Historical Impact of Sports Stadiums on the Environment

Sports stadiums and facilities historically have had a detrimental impact on the environment, causing issues such as waste management, energy consumption, and air pollution, with fans of major sports games creating carbon footprints much higher than day-to-day activities (Wilkes, 2021). For example, regarding the energy consumption in the larger stadiums in the world, the largest stadium in the NFL and home to the Dallas Cowboys can use up to 10 megawatts of electricity on a game day, which is enough energy to power roughly 3,600 homes (Wilkes, 2021). The disposal of waste resulting from these events, including packaging materials, food remnants, and other discarded items, often ends up in landfills, contributing to environmental degradation (Costello et al., 2017). Moreover, the infrastructure and facilities of sports stadiums consume considerable amounts of energy and resources. For instance, the lighting, heating, cooling systems, and transportation to and from these venues contribute to high energy consumption, resulting in increased greenhouse gas emissions (Ke, 2021). Additionally, the transportation emissions generated by fans traveling to and from stadiums have a notable impact on air quality and local ecosystems (Costello et al., 2017).

However, many sports stadiums, such as AT&T and Mercedes-Benz Stadiums, have recently created eco-friendly stadiums through their additions of renewable energy, LEED certifications, rainwater collection, and LED lighting to reduce their carbon footprint and promote the idea of saving our environment (Wilkes, 2021). Even though this process is in its early stages, greening sports has gained traction due to the efforts to gather information on energy, waste, and water usage from various sports arenas (Wharton School, 2013). Despite the

fact that sporting events have a relatively minor environmental impact in comparison to big polluters like coal power plants, the movement is a small step in the right direction that aids in increasing public awareness, influencing fan behavior, and spreading environmentally conscious messages to a wider audience (Wharton School, 2013).

Environmental Concerns and Waste Generation

The waste management operations in sports stadiums have become a pressing environmental concern due to the significant amount of waste generated during events (Costello et al., 2017).

In a study done by Christine Costello, with expertise in life cycle analysis, they collected data on the landfill-destined waste generated at the University of Missouri football stadium in 2014. According to Figure 1 an estimated 47.3 metric tons (mt) of waste was generated. The majority (29.6 mt) came from off-site, pre-game food preparation activities; over 96% was pre-consumer and unsold food waste. The remaining 17.7 mt originated from inside the stadium, with recyclable materials accounting for 43%, followed by food waste, 24% (Costello et al., 2017). Given these numbers, there is a clear necessity for an efficient waste classification and disposal system. Additionally, the large amount of pre-consumer and unsold food waste emphasizes the importance of a system that can efficiently categorize and manage such types of waste, meaning that the system will need to manage compost waste. Lastly, the fact that much of the waste produced in the stadium is recyclable materials and food waste, along with majority of the other waste being regular trash, there is also a need for a waste management solution that can effectively distinguish between different waste categories.

Zero-Waste

Since it has been established that there is a need for a waste management solution that can effectively distinguish between different waste categories, the concept of zero-waste emerges as a guiding principle. The notion of zero-waste has existed for decades and challenges humans to close material loops during the production or consumption of any product or service (Costello et al., 2017). This concept is intended to give rise to innovative and creative ideas that can achieve the zero-waste goal, ultimately creating a significant positive environmental impact. To define it in terms of the Zero Waste International Alliance, zero waste is preserving all resources through careful manufacturing, usage, recycling, and retrieval of items, packaging, and materials, while avoiding any combustion and preventing any releases into land, water, or air that could harm the environment or human well-being. ("Zero Waste Definition", 2018).

The concept of zero-waste, grounded in ecological theory, aims to eliminate waste generation almost entirely during production and consumption. This goal is typically achieved by following the zero-waste hierarchy pictured in Figure 2. Most organizations aim to recycle or compost 90% of the waste stream, considering it the most sustainable option (Costello et al., 2017). However, the solutions to achieving 90% waste diversion involve complex changes in supply chains, coordination, and investment in waste infrastructure.

Shortcomings of Current Waste Disposal Methods

Current disposal methods often lack sustainability and cause harm to the environment, posing a threat to the surrounding ecosystems. For example, in the 2014 World Cup, an average of about 5 tons of garbage was scattered in and around the stadiums after each game. The host

country, Brazil, had to employ around 850 workers to manage hygiene in the 12 World Cup stadiums (Duc Thanh, 2019). Additionally, a 2006 study in California revealed that, on average, each event attendee generated about 2.44 pounds of waste per day. Various stadiums in the US, like Beaver Stadium in Park University Campus, collected approximately 40 tons of waste after each game (Duc Thanh, 2019).

There is a clear problem with the current sports venue waste management system due to the massive amounts of waste generated at games (Wergeland & Hognestad, 2021). For this reason, addressing this issue is vital to mitigate the environmental footprint of sports stadiums and promote a more sustainable future.