johan Cruijff Arena, 2023)

The second good practice in sports facility sustainability to be presented is the Mercedes-Benz Stadium. Mercedes-Benz Stadium, located in Atlanta, is a multi-purpose facility that is home to American football and soccer. The stadium was built at a cost of \$1.5 billion and opened in 2017. Its outstanding features include a retractable roof and a capacity of 75,000 people.

A number of innovative solutions have been implemented in the Mercedes-Benz Stadium to ensure sustainability measures. The stadium is LEED Platinum certified (Leadership in Energy and Environmental Design), a green and sustainable facility certification awarded by the U.S. Green Building Council. (Wedding and Crawford-Brown, 2008) In the ratings awarded by the foundation, the Mercedes-Benz Stadium received a Platinum rating, which was achieved with 88 points out of a maximum of 110. The stadium achieved the highest level of sustainable building design thanks to solutions such as water-saving systems and energy-efficiency innovations. The facility generates 1.6 million kilowatt hours of energy annually with solar panels, providing shade for visitors. Waste management is a key sustainability element. As part of the "Zero Waste" initiative, the stadium recycles or donates 90% of its food, significantly reducing the amount of waste sent to landfills. Composted waste is reused in gardens located on the stadium grounds. Great attention is paid to water management. With the help of an 8 million liter rainwater collection system, the facility uses 47% less water than stadiums of similar calibre. (Mercedes-Benz Stadium n.d., Zero Waste)

Transportation innovations and green spaces are of great importance in sustainability. Both stadiums consider it essential to support alternative transport options. For example, the Mercedes-Benz Stadium also operates bicycle racks and electric vehicle charging stations. The facilities have developed green spaces to increase carbon absorption, where composted soil is used for plant cultivation. In terms of building sustainability in sports facilities, the sustainability strategies of the Johan Cruijff ArenA and the Mercedes-Benz Stadium set an example for the future of sports facilities. Innovations in energy management, water treatment, and waste reduction contribute to reducing the ecological footprint. Technological developments and further greening of construction processes are necessary to ensure the sustainable development of the sports industry.

SUMMARY

The design and operation of sustainable sports facilities are key to reducing the environmental footprint of the sports industry and promoting sustainable development. The research examined two prominent examples, the Johan Cruijff ArenA, and the Mercedes-Benz Stadium, which stand out for their innovative practices in the field of sustainability.

The Johan Cruijff ArenA's sustainability efforts include a photovoltaic system with over 4,000 solar panels, covering 8% of its annual energy needs, and a Nissan LEAF battery solution for energy storage and reuse. The stadium's rainwater harvesting systems and advanced building

management contribute to reducing energy and water consumption while also reducing its carbon footprint.

The Mercedes-Benz Stadium's LEED Platinum certification recognizes sustainable construction and operation practices. With solar panels generating 1.6 million kilowatt hours of energy per year, a rainwater harvesting system, and a "Zero Waste" approach to waste management, the stadium sets an example of environmentally conscious operation of sports facilities.

Both stadiums emphasize the support of alternative transport options and the importance of green spaces, such as the use of composted soil, for environmentally friendly maintenance. According to the study results, energy management, water management, and waste reduction are key factors in the sports industry's sustainability efforts.

The research shows that the sustainability of sports facilities offers environmentally friendly solutions and economic benefits while contributing to increased social responsibility. Technological innovation and greening of construction processes in developing future sports complexes can be a further step towards sustainable development.

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Authors' contact details:

Piroska BÉKI, assistant professor, Eötvös Lóránd University Faculty of Education and Psychology, H-1117 Budapest, Bogdánfy u 12. beki.piroska@ppk.elte.hu

Beáta DOBAY, associate professor, University of Sopron Benedek Elek Faculty of Education Institute of Arts and Sports Sciences, H-9400 Sopron, Ferenczy J. u. 5. dobay.beata@uni-sopron.hu

Beatrix FARAGÓ, associate professor, Research Centre Alexandre Lamfalussy Faculty of Economics Sopron University, H-9400 Sopron, Erzsébet u. 9. farago.beatrix@uni-sopron.hu