

UEFA

SUSTAINABLE INFRASTRUCTURE GUIDELINES



UEFA

SUSTAINABLE
INFRASTRUCTURE
GUIDELINES



MESSAGE FROM THE UEFA PRESIDENT

As a guardian of the world's most popular sport, UEFA aspires to take a leading role as a catalyst of positive change in sports by promoting sustainable development and introducing more sustainable business and operating models in football.

Infrastructure is the cornerstone of any sports development but also remains a considerable investment. Therefore, I am pleased to see how green architecture has developed in recent years, offering solutions for often overlooked problems, such as optimising water and energy usage or creating a more efficient circular economy. The best preparation for tomorrow is doing our best today.

These guidelines offer many innovative solutions and principles, whether you are planning to build new facilities or refurbish existing ones. I am also delighted to see that most of these success stories presented in this document come from Europe. That shows that the voice of football is successfully boosting eco-awareness and triggering actions across the continent.

UEFA wants these guidelines to develop into an interactive platform for knowledge sharing and best practices exchange that will be constantly updated and upgraded. If football comes together and bundles its power to drive sustainable change, it will have a powerful and long-lasting positive impact.

A close-up portrait of Aleksander Čeferin, the UEFA President, looking thoughtfully to the side. The image is overlaid with a semi-transparent green filter. He has his hand resting under his chin.

A. Čeferin

Aleksander Čeferin
UEFA President

FOREWORD FROM FRANS TIMMERMANS

EXECUTIVE
VICE-PRESIDENT,
EUROPEAN
COMMISSION



Frans Timmermans

Executive Vice-President, European Commission

“MY WORLD. MY ACTION. OUR PLANET.”

IT IS THE SLOGAN OF THE EUROPEAN CLIMATE PACT, THE PEOPLE MOVEMENT UNDER THE EUROPEAN GREEN DEAL TO WHICH UEFA HAS BEEN AN AMBASSADOR FROM THE BEGINNING. TOGETHER WITH UEFA, WE HAVE BEEN ABLE TO REACH FANS ACROSS EUROPE, INFORMING ABOUT THE GREEN TRANSITION AND INSPIRING THEM TO ACT.

When it comes to tackling the climate and biodiversity crises, we need systemic change across all sectors of the economy. And at the European Union, we are working on the laws that drive that change. By 2050, we should become the world’s first climate neutral continent.

To get there, we are taking steps to reduce greenhouse gas emissions, tackle pollution, restore nature, and move to a fully circular economy. The Green Deal is Europe’s growth strategy, our ticket to energy sovereignty, and our roadmap to a green and healthy future.

But we will not succeed in keeping our planet liveable without the support of every individual and every organisation. Everyone needs to step up action within their own worlds.

The solutions showcased in these Sustainability Guidelines for Football Infrastructure are real game changers. Renewable sources of energy like geothermal in Faroe Island Stadium or solar panels on Skye can wean us off fossil fuels. Heat loss or gain can be better managed through stadium insulation and renovation.

Wetlands around stadia, like those in London, can be preserved or even restored. Construction materials like the concrete in Cagliari can be reused and water collection systems, installed to reduce waste.

In Nice, where photovoltaic solutions are combined with natural ventilation systems inspired by the Romans, we can even see how technology and tradition work together to keep fans and players cool.

Whether it's construction, transport, waste or energy; it's clear that smart design and operation of football stadia and sports facilities can make them true champions of climate action. Every action counts and this brochure provides a lot of inspiration.

I THEREFORE ENCOURAGE EVERYONE ACROSS THE WORLD OF SPORTS TO CONSIDER WHICH EXAMPLES GIVEN HERE WILL HELP YOUR ORGANISATION PLAY ITS PART IN THE GREEN TRANSITION.

WHILE THE WINDOW FOR ACTION AGAINST THE CLIMATE AND BIODIVERSITY CRISES IS RAPIDLY CLOSING, WE STILL HAVE A SHOT AT KEEPING OUR PLANET LIVEABLE.

**IF EVERYONE CONTRIBUTES,
WE WILL GET A GREENER
FUTURE FOR OURSELVES, OUR
CHILDREN AND THEIR CHILDREN
- A TRUE TEAM EFFORT.**

TABLE OF CONTENTS

07 INTRODUCTION



03 MESSAGE FROM THE UEFA PRESIDENT



04 FOREWORD FROM FRANS TIMMERMANS EXECUTIVE VICE-PRESIDENT, EUROPEAN COMMISSION

10 HOW TO USE THESE GUIDELINES

A.	ENVIRONMENTAL, SOCIAL AND GOVERNANCE CRITERIA	11
A1.	ENVIRONMENTAL CRITERIA	13
A2.	SOCIAL CRITERIA	47
A3.	GOVERNANCE CRITERIA	55

B.	FOOTBALL INFRASTRUCTURE SUSTAINABILITY	66
B1.	PURPOSE	68
B2.	LOCATIONS	76
B3.	TRANSPORT AND MOBILITY TO THE PRECINCTS	86
B4.	ACTIVITIES	100
B5.	CONSTRUCTION MATERIALS	102
B6.	MAIN ELEMENTS OF A STADIUM	107
B7.	PITCH AND LANDSCAPING	118

C.	SUSTAINABILITY MANAGEMENT	129
C1.	BUILDING MANAGEMENT SYSTEM	131
C2.	LANDSCAPED AREAS & SMART TECHNOLOGY	134
C3.	EVENT MANAGEMENT	141
C4.	CROWD MANAGEMENT	146
C5.	AUDITING	151
C6.	CIRCULAR ECONOMY AND WASTE MANAGEMENT	152
C7.	CASE STUDY OF A TRAINING FACILITY	163
D.	HEALTH AND SAFETY	166
D1.	HEALTH AND SAFETY	167
D2.	HEALTH & WELL BEING	173
E.	REFERENCES	175
F.	GLOSSARY	176

INTRODUCTION

SUSTAINABLE FOOTBALL INFRASTRUCTURE

PROVIDES LONG-TERM FINANCIAL AND ENVIRONMENTAL BENEFITS TO OPERATORS AND STRENGTHENS THE LEGACY OF COMMON SPACES FOR LOCAL COMMUNITIES.



Infrastructure Sustainability is one of the eleven Policies currently being deployed as part of [UEFA's Football Sustainability Strategy 2030, 'Strength through Unity'](#).

The Policy's ambition is to continue to raise the bar for European football infrastructure, both at the level of stadiums and training facilities, by setting criteria and sharing best practices for a new generation of sustainable football venues.

Specifically, in the UEFA context, infrastructure sustainability refers to focusing on the development of guidelines for sustainable football venues; to the promotion and application of infrastructure sustainability criteria across UEFA's governance, policies and guidelines;

and to knowledge transfer around best practices in stadium infrastructure.

UEFA is launching this working document aimed at inspiring and supporting football stakeholders across Europe – National Associations, clubs, infrastructure managers, local authorities, stadium operators, architects – to embed environmental, social and governance (ESG) practices at every stage of the football infrastructure lifecycle: the concept and design phase, including the impact on biodiversity and local communities; the construction phase; the management phase, including the end-of-life stage

In a nutshell, the document provides:

AN INTRODUCTION to the concept of infrastructure sustainability, structured around the topics of ESG

A DEEP-DIVE into the realities of football infrastructure – covering topics such as purpose, location, design, conception and construction, pitch, and landscaping aspects

INSIGHTS into the infrastructure management phase – most notably looking at the use of embedded technology in the stadium infrastructure and the pitch as well as means to tackle event and waste management challenges, including at the level of health and safety

The term 'green architecture' is used to describe environmentally conscious design, construction and management techniques. This guide offers a broad overview of all aspects of green architecture that can be incorporated into the design of a new sports facility or even into the refurbishment of an existing facility. Moreover, it goes beyond purely environmental sustainability requirements and also makes recommendations as to how football facilities can ensure their economic and social sustainability, which includes aspects such as accessibility, inclusion and human rights.

All stadium and sports facility developers should be encouraged to take a positive and responsible stance by incorporating as many sustainable principles into the whole process as possible. This is likely to offer long-term financial benefits as, contrary

to common perception, sustainable initiatives are not always more costly; many simply require a more careful and conscientious design and thought process. This may include, for example, developing a road map of sustainable objectives looking many years into the future and taking into account budgetary constraints and construction plans.

The guidelines were developed with the support of subject matter experts externally (architects, clubs, operators, academics) and internally in UEFA (Football and Social Responsibility, Football Operations, National Associations and EU Office). The document was designed to be an online working tool and will be updated on a regular basis (including its numerous case studies) with the latest trends around technology, legislation and stakeholder expectations. The development of the Guidelines has led

to the creation of a database of best practices, backed by a comprehensive set of references to examples, future development ideas and tools for specific topics.

The Sustainable Infrastructure Guidelines will be shared across the European football ecosystem and translated in all languages to cover the 55 countries. UEFA will actively engage with National Associations' and Clubs' sustainability officers to support the implementation of best practices through knowledge transfer workshops and accurate monitoring of the various activities. This living document will be periodically updated based on technologies advancement, legislation, expectations from civil society and ever-evolving UEFA requirements.

Michele Uva,

Director of Football Social Responsibility, UEFA

HOW TO USE THESE GUIDELINES

This document is divided into the following sections:

A**ENVIRONMENTAL, SOCIAL AND GOVERNANCE:**

focusing on the three key criteria for infrastructure sustainability:

01. Environment: touching on climate change issues, the impact of humans on our own habitat and the various issues relating to energy and water, the impact of passive and active design, and the role passive and active sustainability, two fundamental pillars of any infrastructure;
02. Social: providing an overview of sports facilities' impact on human rights and local communities;
03. Governance: covering policy and economic aspects that are fundamental at all stages of a facility's lifecycle.

B**FOOTBALL INFRASTRUCTURE SUSTAINABILITY:**

diving into the sustainability of a sports facility's infrastructure, covering its purpose, location, design, conception and construction, pitch and landscaping.

C**SUSTAINABILITY MANAGEMENT:**

providing a detailed look at sustainability in the day-to-day life of a facility, from the use of technology embedded in the infrastructure and the pitch to event management and finally how waste management can be addressed with a circular economy in mind.

D**HEALTH AND SAFETY:**

zooming in on the measures needed to ensure the safety of anyone working at or attending football matches.

E**REFERENCES:**

providing a list of relevant documents.

F**GLOSSARY:**

listing definitions of uncommon and technical terms.



ENVIRONMENTAL, SOCIAL AND GOVERNANCE CRITERIAL

ESG - ENVIRONMENTAL, SOCIAL AND GOVERNANCE CRITERIAL

STANDARDS AND MECHANISMS ARE INCREASINGLY APPLIED TO LINK THE SUSTAINABILITY, OPERATIONAL AND FINANCING STRATEGIES OF EUROPEAN FOOTBALL, AND ACCELERATE THE SUSTAINABILITY AMBITIONS OF THE FOOTBALL INDUSTRY.

THE GUIDELINES BELOW FOCUS ON THE ESG LENS IN THE AREA OF INFRASTRUCTURE SUSTAINABILITY:

→ **Environment:** touching on climate change issues, the impact of humans on our own habitat and the various issues relating to energy and water, the impact of passive and active design, and the role passive and active sustainability, two fundamental pillars of any infrastructure;

→ **Social:** providing an overview of sports facilities' impact on human rights and local communities;

→ **Governance:** covering policy and economic aspects that are fundamental at all stages of a facility's lifecycle.



— A sound infrastructure strategy will seek to balance the above criteria and weigh potential trade-offs along the way.

A1. ENVIRONMENTAL CRITERIA

Environmental criteria in the context of football infrastructure are about identifying and managing impacts on the environment. Football must strive to preserve and regenerate our shared environment, while empowering others to do likewise, to support social and environmental wellbeing, now and in the future. By embedding environmental considerations into decisions and thereby reducing the sport's impact on the environment, football also strengthens the resilience of European football's physical infrastructure.

The following topics are covered in this specific section:

CLIMATE CHANGE

BIOSPHERE

SUSTAINABLE DESIGN MEASURES

PASSIVE SUSTAINABLE DESIGN

PASSIVE ENERGY

PASSIVE WATER

ACTIVE SUSTAINABLE DESIGN

CLIMATE CHANGE

Greenhouse gas emissions from human activities have accelerated climate change, which is causing intense droughts, floods, fires, hurricanes, rising sea level and declines in biodiversity. Because of this, measuring, reporting and reducing emissions to mitigate those physical risks has become increasingly important in recent years, and this trend is only expected to grow.

The effects of climate change can cause substantial damage to football infrastructure, as explained in the [World Economic Forum 2022 report](#), and those risks need to be acknowledged, addressed and mitigated.

CARBON FOOTPRINT

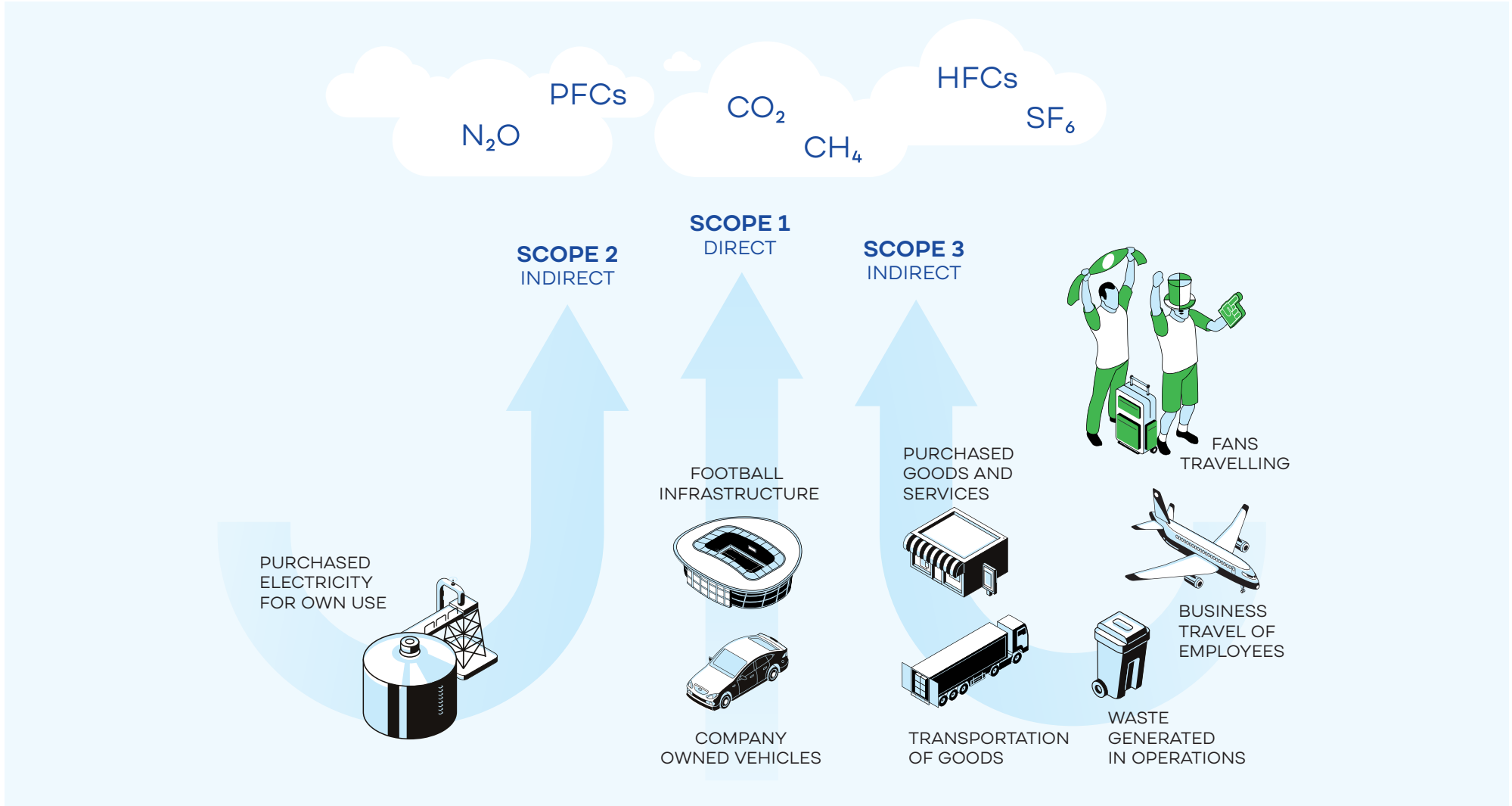
The term 'carbon footprint' refers to the amount of greenhouse gas emissions that are generated from anthropogenic activities caused by an individual, event, organisation, service, product or venue. In the case of sports facilities, it concerns the emissions related to their design, construction and management.

Carbon dioxide (CO₂) is just one of many greenhouse gases, each of which has a global warming potential that is converted into its carbon dioxide equivalent (CO₂e) in order to calculate the carbon footprint.

Practically all governments and most corporations now strive to reduce their carbon emissions, also known as their 'carbon footprint'. While some industries remain reticent because of the initial hurdles (resources, cost,

the complexity of gathering data), it is now generally accepted that such efforts are required. Designers and stadium operators are thus becoming more and more conscious of the need to build stadiums and other sports facilities with an almost-zero carbon footprint and rely on internationally recognised standards like the [Greenhouse Gas Protocol](#), the [Life Cycle Assessment](#) and the EU's [Product Environmental Footprint](#) and [Organisation Environmental Footprint](#) methodologies.

The below picture represents the Greenhouse gas protocol methodology adapted to football and represents the activities that translates in greenhouse gas emissions or carbon equivalent.



Greenhouse Gas Protocol adapted to football

There are 3 categories, also called “scope”:

SCOPE 1

represents the direct emissions, meaning activities directly under your operational and financial control:

- Energy used for your facilities to generate heat (natural gas for space heating or hot water, diesel generators for back up, etc...)
- Combustion of fuels (diesel, petrol, methane, LPG) for your vehicle fleet (car, vans, coaches)

Note: All renewable energy generated on site needs to be reported under scope 1

SCOPE 2

is a “stand alone” and is considered indirect as the purchased electricity (but also heat and steam if applicable) from the national grid was

generated elsewhere, therefore out of your control. In order to convert in CO₂e, the standard procedure is to use the national conversion factor, unless your utility provider can provide a more accurate figure.

SCOPE 3

represents all other emissions related to activities that occur in the running of your operations. Below is a non-exhaustive list of the main contributors:

- Purchased good and services
- Transportation of purchased goods
- Waste generated and disposal (per type of waste is highly recommended, including water consumption and wastewater treatment)
- Employee business travel (plane, train, car)
- Fans travelling to football games. Even though extremelly difficult

to account for (and not under control), it has become common practice for sports instances to assess the impact of fans travelling to events and a duty to influence, and facilitate, more sustainable ways (please refer to B3. Transport and smart mobility to the precincts section for more information)

CARBON REDUCTION AND DISCLOSURE

One of the most important aspects of environmental sustainability is striving in all areas of industry and daily life to achieve a massive reduction in carbon emissions into the atmosphere. In the years since the industrial revolution, humankind has primarily used fossil fuels such as coal and oil to produce energy. A major drawback of these non-renewable resources is that their combustion produces carbon dioxide and other

gases, which has had, and is still having, a significant effect on the planet. From civil society scrutiny to corporate strategy, carbon disclosure has become a true differentiator in the choice of products, services and even investments.

Reporting and disclosure processes are becoming more complete, complex and even mandatory in some instances.

Examples include the [Climate Disclosure Standards Board](#) (CDSB), which is still voluntary in most cases, but performances are marked and ranked, such as by the [Carbon Disclosure Project](#) (CDP), the [Global Reporting Initiative](#) (GRI), the [Global ESG Benchmark for Real Estate](#) (GRESB) and the [Principles for Responsible Investments](#) (PRI), to name a few.

Carbon disclosure means providing information for stakeholders in the annual report on the actual status of the organisation's ESG performances as well as a comparison with the previous year's performance in order to show progress toward the relevant target(s) and strategy.

The emphasis is on providing stakeholders with information and indicating a robust carbon reduction methodology to ensure alignment with any commitments made, such as carbon or climate neutrality, in line with the Paris Agreement mentioned in Governance section.

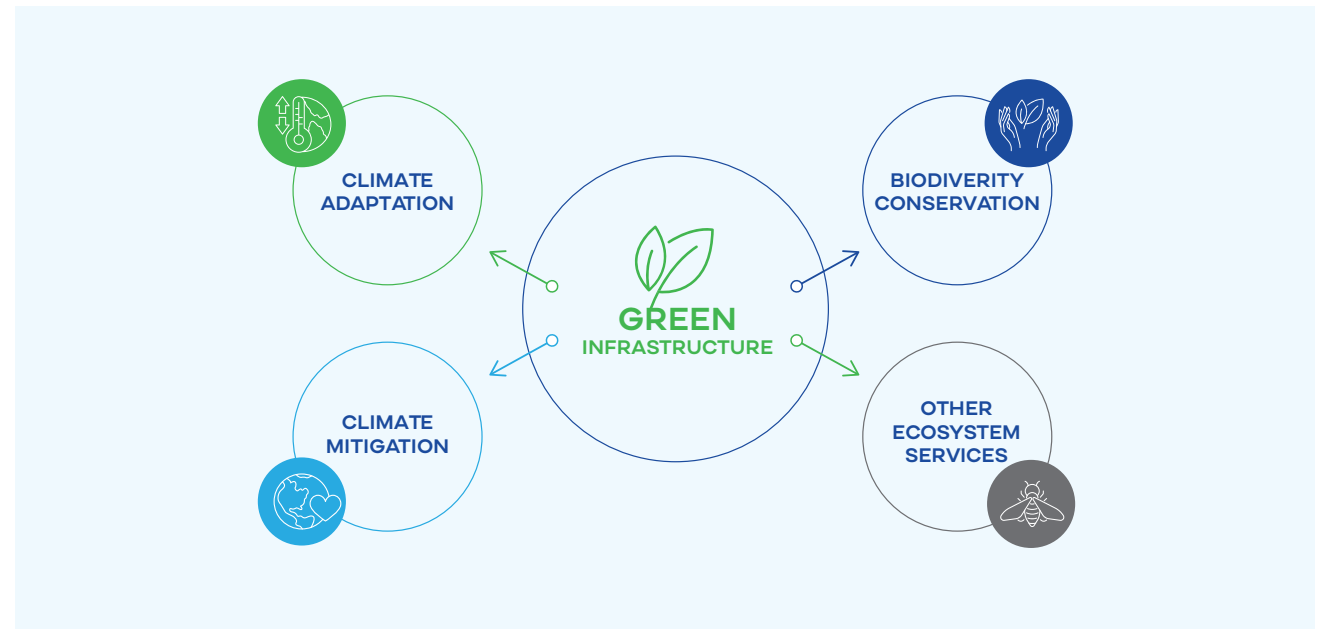
Some mechanisms, such as the energy certificates or carbon offsets, described below, are also common practices, and are accepted if used in accordance with climate-neutral frameworks like the UNFCCC's Climate Neutral Now.

- Renewable energy certificates
- ([RECs](#)) are specifically granted for the production of electricity from renewable sources, such as large solar arrays or wind turbines, and can lower a facility's carbon emissions as calculated under Scope 2 of the [Greenhouse Gas Protocol](#).
- [Carbon offsets](#), when purchased from and certified by a reputable organisation, are an effective way to reduce a facility's carbon footprint. Offsets are calculated greenhouse gas emission reductions resulting from a project that would not have happened if the company reporting the offset had not invested in it. Carbon offsets can lower a facility's calculated emissions and are often used to compensate residual emissions that, despite all efforts, cannot be avoided.

BIOSPHERE

Scientists have defined infrastructure as: “all elements of interrelated systems that provide goods and services essential to enabling, sustaining or enhancing societal living conditions”.

Although traditionally, infrastructure included only all human-made assets, since the 1980s, both scientists and conservationists have suggested that ecosystems should be also considered as a type of infrastructure. Here we review the evolution of the concepts of ‘ecological’, ‘green’, ‘natural’ and ‘blue’ infrastructures and evaluate how these concepts have been used in the scientific literature. We found that although the term ‘ecological infrastructure’ was the most used until 2004, ‘green infrastructure’ became the dominant one after then.



All terms have been applied mostly to urban settings, terrestrial ecosystems and emphasised supporting and regulating ecosystem services, with a strong emphasis on the mediation of water flows in urban centres and the maintenance of species lifecycles, habitat and gene pool protection.

We suggest that green infrastructure should be the term adopted to facilitate communication between scientists, conservationists and decision-makers. We also suggest a general concept for green infrastructure aligned with the major global conventions alongside a set of design principles.

OPTIMISE WATER USAGE

Water is increasingly becoming a precious element even in countries where it is naturally provided by rain or water tables. In modern society, efforts should be made to limit water consumption to the absolute minimum necessary. Systems within stadiums should be designed to reduce water consumption and increase the efficiency of water usage in toilets, ground sprinklers, landscaping, and post-match cleaning processes.

Sports facilities can use large amounts of water, both in interior appliances and during landscaping. Mains water needs to be used with care, and good management may require looking for different water sources, such as rainwater, wells, etc. The use of rainwater should be encouraged at all stadiums, both existing and new.

This serves the dual purpose of reducing the amount of potable water (which is expensive owing to the treatment process to make it suitable for human consumption) used for non-drinking purposes and reducing the amount of rainwater discharged to sewers and watercourses.

Responsible design and management of water is a modern necessity, and all appliances and systems must be designed to optimise the efficiency of water use.

OPTIMISE ENERGY USAGE

Many appliances in stadiums use a great deal of energy and mitigation measures need to be taken in all aspects of energy consumption, making the most of the latest technologies. Energy efficiency has become the norm in some areas, such as in the use of LED lighting in stadium floodlights and lights used to stimulate grass growth, low-

energy elements, lights that switch off automatically outside of opening hours and the fans that facilitate the circulation of air at the pitch level. On the other hand, more energy-efficient measures need to be taken in other areas, such as heating and cooling, where the latest generation of air-handling units should be installed.

Reducing a sports facility's day-to-day energy use is an important management goal. Energy reduction protocols should be implemented even during the construction of a sports facility and is sometimes even obligatory. The necessary energy usage varies between locations, for example because areas with less daylight require more lighting, and the systems needed to maintain a good ambient temperature in both the stadium interior and the bowl depend on the climate.



CASE STUDY

TÓRSVØLLUR STADIUM, FAROE ISLANDS

Tórsvøllur stadium in the Faroe Islands uses LED floodlights to optimise the use of energy, which is scarce in these remote North Atlantic islands. It is also an example of using natural energy sources, since much of energy on the islands is produced using geothermal heat from the ground.

The distinctive shape of the floodlights gives the stadium an iconic identity that stands out in the city's skyline.

USE NATURAL ENERGY SOURCES

Technological developments in the production of energy from natural resources have increased exponentially. Many national governments now support wind, solar, and hydroelectric power, and sports venues can often seek grants and subsidies to implement these energy sources.

Different energy sources are more efficient in different parts of the world; for example, solar power is more effective in countries with many hours of sunlight, while facilities in other countries with an excess of water may be better advised to focus on hydropower.

Those built-in volcanic regions can use geothermal energy from the ground, while others rely on windmills to produce energy. Modern technologies must be exploited to

draw energy from naturally clean sources effectively and avoid the use of fossil fuels.

REDUCE NOISE POLLUTION

Stadiums, on game days, can be tremendously noisy places, especially if they are in an urban setting. Sustainable stadium design should ensure that the noise pollution emitted from the stadium to the surrounding area is kept to a minimum, even during the most exciting moments of an event. Noise can be measured in terms of its intensity according to the human ear and the unit of measurement is the A-weighted decibel (dBA). Human ears can be negatively affected by sounds exceeding 60 dBA, and the higher the volume, the more harmful to humans (0–30dBA = too silent; 30–50dBA = silent; 50–60dBA = moderate; 60–70dBA = loud; 70–80dBA = too loud).



Vuvuzelas are a frequent source of noise at sports events in South Africa and a good example of the need to minimise disruption to the surrounding area while allowing fan noise to be heard on the pitch

REDUCE LIGHT POLLUTION

Light pollution is the result of inefficient use of artificial light sources and can have an impact on people near the stadium; it has been linked to health issues as well as spoiling the aesthetic of the environment.

Light should be focused where it is needed and efforts must be made to prevent it from dissipating in undesired directions. Pitch lighting and event lighting in stadiums can have a major negative impact on the surrounding community, so solutions must be found to contain the light emitted and minimise its effect on exterior spaces and the surrounding landscape or urban area. This can be done by ensuring the correct orientation of the main lights and by using a roof cover. Traditional light towers can be seen from afar and are not acceptable in urban environments.

Light contamination in out-of-town areas may affect birds and other fauna that are used to darkness at night, and it can thus alter the local ecosystem. Careful design of facades is essential to minimise the amount of light emitted outside of the sports facility, especially if certain types of scenic lighting are used on event days.

BIODIVERSITY GAIN

Stadium precincts and training sites offer significant opportunities to integrate native and endemic vegetation to create valuable wildlife habitats within urban areas and provide passages for fauna between otherwise built-up environments.

Incorporating ecological design elements is often required by local planning regulations for new venues, but existing venues should also seek to retrofit habitats under the guidance of local ecological experts.



Integration of restored wetlands along the River Lea at London Stadium

SUSTAINABLE DESIGN MEASURES

The concept of resilience implies an organisation's ability to anticipate and prepare for change, then adapt to circumstances in the manner that provides the greatest chance of thriving over the long-term.

Sustainable design measures are a key element to address risks and enhance resilience, most notably in the face of climate change mitigation and adaptation measures.

The topic is highlighted by specialists reports such as the [practical guide to climate-resilient buildings & communities](#) developed by the UN Environment Programme and the study titled [Sustainable spaces: Countering climate risk in capital projects](#), by McKinsey & Company.

PASSIVE/ACTIVE STADIUMS

Passive and active sustainability measures are the pillars of application of energy to mitigate heat and cold in building through different systems. Reduced energy consumption and sustainable design can be achieved through what are known as passive and active measures implemented in sports facilities' interior and exterior spaces to regulate the temperature.

Active sustainability systems are those that require the use of energy to ensure comfort in buildings, while passive measures rely on natural conditions and the correct design measures to regulate temperatures. In the day-to-day running of the facility, the management team needs to rely as much as possible on passive measures over active measures to keep energy consumption as low as possible.

SUSTAINABLE DESIGN: PASSIVE MEASURES

Passive sustainable measures are those used to ensure that the interior or exterior of any building or sports facility remains comfortable entirely by means of good urban planning and architectural design, without resorting to any mechanical or technological solutions or other active measures.

Historically, most vernacular architecture (i.e. older buildings constructed using local methods and resources) used passive techniques to protect against extreme weather; for example, heat was often mitigated by using thick stone walls or shaded interior patios.

Many older buildings have small windows and allow air to pass through the building from one side to the other, known as cross ventilation.

In places where the sun is an issue, screen-protected windows and cooling and ventilation towers were used to lower interior temperatures without resorting to any form of active air conditioning.

Many historical cities feature colonnades that provide protection from the rain and the sun, as well as narrow streets that have the effect of limiting pedestrians' exposure to the sun.

In modern architecture, thick walls have been replaced with modern insulation, and glass can achieve much better efficiency than concrete. More recently, grass roofs have been used to increase the passive sustainability of buildings.

SUSTAINABLE DESIGN: ACTIVE MEASURES

Active measures involve producing energy using various technological systems and installations in order to heat or cool a building as efficiently as possible. Such systems may incur higher up-front capital costs, but these can often be offset in the long term by the lower running costs of a more energy-efficient system.

When designing new sports facilities, consideration should be given to the possibility of integrating active measures from the outset, and even operators of existing venues may consider investigating the long-term viability of developing and implementing active measures. Various different devices and installations are now available on the market and should be considered when designing or refurbishing facilities.



Green building



CASE STUDY

STADE DE NICE, FRANCE

Located in the Plaine du Var “Éco Vallée”, this stadium is a national project based on exemplary environmental principles:

- 95% self-sufficiency for pitch watering thanks to water collection containers
- Geothermal heat pumps maintaining the pitch temperature
- Photovoltaic panels on the roof
- Ventilation system inspired by the Romans, using the flow of air through the valley to ventilate the arena naturally
- Smart lighting

PASSIVE SUSTAINABLE DESIGN

Passive design' is design that works with the local climate to maintain a comfortable ambient temperature. Good passive design aims at reducing or, ideally, eliminate the need for additional heating or cooling depending on the infrastructure location.

NATURAL COOLING

Natural cooling can be achieved by installing shading elements to protect the facility from direct sunlight. Protection from the sun can be provided by the roof structure: Using elements such as louvres, overhangs or false facades that are free of highly heat-absorbent materials will help prevent surfaces from overheating and will naturally cool

external areas that are hidden from the sun, thus eliminating the need to install artificial cooling systems that consume large amounts of energy.

NATURAL VENTILATION

Natural ventilation can contribute to temperature control and improve stadium air quality, thereby reducing the risk of heat-related discomfort, which is likely to occur when large crowds congregate, and preventing damp and surface condensation.

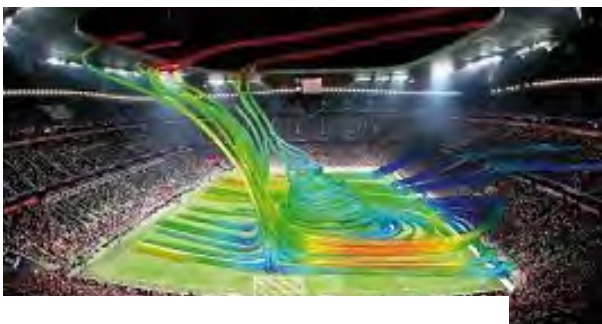
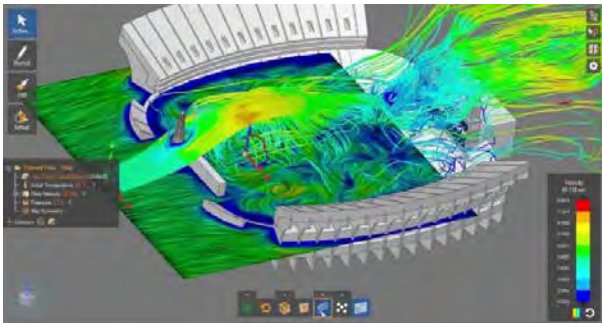
Natural ventilation involves using openings in the facade and roof along with solar chimneys, wind towers and trickle ventilators to control the indoor climate and enable air exchange through the building. Designs that include good natural ventilation are less reliant on energy-intensive mechanical ventilation and cooling systems and thus ensure freshness and cool indoor

temperatures during the hottest seasons of the year with fewer carbon emissions. That said, the cooling effect of natural ventilation is limited, and some form of low-energy cooling system may be needed in very hot or moist climates.

Incorporating natural ventilation in stadiums

Most modern stadiums are designed for the spectators to be close to the pitch, and roofs with small, or no, openings, make natural ventilation difficult to achieve on natural grass pitches. Stadium managers must ensure that natural, passive ventilation methods are in place and active before reverting to active cooling or heating systems that consume energy.

The aerodynamic design of a stadium is not only about spectator comfort but also about the pitch itself.



- ▲ CFD analysis of air flow in a stadium to ensure the best flow of air to the grass
- ▼ CFD analysis of the ventilation in the Allianz Arena, Munich

Stadiums must be designed to ensure the best movement of air over the pitch to stimulate the growth of the grass. This usually requires active ventilation in the form of jets or fans, which consume energy.

In a sustainable stadium, efforts should be made to ventilate the pitch using passive methods as much as possible (i.e., minimum energy consumption), which can be quite complex owing to the round shape of the bowl. Sophisticated computer fluid dynamics (CFD) simulations can be used to analyse the optimal air supply to the grass in the stadium.

CROSS VENTILATION

Buildings can be cooled naturally thanks to the air passing through from one facade to the other as a result of differences in pressure on each side of the building.

This is normally driven by wind movement, whereby air is drawn in by high pressure on the windward side and out by low pressure on the leeward side. The result is a pleasant current of air and a much more comfortable interior temperature.

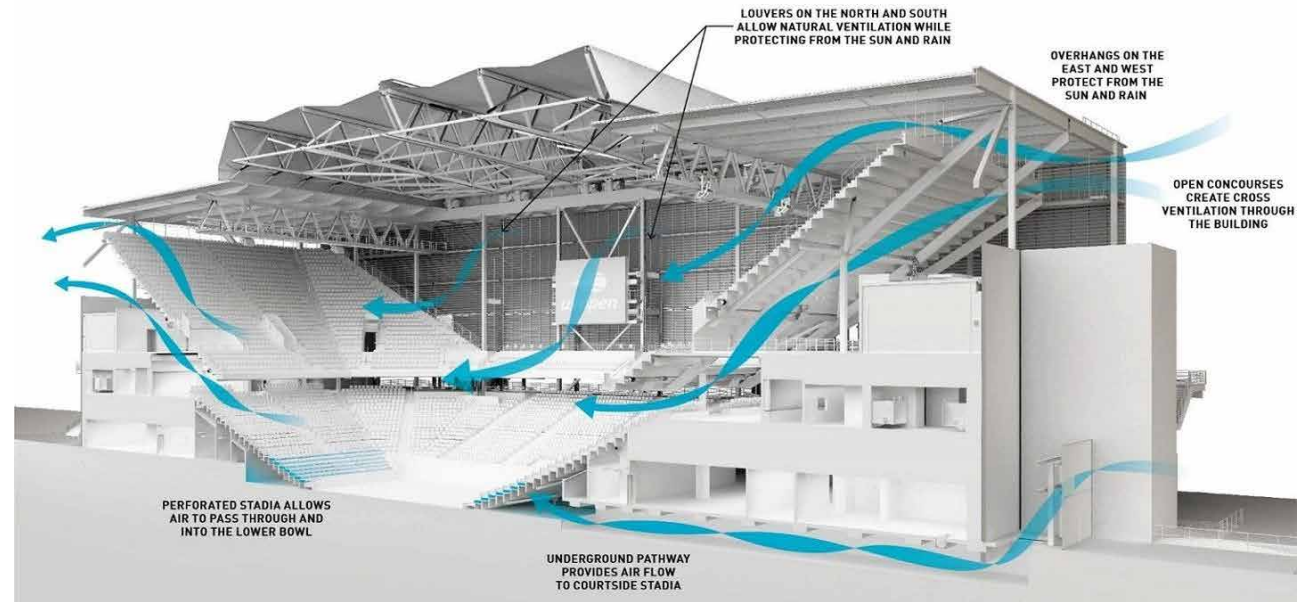
Utilising cross ventilation in a stadium is the most passive and sustainable manner to alter the spectators' comfort and the ambient temperature in the bowl or even in inner areas of the stadium. It reduces the need for energy-intensive mechanical cooling in the hot summer months.

All construction and refurbishment projects should therefore be encouraged to incorporate cross ventilation into their designs, taking into account the local prevailing wind and breeze patterns.

As well as reducing the stadium's environmental footprint by reducing its reliance on active cooling systems, cross ventilation also has a direct impact on the return on investment due to the significant cost savings resulting from lower energy consumption.

GREEN WALLS

A green wall is a vertical structure that attaches to an existing or new wall and to which different types of plants and greenery can be attached. Green walls bring different types of greenery to the building and, if well designed, can purify and cool the surrounding air, offer thermal and acoustic benefits and improve biodiversity.



Beyond conventional passive green walls, it is now possible to incorporate smart active green walls that use technologies such as artificial intelligence and can be automated to provide natural air purification and humidification.

Green walls bring elements of the natural world into areas where they are not generally seen and can stimulate emotional responses in humans, known as biophilia, that enhance their psychological well-being.

PASSIVE ENERGY

Passive energy, a term usually used in reference to passive solar energy, is natural energy which is directly harnessed to achieve a desired goal.

RENEWABLE ENERGY

In recent years, major developments have been made in renewable energies. The era of total dependency on fossil fuels such as oil and gas has been superseded by an awareness that such energy sources not only cause pollution but are also finite, hence the need to develop advanced technologies to potentiate renewable, infinite, energy sources. Facilities powered by renewable energy sources in the construction process require an effective energy management system in order to make the day-to-day functioning of the sports facility truly sustainable.

Renewable energy include the following technologies:

Biomass boilers

Biomass boilers burn organic matter, and the resulting combustion heats up water, which is then used either in the building's heating system or simply as hot water. Biomass boilers work in a similar manner to conventional boilers, but they burn various organic fuels such as grain, wood and pellets instead of fossil fuels. The combustion of these materials is sufficient to provide a sustainable and renewable source of heat.

Wind energy

Wind is now a major source of energy in many parts of Europe, and wind turbine technology is advancing rapidly. Wind turbines are extremely large and are usually concentrated in large wind farms providing energy to the local grid rather than installed for

individual facilities. That said, smaller wind generation systems are now commercially available, and it may be viable to install a series of small wind turbines in the vicinity of a sports facility to produce electricity for internal use. This could significantly reduce the facility's reliance on the grid, and any surplus could be fed into the grid. However, installing even small turbines is more challenging in urban areas.

Geothermal systems

One the most sustainable ways of reducing the energy consumption associated with heating and cooling stadiums is to make use of the ground's natural heat or coolness.

The earth many metres below the stadium is normally at a constant temperature, which depends on the location.

In a geothermal system, the heat of the subsoil brings the water to a temperature close to that desired, thereby reducing to a minimum the need for active methods to either cool or heat the water. For instance, if the soil temperature is 18°C and the water provided needs to be 22°C, then the thermal jump is only 4°C, requiring less energy than if it has to be heated from a colder outside air temperature of, for example, 8°C, or cooled from an air temperature of 28°C.

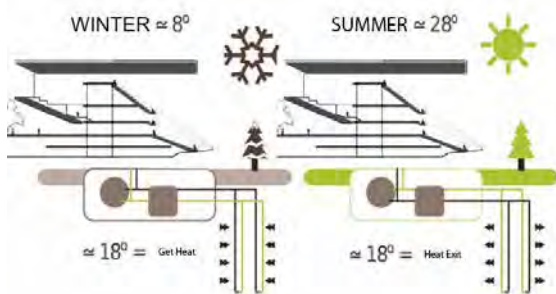


Diagram illustrating geothermal solutions for both winter and summer

Moreover, the required thermal jump is the same in all seasons, since the soil temperature remains at a constant 18°C throughout the year.

In some countries, it is possible to draw heat from the ground. In Iceland, for example, the ground temperature is high and it can be used to produce steam to drive turbines. This is an excellent way to use the area's natural resources without having to consume any form of energy to produce the steam required.

Cogeneration

Cogeneration means harnessing the heat produced when generating electricity. Traditionally, this heat was simply dissipated into the atmosphere, but sports facilities could use it in their heating systems, or to heat water. Similarly, biodigesters can be used to harness the biogas produced from organic waste. A number of venues

are studying this technology with a view to achieving a circular economy (see Section D5, 'Circular Economy and Waste Management').

Solar panels

There are two types of solar panels:

- **thermal** solar collectors on the roof convert the incoming solar radiation into heat and
- **photovoltaic** materials devices convert sunlight into electrical energy

- Solar thermal systems

use energy from the sun to generate hot water. Natural heat generation from solar panels can be used to reduce a stadium's dependence on conventional sources and reduce its overall energy consumption from the grid. For example, low temperature solar thermal systems can use the energy collected and stored by solar thermal panels to heat water for sinks and showers.

All sports facilities use energy to heat water and using solar thermal systems to do this would lead to substantial savings both in money and in energy consumption. Solar thermal collectors can be classified as low, medium or high temperature collectors. Low and medium temperature collectors provide hot water for everyday use while high temperature collectors use solar heat to produce high temperature pressure, which can in turn produce electricity.

- Photovoltaics (PV) panels

which produce electricity from the sunlight that reaches them, are one of the most common systems used to turn solar heat into electrical energy and one of the principal passive methods of energy production. They require little maintenance (aside from cleaning), generate zero carbon emissions and require no mechanical

operation. The installation of PV panels on stadium roofs has proved to be very effective; for example, the Johan Crujff ArenA produces 12% of the energy it needs by means of PV panels, which translates into substantial cost savings and a much smaller environmental footprint.

One important factor to consider in relation to PV power is the battery storage enabling the energy produced to be used during the night. The Johan Crujff ArenA has a large storage capacity that charges during the day and powers the stadium after sunset, thereby greatly increasing the proportion of the arena's energy needs covered by PV power.

Photovoltaic panels produce electricity whenever sunlight shines on them. They require little maintenance, create zero pollution, and require no mechanical operation.

Solar PV panels on the roof generate electricity to power lights and any other energy required in the stadium. The roof also offers shade, thereby minimising the heat gain in the bowl and helping to keep spectators cool.

Solar panels can be even more efficient when incorporated alongside green or blue infrastructure, thanks to their localised cooling effects.

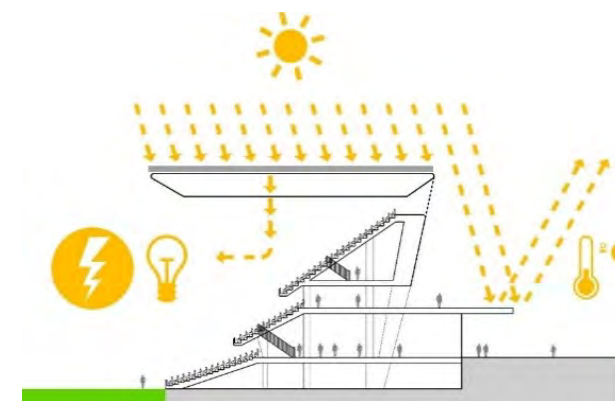


Diagram illustrating how solar panels work



CASE STUDY

SKAGERAK ARENA, SKIEN, NORWAY

Skagerak Arena in Skien, Norway, produces its own energy thanks to the solar panels that cover most of its roof, with 5,700 square metres of solar modules, offering 800kWp of nominal power.

The battery energy storage and the energy management system ensure maximum use of renewable power even when there is low light.

PASSIVE WATER

WATER PRESERVATION

Efforts need to be made to develop both active and passive systems to reduce water consumption and enable water harvesting wherever possible. Water usage in stadiums can be absurdly high, because water is needed to irrigate the pitch (if it is real grass) and clean the venue as well as being used in toilets and showers. Stadiums can help to reduce water depletion by implementing green initiatives such as rainwater collection, water harvesting and recycling.

Artificial pitches also require substantial amounts of water to ensure a safe and playable surface. In the case of both natural and artificial turf, the hotter the country, the higher the evaporation of water on the surface, resulting in less water efficiency.

RAINWATER AND STORMWATER HARVESTING

One of the simplest ways to collect and store water for use in the building is water harvesting. Stadiums tend to have large roofs, and pipes can take the rainwater that collects on the roof to water storage tanks, where it is kept until needed for use. Thought should also be given to whether rainwater harvesting is possible on the pitch and external areas as well as from the roof. For example, the drainage layer within the pitch could act as a large rainwater harvesting tank, which would allow for passive irrigation of the pitch.

Rainwater is not to be used as drinking water, but can fill all 'grey water' needs, such as in toilets or for pitch irrigation. Atomised water that is sprayed on the pitch or landscaped areas should be treated to ensure that it poses no health risk. Because

water harvesting relies on gravity to take the water to the storage tanks, it is primarily a passive measure. However, some active mechanical elements such as filters and treatment systems are needed.

In some locations, it may also be worthwhile to install stormwater catchment tanks, which serve the dual purpose of providing additional water while also reducing the risk of flooding in the area around the stadium.



Diagram illustrating rainwater harvesting from a stadium roof

OTHER WATER MANAGEMENT SOLUTIONS

Other systems designed to reduce water consumption should be considered; for example, waterless versions of appliances such as urinals (see below) can help to increase efficiency in the stadium's day-to-day water use.

Recent technological advances offer innovative water management solutions such as sensors that monitor the pitch's actual water needs or the need for fertilisers, and generate tailored distribution schedules, thereby keeping the use of resources to the absolute minimum necessary. For more information, see <https://sglssystem.com/>.

Encouraging spectators to bring their own water in reusable bottles is a good way to reduce the amount

of drinking water that the stadium uses (although water will always be available for sale in the venue's kiosks, shops and catering areas). This also has the added benefit of reducing single-use plastic waste.

Air conditioning units can generate significant amounts of condensation, which can be collected and used together with harvested rainwater.

Smart attenuation or rainwater systems aim to maximise the amount of water available for rainwater harvesting by combining the stormwater management and rainwater harvesting systems.

This can be enhanced by the use of smart systems that continually monitor the weather forecast. When no storm is on the horizon, the system will simply act as a rainwater

harvesting tank. When a storm is coming, the system will calculate how much rain it will receive and ensure that it can manage that amount.



Diagram illustrating a smart weather monitoring and water management system

SUSTAINABLE DRAINAGE SYSTEMS (SUDS)

Water is a valuable resource and should be managed inside and outside the stadium in a manner that reflects this. Water can enhance the biodiversity and beauty of a stadium's surrounding area and make it more resilient to climate change.

The philosophy of SuDS is about maximising the benefits and minimising the negative impacts of surface water from the stadium and associated surrounding areas.

A SuDS design should incorporate the four pillars shown in below graph.



The four pillars of SuDS¹

1. <https://www.devon.gov.uk/floodriskmanagement/document/sustainable-drainage-system-guidance-for-devon/4-pillars-of-suds-design/>

LOW-WATER-CONSUMPTION FITTINGS

Choosing water-efficient appliances is a fundamental sustainability measure in modern buildings.

All appliances that use water, i.e. taps, showers, toilets and urinals, should be equipped with systems that reduce their water consumption and, in some cases, minimise the amount of water that the user needs.

Day-to-day water consumption and management should be monitored, and proper maintenance of all appliances that use water is important to ensure their correct functioning and keep consumption to a minimum all year round.

TOILETS AND CONCESSIONS

In most sports facilities and especially in stadiums, the public will have access to both toilets and commercial concessions where

various items, ranging from food and beverages to merchandise, are sold. Both energy and water consumption must be kept to a minimum, for example by using low-water-consumption appliances (urinals, wash basins, etc.) in the toilets and low-energy appliances and lights in concessions.

WATERLESS URINALS

Thanks to today's technology, some sanitary appliances, notably urinals, can be waterless. If installed in a sports facility, this can save millions of litres of water per year, during both sporting and non-sporting events. An odour trap and microbiological cleaning agents guarantee the disruption-free, odourless evacuation of waste directly through the wastewater network. The waterless urinal bowl is made from high-quality, durable polycarbonate or ceramic and no chemicals are needed.

This technology has already been implemented in several facilities:

- **RCDE Stadium**
in Barcelona, Spain
- **Anoeta Stadium**
in San Sebastián, Spain
- **Stožice Arena**
in Ljubljana, Slovenia
- **Tottenham Hotspur Stadium**
in London, UK
- **MEWA Arena**
in Mainz, Germany
- **St. Jakob-Park**
in Basel, Switzerland
- **Kybunpark**
in St. Gallen, Switzerland
- **Stade de Genève**
in Geneva, Switzerland
- **Stade de la Maladière**
in Neuchâtel, Switzerland



CASE STUDY

RCDE STADIUM, BARCELONA

RCD Espanyol installed 322 waterless urinals in their 40,000-capacity stadium.

Assuming a standard urinal uses four litres of water per flush and given the number of home games played, this leads to a saving of around 15,000 litres per urinal per year (as a conservative estimate), giving a total annual saving of 4.83 million litres of water, the equivalent of approximately five Olympic swimming pools.

ACTIVE SUSTAINABLE DESIGN

Active design strategies use purchased energy (including electricity and natural gas) to keep infrastructure comfortable. These strategies include **mechanical system** components such as air-conditioning, heat pumps, radiant heating, heat recovery ventilators, and electric lighting.

SUSTAINABLE SOURCES OF ENERGY AND POWER

Efforts need to be made to understand the source of the energy used in any building, and this depends mainly on the energy suppliers. The rapid development of renewable energy sources such as wind generators and solar panels in recent years enables suppliers to offer their clients a range of renewable energy products.

Stadiums can either rely on suppliers to provide energy from off-site renewable sources, which is the most efficient solution, or produce their own energy using solar panels or wind generators.

SUSTAINABLE LOW-ENERGY ELEMENTS

Designers need to select elements that offer low energy consumption and a long life. For example, LED lighting has advanced sufficiently for almost all lighting elements of the sports facility to be low-energy, and large modern mechanical air-handling units producing hot and cold air are much more efficient and require substantially less energy to work than older systems.

HEATING/COOLING

Heating and cooling sports facilities, especially large stadiums, implies the use of massive amounts of energy.

Operators need to look to implement efficient passive and active measures to maintain a comfortable temperature, both within the interior spaces and even in the exterior areas.

For example, modern stadiums in cold countries often need to heat the bowl area to ensure the spectators' comfort while those in extremely hot countries, or milder countries in summer months, may need to cool it. In a European context, this applies particularly to countries in the north of the continent that experience extreme cold and those in the south that experience extreme heat.

The focus in this section is on the outside spaces of stadiums, where spectators are seated, since the heating and cooling of interior spaces is covered by the solutions explained elsewhere.

Heating

Stadiums in cold climates need to offer a constant and comfortable temperature for the spectators in the open-air bowl area. This also applies to the exterior parts of other sports facilities areas where users remain outside for long periods.



Cologne Stadium features radiant heating systems in the tiers

The most common solution for heating outdoor seating areas in stadiums is to use innovative shortwave infrared heaters directed at the spectators, rather than heating the air around them. This is used in many major stadiums such as the Santiago Bernabéu Stadium in Madrid, Stamford Bridge in London and the Letná Stadium in Prague. Heating a stadium inevitably consumes energy, and one solution is to prioritise sustainable energy sources such as wind and solar power, either produced on-site or by purchasing renewable energy from suppliers.

Heat dissipation

Dissipating heat from buildings generally requires electrical appliances to enable heat transmission from different sources. It is essential to use sustainably classified low-energy appliances that

either reduce the amount of energy required due to enhanced efficiency values or are powered by renewable energy, whether geothermal, wind or solar.

Cooling

Sports facilities located in hot climates need to ensure sustainable, low-energy cooling systems. Some stadiums designed in recent years, and especially those built for the 2022 World Cup in Qatar, have had to make use of groundbreaking new technologies to ensure that the open-air football bowl is kept at a comfortable temperature for spectators, in accordance with the relevant legislation and best practices. The stadiums in Qatar have proved the viability of these systems, achieving 26°C on the pitch and seating areas of open-air stadiums while the outside temperatures are well over 40°C.



Al Thumama Stadium in Qatar, built for the 2022 World Cup – one of the first cooled stadiums in the world

These cooling systems often require a substantial amount of energy, but only for a very short time, from the opening of the stadium until the end of each match. It is therefore possible to offset the energy used by feeding clean energy produced on-site through solar or wind power back into the grid. Stadium should take care to ensure a balance between the clean energy produced on-site and energy used for cooling in order to achieve

a neutral or even negative energy balance, meaning that more clean energy is sent to the grid than is used for cooling temperatures. On the other hand, in some cases, cooling can be more energy-efficient than heating because cool air drops and therefore stays in the stadium, while hot air rises. It is therefore easier to maintain a stable temperature using a cooling system, which is more sustainable.

INSULATION TO AVOID HEAT GAIN/LOSS

The use of extensive insulation in stadium areas is essential to minimise the amount of heat lost or gained from the exterior. Insulation materials are very economical, so using as much insulation as possible is highly recommended. When used in the roofs and facades of a sports facility, the internal areas will require less heating and cooling to be kept at a comfortable ambient temperature.

Insulation can be one of the most efficient manners to mitigate energy transfer from the inside to the outside and vice versa. It is one of the key components of sustainable building design and can reduce costs considerably, since a well-insulated building is easier to keep warm in the winter and cool in the summer. It also reduces reliance on natural gas, propane fuel oil and electricity, thereby reducing in turn the amount of carbon dioxide, sulfur oxide and nitrogen oxide (among other gases) emitted.

ELECTRICITY

Electricity is one of the main consumers of energy in any facility as most of the facility's active systems are electrical, from lighting to kitchen appliances, air-handling units, lifts and escalators. Electricity is also required to power charging points for sustainable transport vehicles (e.g. bikes, cars and buses).

Electrical sustainability has two aspects: first, the source of the energy, and, second, the elements using energy. Electricity can be sourced through the local and national network or can be self-produced using various different means, such as PV solar panels placed on the roof or windmills and wind turbines. It is also important to choose energy-efficient electrical appliances and lighting to minimise the amount of energy needed. Lifts, escalators and most other electrical appliances have been developed immensely in recent years to reduce their consumption to acceptable ranges for a sustainable sports facility.

Passive measures can also be taken to reduce the need for electricity; for example, ensuring that interior spaces get plenty of daylight reduce the need for electrical lighting. Natural light also has positive psychological effects and can contribute to the

well-being of the facility's users. However, care must be taken in the design, as allowing more daylight into a building can also imply allowing heat to enter or leave, resulting in energy being used to compensate.

Low-energy lights

Lighting in various different parts of a sports facility constitutes one of its main uses of energy consumption. All light fittings selected need to offer low levels of energy consumption, which translates into effective energy savings in the facility's day-to-day use. LED lightbulbs are the main example of this.

The use of LED lights supports sustainability in many other ways than just low energy consumption. They also emit less heat than other lights, which means less heat gain in the building. A cooler bulb is also safer as it reduces the risk of fire. LED lightbulbs are also manufactured more sustainably, as

they are fully recyclable and contain no harmful chemicals or materials (such as mercury), so they can be collected and recycled easily. LED lights also last longer than older types of bulbs, which leads to less waste. Moreover, they are directional and thus result in less light pollution around the stadium.

LED boards

Stadiums need to provide spectators in the bowl with visual information, which is generally done by means of very large screens. This is vital not only to display the match and for advertising, but to provide spectators with safety and emergency information. The latest screens use LED technology, which allows stadiums to provide high-quality visuals with low levels of energy consumption. LED boards are increasing in size as the demand for information and visual effects as part of the spectator experience grows.



CASE STUDY

SOFI STADIUM, LOS ANGELES

SoFi Stadium in Los Angeles offers possibly the ultimate example of an LED information screen. The video wall is hung over the stadium to produce 360-degree images, providing the operators with countless opportunities to display information.

It features an 18-metre, double-sided, 4K-resolution video board weighing almost 1,000 tonnes and comprising 6,500 square metres of LED lighting and more than 260 speakers

Pitch lighting

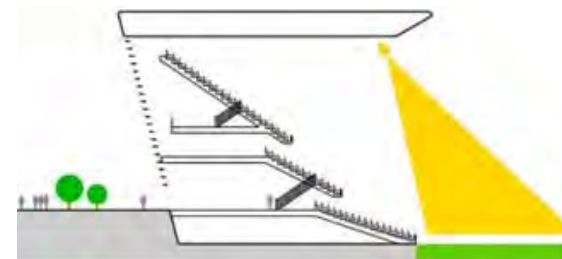
The way that the pitch in a stadium is lit has evolved over time. Older stadiums tend to feature high posts holding packages of floodlights, but the tendency towards full roof coverage in most modern stadiums, especially in Europe as recommended by UEFA for its competitions, has led to a move towards roof-mounted fittings, which have less of an impact on the local environment.

The older post floodlights in each corner of the pitch created four shadows of each player, which is not ideal for spectators in the stadium or those viewing the television broadcast. The more uniform 'ring of fire' arrangement whereby lights are hung all around the perimeter of the pitch on a gantry gives totally uniform lighting on the pitch and avoids glare. The cost of the energy to power such lighting can be drastically reduced using LED

bulbs, which can reduce the energy consumption by over 70% compared with metal-halide lights. In addition, the lifespan of LED lights is high, in the region of around 80,000 hours. This ensures easier maintenance of the facility since the bulbs rarely need to be changed. LED lights also emit a constant amount of light throughout their life, whereas metal-halide lights drop in light efficiency as time passes, while still consuming the same amount of energy.

LED lights also produce a light that is comfortable to the human eye than that produced by metal-halide bulbs. Moreover, the quality and the amount of light achieved by LED bulbs is much better for media and television broadcasting, being fully compatible with recordings in 8K and 4K resolution. Modern lights are also much more focused than post floodlights, being directed onto

the pitch and helping to avoid light pollution to the surrounding area. LED lights also offer several different states and the possibility of using only the number of lights required at any given time; for example, full lighting can be used for games, reduced lighting for maintenance and cleaning, and specific lighting programmes can be designed for other events such as concerts. In some cases, lights can even be focused on gangways for evacuation.



LED pitch lighting can be installed in the roof, which contains the light and reduces light pollution to the surrounding area



CASE STUDY

ESTADIO METROPOLITANO, CLUB ATLÉTICO DE MADRID

Club Atlético de Madrid's Estadio Metropolitano is one of the first stadiums in the world to make the most of the capabilities of LED lights in the stadium. LED bulbs are used in all of the stadium's lighting applications, including lighting the pitch, the interior areas, and emergency evacuation routes. The stadium has used LED lighting for other major events hosted at the stadium, such as a Rolling Stones concert in 2022.

ENERGY STORAGE SOLUTIONS: BATTERIES

When designing sustainable buildings, it is important to think not only about the production of clean energy, but also about its storage.

Larger facilities such as stadiums should try to introduce systems for storing energy produced on-site so that it can be kept and drawn on when required. The technology for this is not yet mature but is developing very rapidly.

GIVING BACK TO THE GRID

One of the advantages of sustainable energy production is the ability to feed energy back into the grid if the amount produced exceeds the facility's own needs. Most stadiums consume a large amount of energy on the day of an event, but by delivering energy to the grid throughout the year, the facility's total consumption



RCDE Stadium

can be offset. Most countries allow facilities to produce their own energy and for surplus energy to be fed into the public grid, and in some cases even offer subsidies for energy produced by localised solar panels. As an example, the RCDE Stadium has one of the largest solar panel

roofs in Europe and the energy that it produces is either sent to the grid or used by the stadium. Similarly, the Johan Cruyff ArenA in Amsterdam has a private aerogenerator, which provides substantial energy for the stadium using wind power and feeds into the local grid.



CASE STUDY

JOHAN CRUIJFF ARENA

The Johan Crujff Arena has a 3MW energy storage facility that serves as a back-up energy source. Its 2.8MWh capacity reduces the need for diesel generators during sport events.

Moreover, the system reuses electric vehicle batteries, almost doubling their operational lifespan.

A2. SOCIAL CRITERIA

Social criteria in the context of football infrastructure are about identifying and managing impacts, both positive and negative, on people. These criteria underscore the importance of relationships with people, communities and society. This implies the need for a proactive way of managing and identifying impacts on employees, workers in the value chain, spectators, customers, and local communities.

The following topics are covered in this specific section:

HUMAN RIGHTS & LABOUR RIGHTS

COMMUNITY ENGAGEMENT

ACCESSIBILITY

END-USERS' VALUES AND BEHAVIOURS

HUMAN RIGHTS AND LABOUR RIGHTS

Policies and procedures for the construction and management of a stadium or sports facility need to be aligned with internationally recognised human rights principles and frameworks. UEFA's [Human Rights Commitment](#) lays out the basis on which UEFA strives to ensure safe and fair access to the game, as well as secure and inclusive working environments throughout football.

ENGAGING AND MONITORING SUPPLIERS

Engaging key stakeholders such as the [International Labour Organization](#) (ILO) and [Building and Wood Worker's International](#) can be very useful in ensuring a project is aligned with existing requirements and regulations, and to support due diligence throughout an infrastructure project's life cycle. Aspects of social sustainability often

interact or overlap with aspects of good governance. When working on protecting human rights and labour rights, contracts and due diligence during and after procurement are the foundations on which the project will stand. Defining minimum requirements for the project should be the first step. The minimum requirements will be the basis on which suppliers create their tenders, will be reflected in contracts for services and should also be the basis for due diligence exercises throughout the project.

Organisations such as the ILO provide a number of [key labour standards](#) and [other resources](#) to which you can refer when setting your minimum requirements. Liaising with your country's labour organisations can also help you to fully understand your country's legislation and specific needs.

Minimum requirements could include aspects such as:

- a commitment to human and labour rights
- wages (i.e., minimum wages, payment policies)
- decent working conditions (i.e., health and safety policies, legal limits on working hours)
- prohibition of child labour, forced labour and human trafficking
- reporting mechanisms for workers to raise complaints, and corrective actions
- supply chain due diligence (i.e., suppliers and their alignment with the minimum requirements)
- policies for migrant workers (i.e., assurance of equal treatment, provisions for accommodation, the language of contracts).

While it is easy to see these minimum requirements as an outline for the development phase of a project

only, they should be considered throughout the entire life cycle of a stadium or sports facility, and should be reflected in procedures not only for construction work, but also maintenance work, cleaning services, security staffing, etc. A contract has an outline of what is expected from the provider, but it is only when the provider delivers that you can see if they meet the minimum requirements. It is important to define a system and process for due diligence checks, and to decide in advance how you will review and report the findings.

Milestones and requirements for reports can be added to the contract and allow for direct input from the supplier. However, this must be combined with active engagement with workers and representatives directly, to ensure that the due diligence process does not only rely on reporting from the supplier.

COMMUNITY ENGAGEMENT

SUSTAINABLE URBAN DEVELOPMENT

Local authorities are responsible for developing, or at least approving, the urban master plans or urban guidelines of towns and cities and approving planning proposals. Local and national authorities are also responsible for taking care of protected or otherwise special areas.

Strong focus on sustainable urban development by local authorities is becoming more and more common, and they are developing laws and regulations to ensure that the local landscape, environment and fauna are respected. Land may need to be redesignated to allow it to be used for sport, and to allow the necessary infrastructure to be installed. This is the case whether the sports facility

is a large building such as a stadium or a more landscaped and open area. The designation of sites must consider sustainability issues such as land contamination and the need to preserve trees and other important vegetation, water systems and even fauna. Designating urban sites for particular uses will always require an environmental impact study to ensure that the use of the site will have minimal effect on its natural elements.

COMMUNITY ENGAGEMENT DURING THE PLANNING STAGES

It is advisable for sports facilities, especially stadiums, to provide benefits for society and the local community, and not just be buildings that harm daily life in the area. The new or refurbished facility can bring jobs and collaboration opportunities to the local area, and residents can even be involved in event strategies and decision-making. Being democratic and transparent will

enhance local social and community involvement and acceptance of the new facility. Positive catalysts for the community. More and more stadiums are looking to develop a different way of interacting with the local community. To become a truly sustainable building, the stadium must fit with the local area and culture.

It is essential to carry out careful studies of the area, to respond to the local community's needs and to make sure local people's expectations are positive. The building must provide the correct facilities for the main sports use, but also aim to include other activities that will enhance the lives of the local community. Stadiums are sometimes perceived as aggressive buildings, creating difficult and even dangerous times when matches are played, so modern stadiums need to aim to become community-friendly and to care for the local people and their well-being.

ACCESSIBILITY

In ensuring that a stadium or sports facility is accessible for all, it is essential to look at accessibility from two main perspectives: disability and diversity. Disabled people must be able to access the venue without barriers of any kind, and the venue must be inclusive for all, regardless of aspects such as gender identity or religion.

ACCESSIBILITY FOR DISABLED PEOPLE

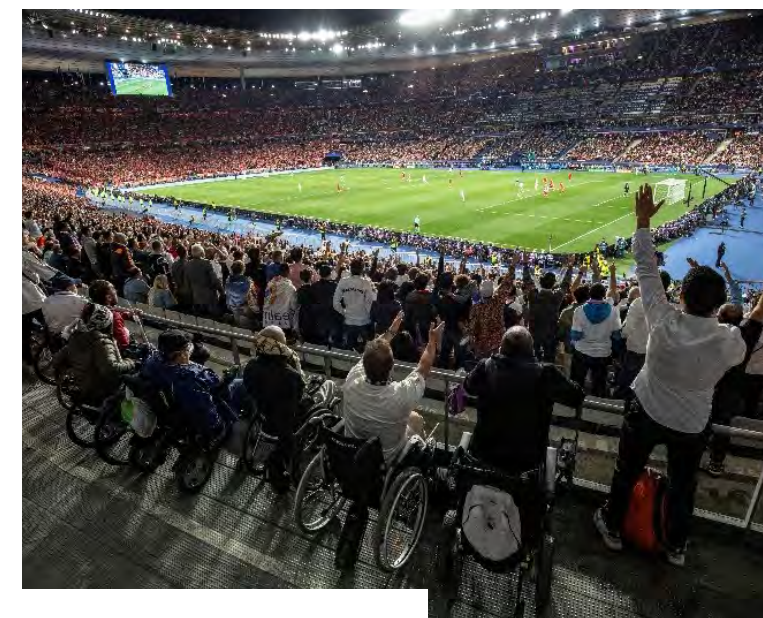
There are several aspects to consider regarding accessibility for disabled fans, volunteers, employees, etc. Accessibility should be considered right from the early development stages of any project, to ensure that the relevant requirements are fully understood and taken into account. UEFA has worked with the Centre for Access to Football in Europe

(CAFE) to provide clear guidance on accessibility requirements in the [Access for All](#) guide. While this guide focuses on stadium projects, it can still be used for all sports facility projects.

It is important to understand that accessibility for disabled people is about not only wheelchair users, but rather ensuring that anyone can access the site independently and without barriers.

It is better to anticipate the potential barriers and to mitigate or remove them in the planning phase, rather than reviewing them after construction and putting in corrective measures. Planning in advance will benefit the project through reduced costs and a higher level of inclusion for disabled people, who will also be able to see that accessibility was a plan all along, and not an afterthought.

In addition to using the [Access for All](#) guide, consulting and potentially collaborating with disability organisations can be useful in improving accessibility.



Accessibility for disabled people

ACCESSIBILITY FOR DIVERSE GROUPS

People can face barriers to access based on aspects of their identity such as religious beliefs, gender identity or gender expression. It is therefore important to consider how potential accessibility issues can be mitigated throughout the venue.

Bathrooms are a key area where access issues can arise. When bathrooms are split by sex (male and female), a binary norm is set, and this directly excludes those individuals whose gender identity is non-binary.



In addition, men's bathrooms tend to have higher capacity because there are urinals in addition to toilets, and stadiums often have more men's bathrooms than women's bathrooms.

Most entities who organise major events have defined ratios for the number of toilets per gender required in any stadium or sports facility in order to ensure sufficient availability during a short period, such as half-time. The architect will need to establish the location of these toilets, which should be close to seating areas, and must ensure that they are accessible to all spectators, regardless of gender identity or disability.

By providing gender-neutral facilities, reducing the number of urinals or ideally fully replacing urinals with individual toilet stalls, the infrastructure sets the basis

for an accessible and inclusive environment. With this baseline, bathrooms can be assigned in equal number to men's and women's facilities, or all bathrooms can be assigned for use by all.

Another aspect to consider in the construction of any facility is diversity of food options and preparing some foods separately. This is important for those with allergies and other dietary requirements, and also those with certain religious beliefs.

There must always be more than one storage option available, so that the main allergens, such as nuts, can be stored separately. If food is to be prepared on-site, multiple preparation surfaces or cooking vessels should also be installed.

END-USER VALUES AND BEHAVIOURS

Football stakeholders and stadium developers have worked in recent years to develop strong social values, within the infrastructure development. As a part of sustainable infrastructure, clear and strong social values, reflected across the project, can play a vital role in the values and behaviours of the end-users.

Sport and football provide valuable social and psychological benefits for those on and off the field. It provides a sense of excitement, joy, and entertainment. It also emphasises the benefits and importance of inclusion and respect, bringing people together based on the love of the game. Strong values around respect - whether it is the respect for the players, respect for the game, respect

for the referee, or respect for fellow fans - will be important for stadiums and sports facilities, and this should be incorporated into the design and concepts within sustainable design.

SETTING VALUES

The values that you envisage for the facilities once they are in use should be embedded in the make-up of the facility so that end users, including both visitors and employees, can easily understand and engage with them. Values should include respect for the environment and human rights and should ideally be set out in a code of conduct to be followed by all.

To support socially sustainable values, both preventive and reactive activities and mechanisms should be considered. The focus for preventive elements should be education and awareness, covering equality, inclusion, accessibility etc.

For reactive aspects, reporting mechanisms for discrimination or harassment should be considered, to actively identify how best to tackle the issue in football, and supporting the wider society in the fight against discrimination.

As technology is developing, new ways of monitoring and recording evidence of abuse and discrimination are emerging, and elements such as video identification systems and ways to report incidents should be considered in the development of a stadium or sports facility. In this work, identifying values that can become part of the stadium or facilities culture will be key. Employees, players, visitors and guests should be able to understand and see the values represented across the project. This should include the full supply chain as well, and should consider labour laws, working conditions, sourcing of material etc.



CASE STUDY

STUTTGART ARENA, GERMANY

Stuttgart Arena has put in place several projects and campaigns for diversity and inclusion and social integration.

There is an ambitious anti-racism plan that includes warnings from the stadium speakers and even the match being interrupted by the referee. Around 30% of the club's employees are women, and this number is rising. There is also a child protection policy and officer.



CASE STUDY

WEMBLEY STADIUM, LONDON

Wembley Stadium has a code of conduct for all staff and contractors and a text service for visitors to report antisocial behaviour.

The stadium team works closely with sporting bodies, event owners, the local council and the police to provide the best possible environment for workers and visitors alike.

A3. GOVERNANCE CRITERIA

Governance involves making sure that rules, norms and actions are structured, sustained and regulated and that people are held accountable for any breaches.

How formal the governance is depends on the internal rules of an organisation and the external rules it has with its business partners.

As such, governance may take many forms, with many different motivations and many different results.

This section will cover both the governance and economics aspects. Due to some overlapping between the two they have been merged to provide a complete set of answers. Will be covered:

GOVERNANCE

ECONOMICS

GOVERNANCE

UEFA's sustainability strategy is aligned with internationally recognised frameworks and standards, including the European Green Deal and the Universal Declaration of Human Rights, and the UN's Sustainable Development Goals, Sports for Climate Action Framework, Guiding Principles on Business and Human Rights and Global Compact principles. The strategy and its implementation are overseen by the UEFA Executive Committee and the UEFA Fair Play and Social Responsibility Committee.

Within this topic of stadiums and sports facilities themselves and not the organisations running them,

it is not necessary to cover how organisations deal with governance. However, governance for stadiums and sports facilities still involves being aligned with local, national and international policies related to environmental and social compliance. The policies outlined below are examples of policies and guidelines that need to be adhered to.

UNITED NATIONS POLICIES AND PLATFORMS

UN Sports for Action Framework

UEFA is one of the founding signatories of the UN's [Sports for Climate Action Framework](#), which aims to support and guide sports actors in achieving global climate change goals. The framework supports the goals of the Paris Agreement in limiting the global temperature rise to 1.5C above pre-

industrial levels. As a signatory of this framework, UEFA has committed to its five principles, which requires demonstrated ongoing progress at each UEFA sports facility.

UN Race to Zero campaign

As part of its commitment to the UN Sports for Action Framework, UEFA has adopted the UN's [Race to Zero](#) campaign as a guide to achieving zero carbon emissions for projects and facilities. UEFA is determined to be part of the solution to preserve and regenerate the environment by leveraging the power of football to raise awareness and spark action.

To achieve its target of cutting greenhouse gas emissions by 50% within UEFA, across UEFA events and collaboratively across European football by 2030, UEFA has committed to measuring the environmental impact of all UEFA

events by 2024, encouraging national associations and clubs to measure the impact of domestic competitions and working towards embedding climate criteria in UEFA regulations, policies and guidelines.

UN Football for the Goals

[Football for the Goals](#) is a United Nations initiative focused on football advocacy and solutions in support of the Sustainable Development Goals (SDGs). It was launched on 7 July 2022 with UEFA as inaugural member. 50+ members so far across the football community – including 6 national associations so far (Albania, Germany, Norway, Portugal, Romania, Slovenia).

Global Waste Management Outlook

The [Global Waste Management Outlook](#) (GWMO), a collective effort by the UN Environment Programme (UNEP) and the International

Waste Management Association, is a pioneering global scientific assessment of the state of waste management and a call for action to the international community. Prepared as a follow-up to the Rio+20 summit and as a response to UNEP Governing Council decision GC 27/12, the document sets out the rationale and tools for taking a holistic approach towards waste management and recognising awaste and resource management as a significant contributor to sustainable development and climate change mitigation.

The GWMO is primarily focused on the governance issues that need to be addressed to establish a sustainable solution, including regulatory and other policy instruments, partnerships and financing models. Broad in scope and global in coverage, the GWMO includes a series of topic sheets and

case studies addressing specific issues and illustrating featured initiatives. It provides an inspiring potential way forward on waste management, drawing conclusions and making recommendations to assist policymakers and practitioners to develop local solutions for waste management. To complement the SDGs set out in the UN's post-2015 development agenda, the GWMO sets forth global waste management goals and a global call to action to achieve those goals.

EUROPEAN UNION POLICIES AND FUNDING

In response to the urgent environmental and social challenges that Europe and the rest of the world are currently facing, the EU has implemented major policy actions aimed at building a more resilient, more sustainable and greener Europe that is capable of

facing future social, economic and health threats.

One of the most important actions taken at EU level is the [European Green Deal](#) which puts forward an ambitious roadmap towards a climate-neutral EU by 2050, aiming to decouple economic growth from resource use and to make the green transition just and inclusive for all.

The European Green Deal covers all sectors of activity, notably transport, energy, agriculture and industry (including the sport sector) and is embedded across all major EU policy areas. Therefore, all EU funding programmes are geared towards meeting the objectives of the European Green Deal and promoting environmental protection, circular economy principles, green skills and social inclusion across their investment priorities.

Cohesion Policy funds

The EU Cohesion Policy is currently the largest EU financial instrument, with a total value of €392bn for 2021 to 2027, which accounts for approximately one third of the total EU budget for that period.

The Cohesion Policy is the EU's strategy for regional development, with the aim of strengthening economic and social cohesion and reducing disparities in the level of development between areas within the EU. In line with the European Green Deal, the implementation of the Cohesion Policy must meet specific climate targets. This means it must invest in two of the EU's funds (the European Regional Development Fund and the Cohesion Fund), which are dedicated to projects promoting environmental sustainability and the transition to a carbon-neutral economy.

The Cohesion Policy and football - Sport, and particularly football, is an excellent vehicle of change that is capable not only of raising awareness of the benefits of the green transition, but also directly contributing to lowering society's carbon footprint by reshuffling and renewing the management and infrastructure of football activities.

Therefore, the football sector is in a good strategic position to receive Cohesion Policy funding, including for:

1. renovating and decarbonising existing football facilities,
2. building new sustainable football facilities (in line with the guidelines in this document), and
3. developing new green skills, including in managing sustainable football facilities.

Given that Cohesion Policy funds can contribute a large amount of the cost of a project (50% to 85%, depending on the level of development of the region), national associations should consider applying for Cohesion Policy funding.

Unlike other EU funding, Cohesion Policy funding has a decentralised management system, and is therefore implemented at regional level in each EU member state.² Funding is allocated according to the issues and specific needs of each region and exclusively to organisations based in the region. Cohesion Policy funding is therefore less competitive than funding from EU programmes that are centrally managed by the European Commission. Each region that can receive support under the Cohesion Policy has a public managing authority to manage the allocation of the funding.³

2. List of EU regions (by country) that are eligible to receive support from the Cohesion Policy: https://ec.europa.eu/regional_policy/en/atlas.

3. List of managing authorities by country: https://ec.europa.eu/regional_policy/en/atlas/managing-authorities.

UEFA capacity-building programme

UEFA is currently developing a capacity-building programme to help national associations to apply for Cohesion Policy funds for their sustainability initiatives. The capacity-building programme would support national associations in:

1. identifying the available Cohesion Policy funds and the managing authority of a specific fund in their country
2. framing their projects so that they are in line with the Cohesion Policy investment priorities in their country
3. collaborating with the relevant managing authority, which would ensure the best chance of receiving funding
4. writing a funding application.

For more information on the Cohesion Policy and the UEFA capacity-building programme, contact UEFA's EU office at eu.office@uefa.ch.

Legal compliance

All stadiums and sports facilities must comply with local laws. However, local laws rarely cover the complex issues that need to be considered in large structures such as stadiums, therefore international laws must be applied to ensure safety and well-being. International best practice may also need to be followed for sustainability.

In most countries, local and national governments and other institutions require modern buildings to be more and more ecologically efficient. In many countries, laws are in place under which a sustainable design must be used or permission to build will not be granted, and projects

need to demonstrate that the agreed level of sustainable design measures are being implemented. Stadiums and sports facilities must follow local and national laws for design and construction, and must consider the sustainability requirements from the early design stages. The designers must also be aware of any national or international guidelines that should be applied to the design where budget and location permit.

For example, in Italy, football clubs must appoint an energy manager if their energy consumption is over a certain threshold, must manage certain types of waste in accordance with rules about record-keeping and transport documents (this applies across the EU under the Waste Framework Directive) and must obtain a permit to use underground water if the club has a well for irrigation.

CASE STUDY

ECO PARK STADIUM, UK



The 5,000 seat Eco Park stadium and outdoor playing fields, near Stroud in the UK, is to be built on agricultural fields. Other facilities such as a hotel, a football academy and a care village for older people will complement the development. Several local, national and international planning policies and guidelines were used.

The international guidelines used were:

- UN 2030 Agenda for Sustainable Development
- 26th UN Climate Change Conference of the Parties (COP26)

The local and national guidelines used were:

- England's National Planning Policy Framework, July 2021
- Stroud District Local Plan, November 2015
- Eastington Neighbourhood Development Plan, 2015-2031
- Gloucestershire's Local Transport Plan, 2020-2041
- Stroud District Council Environmental Policy, March 2019
- Stroud District Council, The 2030 Strategy – Master Plan
- Stroud District Pre-Submission Draft Local Plan, May 2021

WATER

Water has become increasingly important in environmental policies over the last 50 years. Some of the main contributors and agents of change in this field are:

- [Water Policy International](#)
- [Un-Water policies](#)
- [International Water Association](#)
- [The Water Convention and the Protocol on Water and Health](#)
- [International Water Policy](#)
(developed by the German federal government)
- [Alliance for Water Stewardship certification](#)

SOCIAL POLICIES AND FRAMEWORKS

In line with the Universal Declaration of Human Rights, [UEFA's Human Rights Commitment](#) aims to ensure that dignity, respect and equal rights and opportunities are afforded to

everyone involved in football in a spirit of freedom and justice. This means that football welcomes everyone, with equal access, in a safe and secure environment.

To ensure a socially sustainable project, the topics of human rights, equal access, and health and well-being, such as minimum wages for construction workers and access

for disabled people, need to be considered throughout the life cycle of any stadium or sports facility project. In line with existing declarations and frameworks, social policies should always reflect the rights defined in the [Universal Declaration of Human Rights](#), and, particularly for working conditions and business management, the [UN Guiding Principles on Business and Human Rights](#).

ECONOMICS

Sustainability is sometimes seen as a cost, and its immediate advantages are not always apparent. But while there may be a larger initial cost output for stadiums to be built or refurbished using sustainable concepts, green projects are essentially an investment in more cost-efficient ways to sustain and operate football infrastructure.

COST SAVINGS

In the long run, the returns, both economically and socially, and especially environmentally, are worth the output. Expect lower water, energy, maintenance and insurance premium costs, and very large reductions in the use of non-sustainable energy sources. The value of the project will also appreciate over time as the reduced costs for energy and water will result

in much lower yearly budgets. In many cases a stadium could even produce as much energy and water as it uses. In many cases the initial expenditure will be paid back in just a few years as technology is producing more efficient elements such as PV panels, reducing the time taken to break even.

The implementation of green infrastructure within a sustainable stadium or sports facility will have additional health and well-being effects for people working within them and living close to them.

INCREASED INCOME

In addition to cost savings, there are ways in which a sports facility with sustainable measures can receive income, such as from sponsors or the energy produced on-site. Sustainability can be marketable, and stadiums and sports facilities with sustainable elements may have access to income

from sponsors or patrons who otherwise would not be interested. Stadiums are major options for naming rights and for suppliers, and companies now often become involved only with clubs or stadiums that share their values of sustainability. The less water and energy used by the venue, the more marketable it may be.

DAILY USE

As a major entity in any city, stadiums and sports facilities need to function not only on matchdays, but rather every day of the year. Planning for a wide range of commercial and sporting uses can enable the different facilities to be used on a permanent or daily basis, giving the venue a better return on investment and making them truly sustainable from both social and economic standpoints.

Stadiums and sports facilities must also have an effective management



CASE STUDY

RCDE STADIUM, BARCELONA

In 2011, the new RCDE Stadium became the first stadium in the Spanish premier league to have income generated from PV panels on the roof.

The 2,700 panels are a 25-year project that will produce more than 700,000kV per hour a year and generate substantial alternative income.



CASE STUDY

SL BENFICA'S STADIUM, PORTUGAL

Although SL Benfica is best known for its professional football team, the club also has teams for basketball, volleyball, handball, roller hockey, rugby, martial arts, swimming, gymnastics and more.

Today its ambition is to expand from being one of the largest multi-sport clubs in Portugal to one of the largest in Europe.



CASE STUDY

JOHAN CRUIJFF ARENA, AMSTERDAM

Amsterdam's Johan Cruyff Arena, the home of AFC Ajax, is an excellent example of how a stadium can be used all year round and host large events such as concerts. Concerts by huge acts such as the Rolling Stones, Rihanna and Coldplay have been held in the multi-function arena.

The arena has many sustainable features, such as a retractable roof that takes under 20 minutes to close, which allows events to take place even in adverse weather conditions.

B. FOOTBALL INFRASTRUCTURE SUSTAINABILITY

ONE OF THE EARLIEST DECISIONS TO BE MADE

FOR ANY SPORTS FACILITY IS WHAT IT WILL PRIMARILY BE USED FOR, SUCH AS HOSTING MATCHES OR TRAINING.

THE ENTITY THAT WILL OWN AND RUN THE FACILITY MUST ALSO ESTABLISH AT THE VERY OUTSET THE LEVEL OF SUSTAINABILITY TO BE ACHIEVED IN THE DESIGN, CONSTRUCTION AND RUNNING OF THE FACILITY THROUGHOUT ITS LIFESPAN, AND THIS WILL BE AFFECTED BY WHAT THE STADIUM IS TO BE USED FOR.

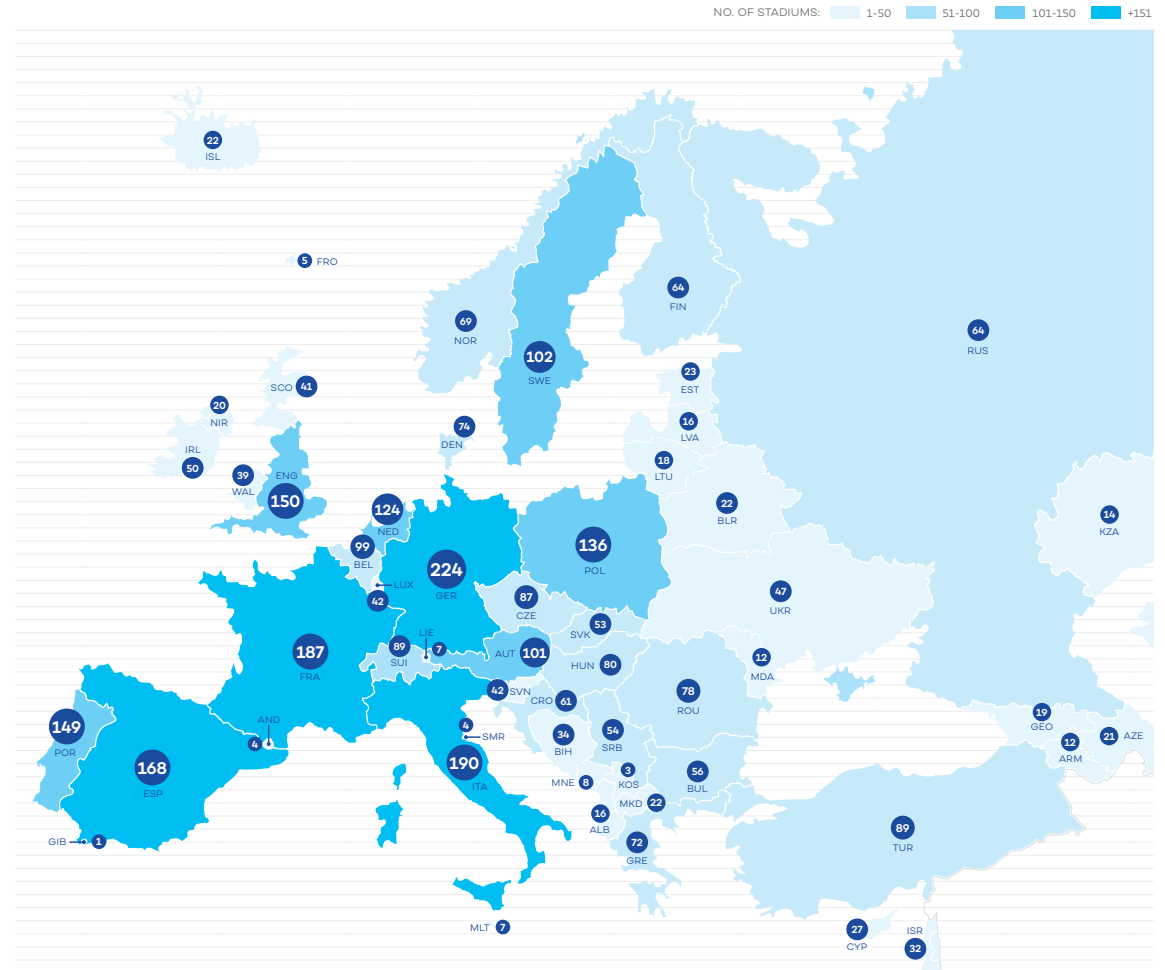
Landscape - Stadiums used in UEFA competitions

The following map shows the geographical distribution of 3,250 stadiums, referenced in the UEFA database, currently in the UEFA competitions. It represents a snapshot (beginning of 2022-23 season) of the current quantity of stadiums.

They are categorized in four categories by applying the classification method defined in the [UEFA Stadium Infrastructure Regulations](#) and used across the wide range of UEFA matches for Youth and professional competitions. Women's and Mens's Finals and Tournaments follow the requirements defined in the Bidding and surpass widely the minimum requirements defined in the pre-described 4 categories. The list on the right-hand side is in alphabetical order.

3,250 STADIUMS USED IN UEFA COMPETITIONS

CODE / COUNTRY	NO. OF STADIUMS	
ALB	Albania	16
AND	Andorra	4
ARM	Armenia	12
AUT	Austria	101
AZE	Azerbaijan	21
BEL	Belgium	99
BIH	Boznia & Herzegovina	34
BLR	Belarus	22
BUL	Bulgaria	56
CRO	Croatia	61
CYP	Cyprus	27
CZE	Czech Republic	87
DEN	Denmark	74
ENG	England	150
ESP	Spain	168
EST	Estonia	23
FIN	Finland	64
FRA	France	187
FRO	Faroe Islands	5
GEO	Georgia	19
GER	Germany	224
GIB	Gibraltar	1
GRE	Greece	72
HUN	Hungary	80
IRL	Republic of Ireland	50
ISL	Iceland	22
ISR	Israel	32
ITA	Italy	190
KAZ	Kazakhstan	14
KOS	Kosovo	3
LIE	Liechtenstein	7
LTU	Lithuania	18
LUX	Luxembourg	42
LVA	Latvia	16
MDA	Moldova	12
MKD	North Macedonia	22
MLT	Malta	7
MNE	Montenegro	8
NED	Netherlands	124
NIR	Northern Ireland	20
NOR	Norway	69
POL	Poland	136
POR	Portugal	149
ROU	Romania	78
RUS	Russia	64
SCO	Scotland	41
SMR	San Marino	4
SRB	Serbia	54
SUI	Switzerland	89
SVK	Slovakia	53
SVN	Slovenia	42
SWE	Sweden	102
TUR	Turkey	89
UKR	Ukraine	47
WAL	Wales	39



B1. PURPOSE

There are many fundamental reasons why it is essential for stadiums and sports facilities to be examples of sustainability, as regards both the buildings themselves and the landscape which surrounds them.

No effort should be spared to develop stadiums and sports facilities in such a way that they respect nature and the environment, and the society where they are located. Stadium and sports facility owners or developers need to implement, from the earliest stages of the design and site selection process, all possible sustainability strategies as regards the development, construction and management of stadiums and sports facilities.

Taking a broad and open view of sustainability principles and applying them to the development and management of stadiums and sports facilities is not only responsible in terms of the planet and people, it can also produce economic benefits in the long term over the stadium's life.

This section will address the following points:

SPORT AND SUSTAINABILITY

NEW BUILD OR REFURBISHMENT?

REUSE OF OTHER FACILITIES

RECYCLING MATERIALS

DEMOUNTABLE STADIUMS

SPORT AND SUSTAINABILITY

The main aim in modern day venues is for stadium and sports facilities to embrace sustainability and become champions of its application in their buildings, in their landscaped grounds and even in the society around them. Sport is one of the most high-profile activities on social media and acts as a model across society, especially for the younger generations.

Sports activities, and the facilities in which they are played, are subject to close scrutiny and should be models of best practice in every respect – in terms of human, social and economic values and, in the case of this guide, on a sustainable level. The mass exposure of sports events means that these questions of suitability are more prominent than in almost

any other area of society. It is clear that sport can educate by setting a good example, so all sports entities are strongly recommended to look to apply best sustainability practices where possible in their sports facilities.



Children play during the UEFA Champions League Final 2021/22 Festival one day ahead

NEW BUILD OR REFURBISHMENT?

One of the main aims in sustainable architecture is to reuse existing facilities where possible, so it is worth considering whether refurbishing an existing venue is a viable solution. Sometimes it is not possible to refurbish an existing stadium, as the design of stadiums has changed over the years and the cost of refurbishment could be higher than the cost of a new stadium. However, refurbishment should always be considered, as it could avoid the need to demolish an existing structure, which would need to be recycled or relocated in a sustainable manner.

NEW BUILD

In recent years, many new stadiums have been built in various countries. Building a new stadium involves drawing up a plan from scratch and

integrating all possible sustainability values from the start of the project. Building a new stadium may require more energy and water and create more CO₂ emissions, but if the stadium is designed on the basis of the latest zero-carbon design techniques, it could, over its lifetime, become much more sustainable than the refurbishment of an existing inefficient venue. New-build stadiums enable all modern sustainability techniques to be integrated into the design and enable both active and passive sustainable architecture, ensuring that as little energy and water use and contamination as possible is achieved in both the construction and the daily use of the venue.

REFURBISHMENT

Many existing sports facilities may not be modern enough, so they may need to be refurbished to meet the latest requirements and legal norms. Many stadiums and sports facilities were

developed when different construction norms were in place, and if they are redesigned, the latest legal and urban planning guidelines will need to be applied. For example, the tiers may now need to have a shallower incline than before, or the space between seats may need to be wider to facilitate safety and evacuation. Stadiums can be refurbished either partially or fully, and the best commercial, economic and sports strategies available in modern sports design can be implemented. Refurbishment is an excellent option for sustainability, as it can reduce the amount of new construction, thereby reducing construction, transport and demolition costs. The decision to refurbish could be influenced by a need to stay in the same location or a lack of funds, but refurbishment can be just as expensive as a new-build stadium – or even more so – so the choice between a new build or a refurbishment needs to be carefully considered, while always keeping sustainability in mind.

REUSE OF OTHER FACILITIES

Another sustainable solution is to reuse and extend an existing facility that is not up to modern standards or is in limited use, reusing the existing structures or integrating them into a new sports facility on a larger scale.

This can allow great cost and sustainability savings compared with demolishing the existing facility and building a new one.

The reuse of a sports facility is a good opportunity to optimise what was possibly an old or underused building or ground. With a new design, a more useful and modern facility can be developed on the same plot of land. This is an excellent sustainable solution, as the refurbished building will use existing road and transport connections and reduce the need

for new construction. But if the capacity of the venue is increased, care must be taken not to overload existing transport hubs; otherwise, any benefits may be outweighed by the need to improve or upgrade the transport network.



The model of the restructuring and expansion project for the Meinau stadium



- ▲ After
- ◀ Before

CASE STUDY

STADE DE LA MEINAU, STRASBOURG, FRANCE

Set to undergo a €100m transformation that will enable the venue to host major sporting events. Highlights of the project include an increase in capacity and the use of sustainable materials such as repurposing old aircraft fuselages as sunshades.

The design seeks to modernize the existing stadium, bringing it firmly into the 21st century and allowing it to meet all the necessary requirements for hosting major sporting events, such as the French Ligue 1 championship and UEFA Champion's League games as well as international games. The scheme will increase the stadium's capacity from 26,282 to around 32,000.



CASE STUDY

CLUB ATLÉTICO DE MADRID

Club Atlético de Madrid decided to demolish their existing stadium and move to a more suburban site just outside the city. A modern football stadium was designed, utilising an existing athletics stadium that was in disuse.

- ▲ The Estadio Metropolitano in Madrid, which uses the old western stand of the athletics stadium as part of the new stadium design in a new format
- ◀ La Peineta stadium, which was used for athletics

RECYCLING MATERIALS

Masses of unneeded materials arise from any major demolition project, and they are normally taken to dumps instead of being reused. Modern sustainability principles require construction sites to recycle such materials as much as possible.

If an existing stadium is to be refurbished or rebuilt, a review must be carried out into how materials from the existing stadium can be recycled, reused or biodegraded through natural or technological processes.

All construction materials can be recycled, including concrete, steel, wood, stone, brick and masonry.

DEMOUNTABLE STADIUMS

After some recent major sports events, stadiums have ceased to be required or, even worse, have been impossible to maintain due to excessive maintenance costs, thereby becoming not only economic failures, but also social and community failures. Demountable stadiums, which can be taken apart, relocated and reused, are therefore a good option for modern sports venues.

One of the most important tasks when designing a stadium for an event is to ensure that it becomes a worthwhile and useful facility for the local community. There are many examples of stadiums that have been built at great financial and environmental cost, only to be abandoned a short while after the event – so-called

‘white elephants’. Within the legacy strategy for a stadium, there should be a strong post-event strategy to help determine whether the stadium should be built or not. If there is a real need for a stadium for a given major event, such as a World Cup or another international championship, but little need thereafter, one option could be to use a demountable stadium.

Care must be taken to minimise the carbon footprint of moving the stadium from one location to another, but there should still be substantial carbon savings compared with building a new stadium on the new site.

Some earlier examples of demountable facilities were used for the London Olympics in 2012. Venues such as the swimming facility had their capacity reduced, and others such as the beach volleyball facility were taken away entirely.



CASE STUDY

CAGLIARI,
ITALY

Existing concrete can be crushed and reused as aggregate in new concrete.

In Cagliari, Italy, a new stadium is being built using recycled concrete from the old stadium, making it an example of the circular economy.



CASE STUDY

DOHA, QATAR

One of the first real-life examples of a demountable stadium is Stadium 974 in Doha, Qatar. Built for the 2022 FIFA World Cup, it will be fully dismantled, and its components transported and reused elsewhere.

This is the ultimate sustainable solution for the event organisers, as the original site can then be used for whatever the local community needs.

B2. LOCATIONS

The location of football infrastructure has ample ramifications across politics, economics, the environment, and the social sphere.

This section will address the following points:

LOCATION IN THE CITY

SUSTAINABLE SITING

BIODIVERSITY

LOCATION IN THE CITY

The site chosen for a sports facility can greatly affect the sustainability of the final building, so the surroundings of the site must support the sustainability plans.

It is essential to choose a site served by public transport to reduce the need for car parking. It is beneficial to excavate no more land than is necessary, so that less earth needs to be transported away.

A site with access to renewable energy is recommended. These are just a few of the things to consider. Finding a sustainable site is paramount and different options must be investigated before the final location is chosen.

URBAN vs. SUBURBAN SITE

There is debate as to whether stadiums should be placed in urban or suburban locations. There are good existing examples of both. For instance, Real Madrid CF's stadium is in an urban location, and its refurbishment will enable the team to stay in the city.

Both urban and suburban solutions are viable, as many other things also need to be considered, such as commercial opportunities and options for urban development.

In terms of sustainability, the stadium must be located where the least movement of people and use of private transport occurs. The ideal scenario is to have stadiums within walking distance of major public transport nodes.

Stadiums outside the urban fabric tend to need much larger car parks, reducing their sustainability. And out-of-town sites that have not been developed need roads to be built to access the site and need utilities to be brought to the site, both of which have a major impact on the surrounding natural landscape.

Urban or close suburban sites tend to be more accessible in terms of public transport, roads and utilities, so they start with a better sustainability score.

URBAN PLANNING REGULATIONS

Local urban planning rules are a key consideration when deciding where to locate a stadium, and the city's norms and regulations must enable the site to be classified for sports and commercial use.

Commercial use has become important in recent years, as, in addition to their main use for sport, stadiums have increasingly become commercial entities. The economic sustainability of stadiums depends on their economic viability, so stadiums need strong commercial support.

Sites require a responsible urban planning design and full support from any necessary environmental, geotechnical and traffic studies to ensure that they address all of the various factors and do minimal harm to the local environment and fauna.



- ▲ Fußball Arena München, which was built on the outskirts of the city
- ◀ Stamford Bridge in the centre of London, which has been refurbished

CASE STUDIES

FUßBALL ARENA, MÜNCHEN / STAMFORD BRIDGE, CHELSEA

Fußball Arena München was located outside of the city and a new public transport (railway) link was created. Even though substantial public transport links are located near the stadium, the project still involved considerable car parking next to the stadium. Road connections were revised and major links to the existing road network were built.

On the other hand, when Chelsea FC needed to refresh their stadium, they decided to keep Stamford Bridge, in the centre of London, rather than relocating to the outskirts of the city. This has meant that the refurbished stadium has public transport nearby, the surrounding neighbourhood has parking for fewer spectators, and utilities were already connected. Purely in terms of location, an urban site can be more sustainable than a suburban site.

SUSTAINABLE SITING

It is important to select a site which is capable of supporting a sustainable sports facility. This entails a search for sites which meet specific detailed criteria, looking not only at the site itself, the quality of the land, the lack of contamination or the type of terrain, but also at how the site responds to the surrounding climate and the ways in which the sun, shade or wind can affect the site and its use.

STADIUM ORIENTATION

In most parts of the world, and especially in Europe, the ideal orientation of a stadium is north-south, to ensure that the path of the sun does not hinder the game at either end of the pitch or create unfair glare in either half of the pitch.

The preferred orientation of the stadium, and therefore the pitch, is north-south, owing to the position of the pitch in relation to the sun, as well as prevailing winds. This orientation ensures optimal comfort for both players and spectators.

For players

With a north-south orientation, games played at midday, in the evening and even in the morning will not have the sun low on the horizon causing glare, whereas a stadium facing east-west would mean that for evening games, which is when most official games are played, the sun setting in the west would create glare and a poor view for those facing the western goal.

This results in unfair conditions for one of the teams, so stadiums need to be designed to avoid glare behind the goals.

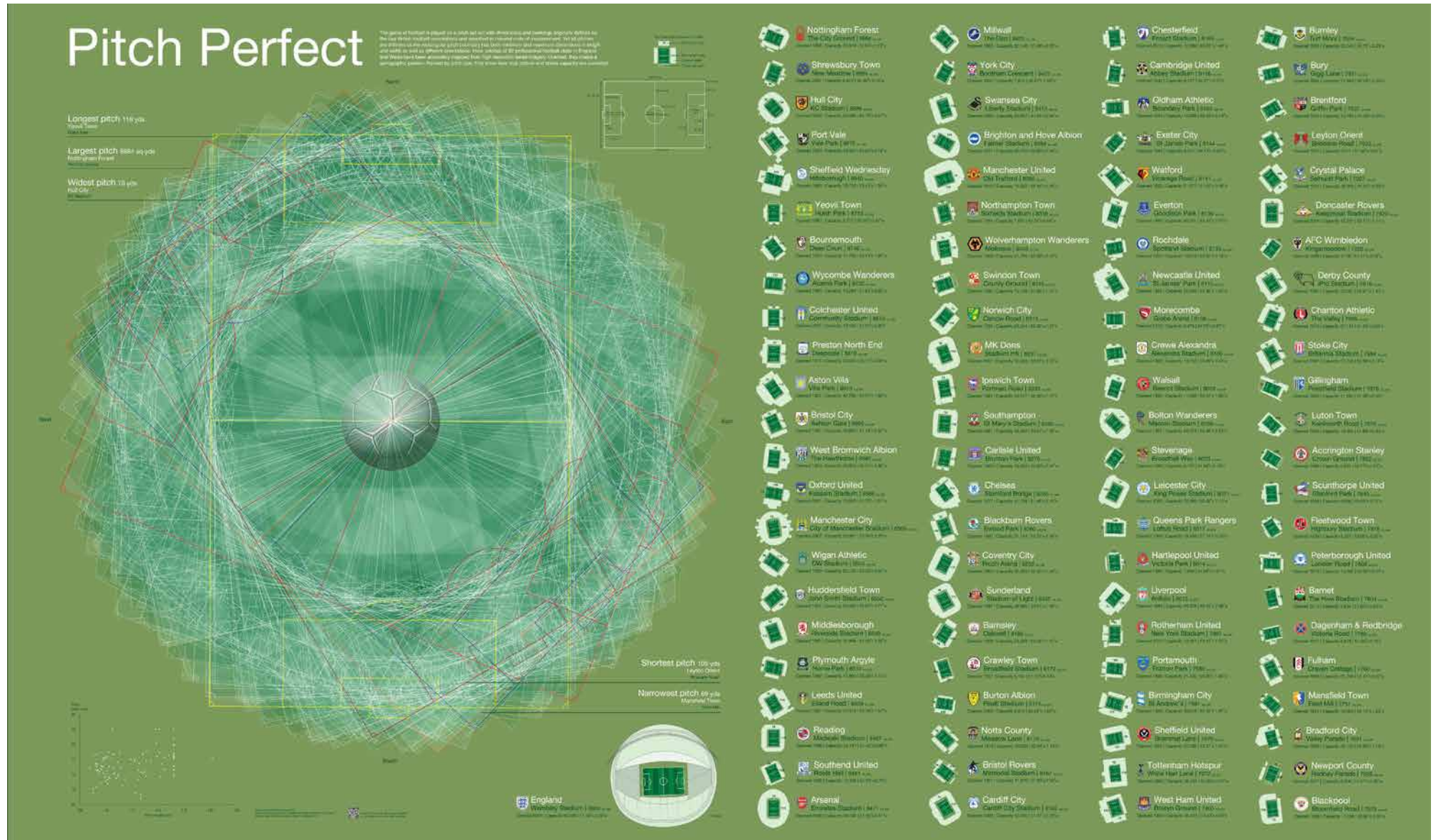
For spectators

Spectators in the main western stand face east, so during evening games, when most official matches take place, their view will not be hindered by glare from the setting sun. VIPs and media representatives are therefore seated in the western stands and the players' benches are on the western side.

For the media

One of the most important reasons to consider the path of the sun is to have optimal light for TV cameras, and the main camera is usually also in the western stand.

This ensures that the glare from the sun does not affect the quality of TV images and photographs during evening matches.



The orientation of English teams' football pitches, mostly north-south – Source "Pitch Perfect"

PATH OF THE SUN

For a truly sustainable stadium, it is essential to study the path of the sun at all times of year. Sun is needed on the pitch for optimal grass growth, so this must be taken into account when designing the stadium roof. In addition, sunlight must be brought into the stadium so that as little lighting as possible is required (except, of course, at night) and less electricity is used. Solar panels on the roof or around the stadium must receive as much sunlight as possible, so the best side to place them on must be considered.

WEATHER CONDITIONS

Stadiums must be designed to suit and adapt to the local climate. Architecture has always responded to the local climate, with pitched roofs for rainy or snowy areas, and small windows and thick walls for hot areas. For both hot and cold climates,

stadium design should look to the local area for inspiration in how to protect spectators from different weather, such as rain, wind, snow or sun, in a sustainable and passive manner. Rain can be negative, as heavy rain can have an impact on spectator and player comfort. The site must be analysed to establish the effect of rain on the stadium, and how the roof should be designed to protect against rain. However, rain can also be positive. Collecting rainwater from the stadium roof and surrounding areas and storing it for future use in the stadium can lead to major water savings, both for human (but non-potable) use and for irrigating the field of play and the landscaping around the stadium.

TOPOGRAPHY

Stadiums require very large sites that are ideally as flat as possible. To enhance sustainability, there must

be as little movement of earth as possible, as excavation and taking soil to other locations requires transport and therefore produces carbon emissions. The site should have ground levels that do not require major earth movement works in order to construct the sports facility.

The stadium can be at ground level or slightly below, but it is better from an ecological point of view for ground works to disturb the earth as little as possible. All excavation work requires land storage areas and transportation to other locations, which implies greater carbon emissions.

SOIL QUALITY AND GEOTECHNICAL CONDITIONS

The ideal site will have strong physical support for the stadium, reducing the need for aggressive and intrusive foundation methods such as pilings going deep into the ground.

Care should be taken to avoid sites with contaminated soil and waste refuse sites, which would require complex and expensive foundations, most likely with aggressive piling methods. When selecting a new site, a good geotechnical survey will highlight any bad soil conditions and any need for special foundation methods. If the existing topsoil is of good quality, it should be stored and retained for use when the stadium is completed.

Land contamination

Reports must cover previous uses of the land and indicate whether the land has at any time been contaminated by industrial use or other means. Contamination may include heavy metals, asbestos or oil in the ground. Any sort of contamination must be dealt with by specialist companies to ensure that protocol is followed. This will incur major costs, increasing overall site costs substantially, and it

can take a long time before the site is declared officially clean.

Archaeology

Initial soil investigations may reveal archaeological remains. In that case, archaeological specialists will need to be involved to decide on the correct action to take to ensure respect for history and allow the site to be used. Care must be taken to avoid sites where important archaeological remains would be destroyed by the work. Some sites will have a high probability of finding archaeological remains in the ground, so local historical archives and existing archaeological knowledge of the site and its surroundings should be used to decide which archaeological studies are required. Archaeological studies must prove that there would be no loss of historical treasures, or that any findings can be taken safely off-site to be preserved.

URBAN UTILITIES

All sites must be close to existing public utilities (such as electricity, gas, water and sewerage) to minimise the need for expensive and intrusive cabling for mains electricity and ensure sustainable waste treatment in local sewage plants.

Sustainability means having the lowest possible levels of intervention, both on and off-site, so sustainable stadiums should avoid adding expensive and intrusive infrastructure as much as possible.

Adding infrastructure will also cause major ground and transport issues, thereby increasing the carbon footprint. For this reason, the most sustainable sites tend to be in urban or suburban locations where the city's utilities can support the facility's requirements.



CASE STUDY

MUNICIPAL STADIUM OF BRAGA, PORTUGAL

The Municipal Stadium of Braga in Portugal had to negotiate the very aggressive terrain around the stadium. One of the main stands is built into the edge of the mountain, while the opposing stand is freestanding.

This excellent design involved designing the different stands differently depending on existing topographical land levels in order to reduce the need for land excavation.

BIODIVERSITY

RESILIENCE THROUGH BIODIVERSITY

Biodiversity encompasses the full variety of life on earth, with environmental factors in many areas – whether animal, climate or vegetation – existing in a complex and delicate state of balance.

Ultimately, biodiversity provides clean water, oxygen and all other elements which contribute to quality of life.

Any destruction of local habitats can threaten that balance, causing irreversible damage to ecosystems. Stadiums and sports facilities need to understand and safeguard the biodiversity of the local area in order to maintain a sustainable community.

The International Union for Conservation of Nature (IUCN) has developed a framework describing how sport and biodiversity can cohabit through the use of nature-based solutions, which is accessible here.

NATURAL VEGETATION

As much as possible, sites should avoid cutting down trees or other major vegetation (which may, in any case, be protected by law). Many countries now consider it a serious offence to cut or cut down trees without a licence. In certain cases, trees can be removed, but this must always be managed by professionals. Replanting the trees removed or planting new ones in other areas with existing trees is sometimes required.

When selecting a site, it is important to avoid locations with protected

species or special landscapes, prioritising sites that can be developed with minimal damage to the natural environment.

LOCAL FAUNA

There should be a detailed study of all local fauna. Stadiums must not harm local fauna and should affect it as little as possible.

There may, for example, be a need to develop mitigation measures to ensure that local fauna is not severely by construction work.

The site may have protected species on it, from insects to large animals, it may be a route for animals travelling from one area to another, or birds may nest on the site. All of these factors need to be established in reports.



CASE STUDY

OYMPIQUE LYONNAIS TRAINING CENTRE, LYON

Olympique Lyonnais has implemented several environmental initiatives, including the following:

- Fair Play For Planet – two-star certification.
- Creation of an educational permaculture garden spanning 550 m², called the Hero's Garden, to promote biodiversity.
- In 2016, six beehives were installed at the club's stadium, and that was increased to 12 in early 2020. Approximately 360,000 bees produce 100 kg of honey each year (260 kg in 2020).
- Workshops on the theme of beehives and the environment (biodiversity, food, health, composting, pollution and the five senses) are run for people in the local area (schools, medical and social services, general public, etc.) to raise awareness of environmental issues.

B3. TRANSPORT AND MOBILITY TO THE PRECINCTS

How easily visitors can reach the stadium is a major consideration. Any traditional mode of transport to the site has a carbon footprint, so the main modes should be public transport, preferably using vehicles running on renewable energy. Stadiums should have minimal parking. That being said, there is a need to ensure that alternative – sustainable – means of transport are available.

This section will focus on:

TRANSPORT

SMART MOBILITY AND PRECINCTS

CAR PARKING AND THEIR VARIOUS FUNCTIONS

SUSTAINABLE MOBILITY OPTIONS

PRIVATE CARS

TRANSPORT

The stadium should ideally have all possible public transport options within walking distance. This will mainly be buses, trains (both local and inter-city), trams and any underground system. Parking and charging points should be provided for bikes and for vehicles run on renewable and clean energy, and efforts should be made to encourage walking, cycling and other sustainable forms of individual transport. A good example here is the Olympic Walk – a pedestrian area linking Wembley Stadium to nearby tube stations.

Transport and carbon dioxide (CO₂) emissions from transport are huge contributors in term of sustainability, so major emphasis should be placed on ensuring minimal use of personal transport and encouraging the use of public transport where it is needed. In order to address this, at some stadiums there is little or no car parking, except perhaps for VIPs, players and staff, thereby encouraging visitors not to use their own personal vehicles. This enhances the sustainability of the whole venue.



CASE STUDY

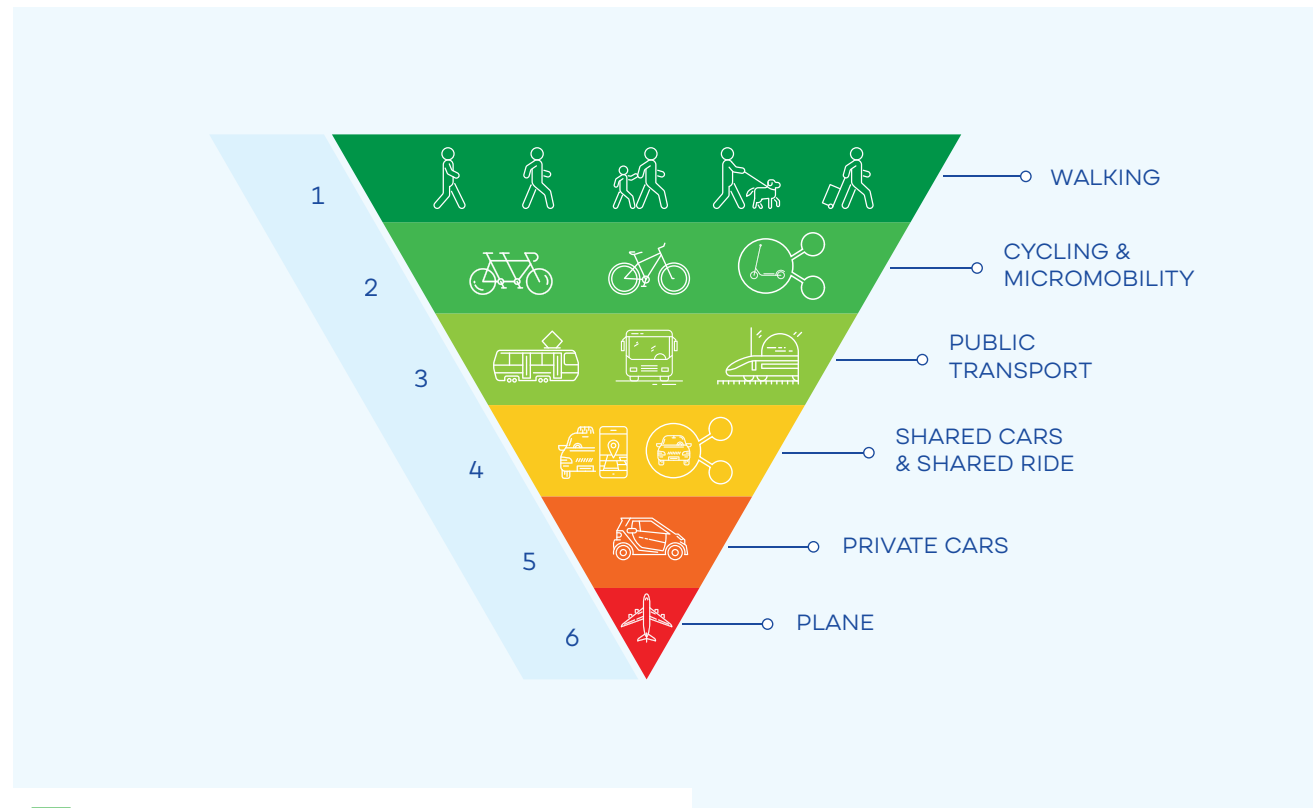
ARSENAL STADIUM, LONDON

Arsenal Stadium has no public parking, except for VIPs and disabled people, and a residents' parking scheme around the stadium means that no supporters can park within approximately 3km of the stadium on major event days.

SMART MOBILITY AND PRECINCTS

Most cities have traditional modes of transport: buses, trains, taxis and perhaps an underground system. Some more advanced cities have very sustainable means of public transport, such as gas or electric buses and trains or trams. This is ideal for a sustainable venue, as it minimises carbon emissions from cars, and if the site has fewer private vehicles arriving there should be fewer accidents, which is also good for sustainability.

According to the inverted traffic pyramid shown the figure below, the best transport solution is to walk. The next best is to cycle or use a small personal eco-friendly transport vehicle such as an electric scooter, Segway or electric golf cart. The least advisable method is private CO₂-emitting cars.



Inverted traffic pyramid showing the most sustainable means of transport at the top and the least sustainable at the bottom

CAR PARKING

Car parking is a major issue for modern stadiums and the requirement for car parking is an issue of concern with sustainable venues. Obviously, the main objective in terms of energy use is to have all spectators arriving at matches on foot or using a sustainable form of transport – either public transport or energy-efficient forms of private transport.

UEFA's major events usually require substantial car parking facilities near the stadium. Car parking takes up a lot of land, which may encourage the use of high-rise car parking, or even underground car parking in some cases. The easiest is ground-level parking, but at an average of 30m² per car parking space, vast amounts of land will be required to comply with tournament requirements.

Another option is to look for existing parking facilities in the vicinity and have them available for matchdays, hence reducing the need for specific parking areas. Having fewer car parking spaces will reduce the number of cars arriving at the stadium, thus reducing emissions. The precincts surrounding the stadium should be included in the sustainability masterplan for the stadium.

BLUE/GREEN INFRASTRUCTURE

Normally, hard standing areas such as car parking are built using asphalt or hard surface covers; however, there are good examples of parking built using more sustainable cellular green finishes, and where grass or plants are allowed to grow between the hard finishes. There are many types of cellular finishes for car parks, and these can be complemented with green vegetation or gravel which allows the car park to drain naturally

into the ground. The use of trees and shrubs between the parking spaces is advisable, as the resulting shade and comfort can enhance the environment and give the car park a much-reduced heat footprint. The environment can benefit from landscaped car parking areas, as this will support the carbon footprint of the project, with trees and shrubs reducing CO₂ levels around the stadium.



Green parking

Integrating green finishes into the drainage system will transform them into blue/green infrastructure, which will help in managing the volume of surface water generated by rainfall. Green/blue infrastructure can take the form of raingardens, mini swales, water features, bioretention zones and SuDS-enabled tree pits, which are extremely good at mitigating the amount of water that falls on a hard surface area, while also making the trees healthier and more robust.

Urban heat footprint

For car parking to be sustainable, there is a need to develop an environment which has a reduced surface temperature. The term 'urban heat footprint' describes a situation where the temperature of a hard urban is much higher than it would be if there were green areas. This higher temperature causes an increase in greenhouse gases

and contributes directly to global warming. The car park's design should consider the need to reduce the formation of urban heat Islands, or areas where the temperature difference relative to surrounding areas is high. Use of softer landscaped materials in the car parking and precinct areas will reduce temperature differences and provide a much cooler environment around the stadium. Introducing green/blue infrastructure will further reduce temperatures around the stadium by maximising evapotranspiration potential.

Porous surfaces and infiltration

A good sustainable car park will also allow water to drain through the finish into the sub-base. Porous surfaces are effective at managing surface water close to its point of generation, intercepting and reducing it. Porous surfacing is not restricted

to concrete block paving; it can be new types of sustainable floor finishes such as resin bound, porous asphalt and porous concrete, and grass re-enforcement. Infiltration can be used to capture surface water run-off and direct it to the subsoil, reducing the amount of water going to adjacent sewers and watercourses, and reducing the pressure on the sewerage systems. Infiltration also tops up the water table, which is beneficial in areas where borehole water abstraction has reduced these levels. Water should not be infiltrated into a subsoil which contains a source of groundwater contamination within one metre.

Automated parking systems

Sustainable parking areas have a fully automated system which allows the user to know the number of spaces available, and the location of those spaces in the parking area.

Modern car parks have advanced technology which allows visitors to have a clear idea of where there are empty spaces available. The use of automated systems means that cars take less time to get to an empty space, thereby using less energy.

The more efficient the system, the better the car park will work.

Recycled materials

Car parking takes up very large areas of ground, and the natural choice of finish is asphalt or concrete. To ensure that the construction of the car park is sustainable, there may be a need to use recycled asphalt or other recycled materials for the finish.

When selecting materials, the 360° criteria should be applied to ensure that all materials used can ultimately be recycled for further use in new buildings or projects.

Car parking as a satellite service for cities

Stadium car parking can be used to support the urban community around the stadium or sports facility, being used to avoid city centre congestion. The car parks of some stadiums and sports facilities can be used daily as alternative parking outside the city centre. Some stadiums do not need their large car parks on non-event days, so these areas are underused and a source of heat gain in the urban environment surrounding the stadiums. Such car parks can be used for short-term parking outside the city, with shuttle bus services taking people to the city centre, thus preventing those cars and other contaminating vehicles from entering the urban area.

Using car parks for sport

Where large car parks are only really used on matchdays, one sustainable

option is for the car park to be used in other ways on other days, contributing to the health of the community. Car parks can be used for sports such as mini-football or basketball. Car parks can be empty much of the time. If the floor finish is designed carefully, with additional lines painted on it, the surface can be used by people of all ages playing a variety of different sports. This means that the community can use the car park every day.



Multi-use car park



Solar panel parking

Car parking and solar panels

Car parks are large expanses of space near to stadiums. This makes them a good place to put solar PV panels, not only providing shade for the cars below, but also providing energy to the club or stadium.

Solar panels can be a good energy source for the stadium, and on non-matchdays the power can be sent to the local grid or saved for later. The shade of the solar panels also reduces the heat absorbed by the ground, allowing the air to cool.

Charging points

An important part of any sustainability project is to provide the right number of recharging points for electric cars and other means of transport.

The right percentage of parking spaces needs to be devoted to electric car users to create incentives for these vehicles. Parking areas need to encourage sustainable use of transport, and the ability to charge cars or other vehicles in the stadium car parks is a responsible approach to the environment.

Electric cars are becoming more and more common, and having charging facilities at the stadium will help to support this trend.

SUSTAINABLE MOBILITY OPTIONS

Transport is one of the very biggest causes of CO₂ emissions, in some cases accounting for as much as 26% of the total emissions of a country (Spain, 2007). With millions of journeys taking place every day, transport has a major impact on the environment, the climate and people's health.

Management of mobility in relation to a club, stadium or sports facility is essential to develop a model which is not only healthy but can also enhance social and economic benefits. Sports venues generate very large amounts of mobility, either directly or indirectly, and this entails significant consumption of energy and production of contaminating emissions. Sports venues should measure the impact that all their mobility movements

have and, where possible, develop a model which is as sustainable as possible. This entails studies of the movements and mobility of staff, players, all associated professionals and spectators. All mobility strategies must evolve towards a system which is safe, comfortable, responsible, and sustainable for everyone. Campaigns to educate people on the importance of using public transport systems or alternative options with low environmental impact should be considered to avoid the use and abuse of private transport. Staff should be given guidelines with a view to improving their way of life, while reducing the consumption of petrol and the associated carbon footprint.

SUSTAINABLE VEHICLES

Car parking should support the use of sustainable forms of transport. Thus, a car park should help people to use electric cars to arrive at

stadiums, thereby reducing CO₂ emissions, and this can be achieved by having recharging points in the car park. There should be a substantial number of recharging areas, and they should be placed in prime locations close to the stadium's access points, giving users of sustainable vehicles preferential treatment.

ECO-FRIENDLY TRANSPORT

More and more new forms of transport are coming on to the market, helping to provide totally sustainable modes of transport. The need to reduce the carbon footprint in cities has brought about a need for alternative eco-friendly transport vehicles, both for public and for private transport.

A 'green vehicle' is one that is environmentally friendly and causes minimal impact comparing with other internal combustion vehicles powered by petrol or diesel.

Thus far, the main focus has been on the development of electric cars – either fully electric vehicles, or hybrid options, which are also a valid means of reducing carbon emissions. Other eco-friendly options include vehicles powered by hydrogen or biomass, although these are less common.



Eco-friendly transport vehicles

Having eco-friendly transport vehicles serving the stadium is essential to reducing the venue's indirect emissions. The more people arrive at the stadiums in eco-friendly transport vehicles, be they be electric buses, trams, etc. or electric cars, the better it is for the stadium and the community in terms of sustainability.

There is now a wide range of eco-friendly transport options, from bikes and scooters, right up to electric buses, trams and even trains.

Examples of different types of eco-friendly transport, as illustrated in the figure below, include: bicycles, electric bikes, scooters, electric motorbikes, electric and gas / hydrogen-powered vehicles.

BICYCLES AND OTHER SUSTAINABLE VEHICLES

Ideally, non-contaminating vehicles should be used to travel to stadiums and sports facilities. The use of bicycles is highly recommended, and all new buildings should anticipate locations for the parking of bikes (including electric bikes – either privately owned ones or publicly available hire bikes).

Other sustainable vehicles include Segways and small electric vehicles such as golf carts, all of which require preferential car parking locations, as well as charging points. At the same time, however, studies (such as a recent survey by Real Betis) have shown that many fans are reluctant to leave their bicycles at the stadium, afraid they will be stolen or vandalised. Some initiatives are being investigated to mitigate this issue, such as video surveillance cameras and safe lockers.

CASE STUDY

JOHAN CRUIJFF ARENA, AMSTERDAM



The Johan Cruijff Arena in Amsterdam provides charging points in its car parks, allowing visitors and spectators to charge their cars while at the different events. The arena has also installed bidirectional charging stations, and in the future all car parks are to be equipped with intelligent charging infrastructure. Bidirectional systems allow visitors to give back clean energy to the stadium to have a smart way of contributing to the ecosystem.

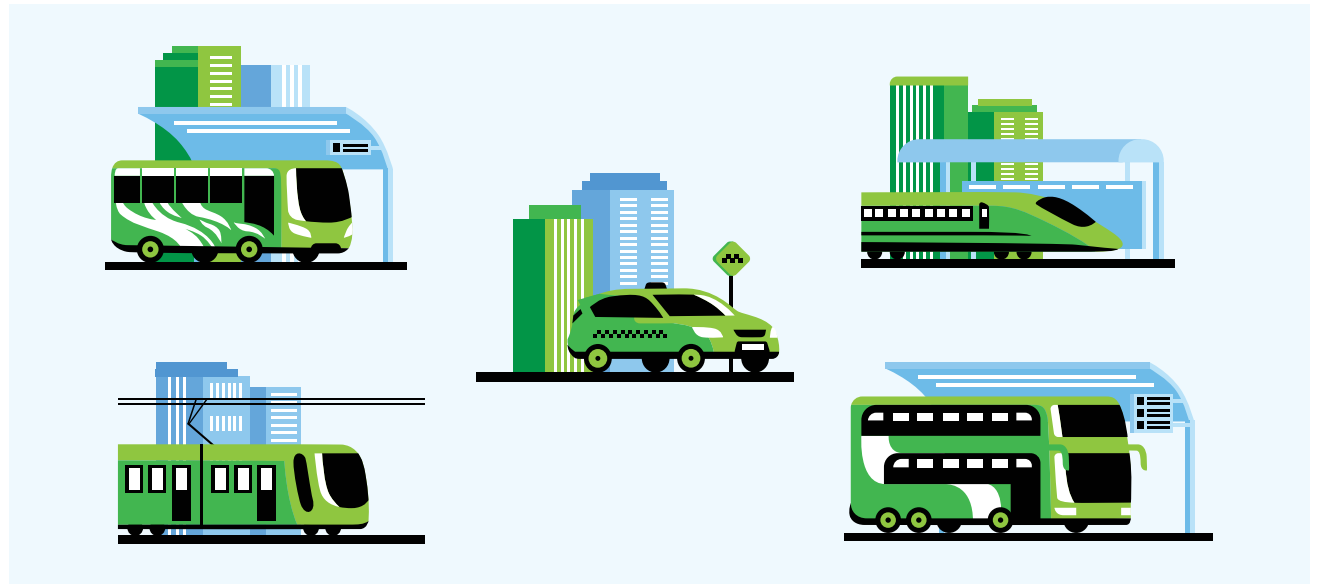
The arena provides visitors to choose from various alternatives for travelling and there are also escalators which move people from floor to floor to generate power. 80% of the lighting in the stadium is very efficient LED lights controlled by motion sensors, which turn on and off as needed. Old and new electric vehicle batteries have been used to create a storage system, which provides back-up power and eliminates the need for contaminating generators. Finally, the stadium procures 100% green energy from the power company for its energy needs.

PUBLIC TRANSPORT

Stadiums should be close to all means of public transport to ensure that all visitors arrive using sustainable modes of transport.

One of the most important aspects for the overall sustainability of the day-to-day use of the stadium is to ensure minimal use of private transport and minimise the effect that mass transport has on the environment.

The best way to minimise the contamination of the environment is by using public transport. The closer the stadium is to any sort of public transport – be it buses, trains, an underground station, trams, etc. – the better.



This tends to create a preference for more urban locations, as cities and towns have all the public transport options close at hand. However out-of-town sites can be considered if adequate public transport close to the stadium will ensure that a great

majority of the spectators can arrive and leave by these methods. There should be discounts on tickets or other incentives if public transport is used, as this has a major impact on the reduction of CO₂ emissions.



CASE STUDY

WEMBLEY STADIUM, LONDON

Wembley Stadium in London has direct rail connections, with three stations close to the stadium itself. It is served by two different underground stations – Wembley Park and Wembley Central – as well as a mainline station with fast links to central London and the rest of the country. National Express also run event-specific coaches from around the UK. The stadium’s website has a system called ‘Sofa to Seat’, which allows a visitor to plan their trip to Wembley Stadium on public transport.

PRIVATE CARS

Most cars arriving at a venue belong to private users, and incentives are needed to ensure better sustainability. The venue should look to provide benefits where cars bring more than two people or have full capacity, thereby reducing the total number of vehicles. In most European countries, parking policy is determined by local legislation, within guidelines provided by national or regional governments. If parking requirements can be laid down at a local level, municipalities can explore better alternatives.

For example, if the building project is in an area with good public transport connections or mobility concepts, less parking is required. Another option is to set a maximum number of parking spaces for new buildings.

On the other hand, some entities organising football events require a certain number of car parking spaces to be available at the stadium or in the vicinity, although it is acceptable to revert to the park and ride concept for greater distances.

UEFA guidelines can require up to one car parking space for every seven spectators, which translates into quite a large number for a stadium hosting major events, or up to 75% of the total capacity of a stadium and must consider fan segregation.

Guidelines will carefully define the car parking that needs to be available within the stadium itself (or very close by and with direct access) for stakeholders such as teams, match officials, team guests, team supporters, VIPs and state-protected principals, commercial

partner guests, corporate guests, organisational staff, TV and media, suppliers and disabled spectators.

Car parks are subject to minimum size requirements based on local norms or stadium capacity, bearing in mind the ability to use public transport. Cars can be managed by automated systems showing how many spaces are available and where they are, which reduces the time taken to find a space, thereby reducing emissions.

CAR-SHARING INITIATIVES

It is essential to reduce the number of vehicles which come to the sports venue, either daily or on event days. Sustainability looks to reduce the number of cars and the emission of gases into the atmosphere, so any solution that could reduce the number of cars arriving at the venue and maximise the number of

passengers in each vehicle should be studied with a view to putting incentives in place. Many stadiums have initiatives encouraging car users to share with other passengers, with some even providing dedicated car parking facilities or in-stadium incentives for cars with four or more people in them.



Park & Ride parking

PARK AND RIDE

A park and ride system involves cars being parked in areas where there is a low impact on the environment or on the traffic in any city or town.

Users will need to park their cars in specific locations, and these have shuttle buses or trains to take the public to the stadium or the sports facility. This means that the car parks can be located away from the venues, and from the cities, and decongest more critical locations and bring spectators directly to the event.

Car users will pay a fee for their stay in the car park, and this normally includes the cost of the shuttle bus to the stadium or sports facility, although other systems can be used. Good management of the park and ride option allows stadium operators to control and monitor access to the stadium.

PARK AND CHARGE

A park and charge system is one where cars can be charged on-site in the parking areas of the stadium or sports facility.

Many modern facilities in other sectors (such as retail) have developed options for users to park their electric vehicles in specific spaces, where they can charge their car from the grid supplied by the venue operator.

B4. ACTIVITIES

Many sports facilities can increase sustainability by allowing other sports to be played on the site. This supports the idea of social sustainability, as it brings an element of social diversity to the site, allowing the facility to be used for more than just football. This section will cover:

MAIN ACTIVITY: SPORT

SECONDARY ACTIVITY:
OTHER ACTIVITIES

MULTIPURPOSE STADIUMS

EDUCATION

MAIN ACTIVITY: SPORT

When designing a sports facility, it is essential to be clear about its main use, which could range from holding large events to being a small training facility.

It is also essential to decide whether there is a need to include non-sporting areas, such as commercial premises, medical facilities, a hotel or something specific to the local culture. The main activity, however, will be sport, and overall the facility will aim to provide the best building and landscaped areas for sports matches and training.

SECONDARY ACTIVITY: OTHER ACTIVITIES

Sports facilities now aim to be viable for more than one activity. Even stadiums built specifically for football can be used for many other activities, and the more activities a stadium can be used for, the more socially and economically sustainable it will be.

The early stages of the design concept or brief need to cover a wide spectrum of other activities that can happen at the facility.

These activities could be social, leisure, commercial or community ventures, and will be determined according to the location of the facility and its surrounding community.

The early stages of the design concept or brief need to cover a wide spectrum of other activities that can happen at the facility. These activities could be social, leisure, commercial or community ventures, and will be determined according to the location of the facility and its surrounding community.



Multipurpose stadium,
North Collins High School,
North Collins, NY, USA

MULTIPURPOSE STADIUMS

A stadium with multiple functions can be used more often. It can be used more by the local community, support local values and enhance the local area.

Stadiums are large and expensive. To obtain maximum benefit from that expenditure, the design of the stadium must enable it to be used almost every day of the year, for a variety of sports and other activities.

EDUCATION

Stadiums and sports facilities have strong links with society and are 'influencers' for young people. Seeking to educate people on sustainability should be an essential part of the responsibility of sports entities. UEFA looks to education in many areas of society, and the need to provide educational resources through sports venues is essential. There is a strong need to develop educational systems in all areas of society to ensure that sustainable development is a key element of people's learning processes from a very early age. Sport is a key point of reference for young people, and all sports entities need to promote as many sustainable educational opportunities as possible to ensure these values are instilled in young sports men and women.

B5. CONSTRUCTION MATERIALS

The construction industry is responsible for over 30% of the extraction of natural resources and 25% of the solid waste generated in the world, so any reduction in the use of construction materials can have a major impact.

Numerous studies have been carried in this field and there are several references that can be found. This section will only cover some basic points to provide a general content to the reader, namely:

MATERIALS

SUSTAINABILITY CERTIFICATION

MATERIALS

SUPPLY CHAINS AND LOCAL SUPPLY

To ensure that any project is sustainable, it is essential to carry out a full and detailed analysis of the supply chain. Such analysis involves looking at the source of the raw materials required for the product, then at how they are transported and managed, and how the final product is produced, and finally at the transportation and delivery of the final product.

The supply chain involves economic, environmental and social issues, all of which must be considered in a holistic assessment of how the supply chain affects not only the planet, but also people's lives, working conditions, and health and safety.

Buy local - When deciding on the materials to be used for the construction of a new stadium, the design team should plan to use materials that are located or manufactured close to the stadium to reduce the need for transport to the site, whether by air, sea or road.

Using local products is an efficient way to reduce carbon emissions.

USE OF SUSTAINABLE MATERIALS

The classification of available materials is now focused on the sustainability of both the material itself and the production process.

Sustainable materials are classified and certified by official sources. More and more projects worldwide, from stadiums to towers, are now using wood as a natural sustainable material. Timber is a traditional

building material and can often be sourced locally. It also has a much lower carbon footprint than steel or concrete, the usual elements of stadium design, and so its use in sports facilities could avoid the release of a huge amount of carbon, perhaps as much as millions of tonnes annually.

It is essential to develop renewable forests that provide wood for the construction industry in a controlled manner properly managed through the Forest Stewardship Council, so that the use of wood does not require deforestation. A strong emphasis on materials composition has emerged to ensure materials are:

- **Non-toxic materials** are materials that have been created or manufactured without any substances that could be harmful to the environment or people who

use them. Toxic materials can come in many different forms and can be dangerous when inhaled or ingested, or even as a result of the waste they create, whether in solid or liquid form.

- Not from **Microplastics** - Microplastics are the most extreme example of how uncontrolled plastic waste has developed into a worldwide threat, both on land and at sea. Microplastics are very small pieces of plastic, usually defined as smaller than 5mm in length, according to the US National Oceanic and Atmospheric Administration. These very small pieces of plastic, which take hundreds of years to degrade, accumulate in the bodies of many natural organisms and can enter people's bodies through food and water. There is major microplastic pollution in the world's oceans,

but such pollution can also be found on land, even in deep layers of sediment. Managing the use of plastics and preventing the development of microplastics in the future will be a major challenge.

- **Fire-protected materials:**

In previous years there have been major safety issues at stadiums due to the use of flammable materials. Fire is one of the worst possible dangers for any stadium, as stadiums contain large numbers of people. New stadiums must comply with the most stringent specifications for all materials to avoid the spread of fires. Such specifications are also included in most countries' local and national building regulations.

RECYCLABLE AND RECYCLED MATERIALS

When selecting materials for new and refurbished stadiums, it is essential to review the materials' specifications to ensure that the materials can be recycled into new materials or even directly reused at the end of the facility's life cycle.

Every material or product has its own specific carbon footprint based on the extraction of the raw material, the manufacturing process and the transport to the site where it is to be used. Manufacturers are constantly trying to develop better production technologies, increase recyclability and reusability, and lower carbon emissions, and are becoming more and more transparent in describing the carbon footprint of their materials, allowing for easy comparisons. The designers of new sports facilities need to be aware of the latest

recyclable materials on the market. Such materials will ideally be sourced locally to reduce transport costs and emissions, and the whole process from start to finish should aim to respect the values of the circular economy.

Many types of building material can be recycled from other construction and demolition projects. Such materials include plasterboard, aggregate, metals, plastics, glass, wood, bricks and blocks, floor and wall coverings, insulation and even packaging (cardboard, wood, etc.). This covers a large percentage of the materials used in construction, and in fact the percentage of materials that can be recycled has greatly increased in recent years. The use of green building materials results in lower waste and pollution in the environment. Even today, many stadiums are built using recycled materials, as well as sustainable materials than can be recycled in the future.

SUSTAINABILITY CERTIFICATION

Various bodies award stadiums different levels of sustainability certification on the basis of the sustainable measures implemented.

New and even refurbished stadiums are advised to obtain some form of certification. The certifying body is involved in the project even in the early design stages, helping the designers to implement the correct systems for a truly sustainable design.

It is also involved in the construction process, monitoring the use of different materials and the management of waste.

There are two main sustainability standards:

1. Building Research Establishment's Environmental Assessment Method ([BREEAM](#)), which is mainly Europe-focused and uses quantitative standards. Millions of buildings around the world are certified as complying with BREEAM's holistic approach to achieving health, net-zero and environmental, social and governance goals.
2. The Leadership in Energy and Environmental Design ([LEED](#)) rating system, which is widely used in the United States. It is, generally speaking, simpler in its approach than BREEAM, as it is based solely on ecology-oriented performance.





CASE STUDY

THE PLANNED ECO PARK IN GLOUCESTERSHIRE, ENGLAND

The planned Eco Park in Gloucestershire, England – the future home of Forest Green Rovers – will be built entirely from wood and powered by sustainable energy sources.

The use of wood in construction is a reasonably modern response to the desire for sustainability in building materials. The stadium's large-span roof and wooden structural supports give it a unique and original look.

B6. MAIN ELEMENTS OF A STADIUM

A stadium is composed of a multitude of elements. This section focuses on the following the bowl and seats as well as the roof and facade:

BOWL AND SEATING

ROOF AND FACADE

BOWL AND SEATING

SEAT LOCATIONS

The seats are in the bowl, which fully surrounds the field of play. The seats are placed on tiers, and stadiums may have multiple tiers.

The bowl must allow all the seats in the stadium to have an unimpeded view of the match, and the angle of the bowl should comply with the correct c-values (vision over the top of the head of the spectator in front) to always guarantee a good view.

Modern stadiums must create a bowl that is both comfortable and safe and provide seats for all stakeholders: the public, VIPs, media representatives, event delegates, emergency services and disabled spectators.

Seats should be arranged in a way that allows quick and easy evacuation from all seats in the event of an emergency and

should preferably tip up to provide maximum space for people to move. There should not be too many seats in each row, to ensure easy access to stairs and gangways for evacuation.

The stadium bowl should have access tunnels at the corners for maintenance and storage, but also so that emergency services can enter and exit the field of play. There should be a tunnel in the centre of the western side of the bowl for the players and match officials to enter and leave the pitch.

Most stadiums locate the VIP seats, players and media in the western stand, as this stand is shaded during evening games.

The best position for seats is in the main stands close to the centre line (with seats becoming less good the closer to the corners they get).

Seats in the centre of the north and south stands are also good and are normally used for the home and away fans. Some of these fans might clash, so the home and away sections need to be positioned carefully to keep them apart, for their own safety and that of other people.

Seats for safety and security staff are normally located in front of the security rooms and close to the stadium's crisis room, which is also usually close to the main VIP lounge in the western stand. These seats must always have a full and unobstructed view of the bowl so that staff can react immediately in the event of any crisis or safety issue.

SEAT ERGONOMICS

Modern seats need to be designed to ensure that the spectator is comfortable and safe. Stadiums have different commercial levels of seating,

ranging from VIP seats to general spectator seats, and they may have slightly different levels of comfort. But all seats, regardless of the price of the ticket, should ensure the same level of safety and ability to evacuate in an emergency.

As mentioned above, seats should tip up to provide more space for people to move in an emergency. All stadiums in Europe must comply with the [relevant European standard](#).

RETRACTABLE SEATS

To allow more flexibility and enable multipurpose stadiums and sports facilities to be used for other events on non-matchdays, designers may wish to have some sections of seating that retract away into storage areas into the floor or a back wall, leaving a substantial open space.

The use of retractable seats will come under increased scrutiny, as there is growing demand from fans for standing areas, which would also provide the space needed for other purposes on non-matchdays. However, any additional costs and the health and safety of spectators and staff must be paramount in the decision-making process.

Retractable seats allow the necessary flexibility for stadium and sports venue events teams to host a diverse range of events all year round, thereby enhancing their business models. A cost-benefit analysis should consider the extra cost of the retractable seats against the greater flexibility to ensure that the initial cost is recouped in a short period of time.

TIP-UP SEATS

One of the most important safety aspects in a safe and sustainable stadium is the ability to react when an emergency occurs. Most stadiums now require seats that close automatically when the user stands up to allow more space between rows. These seats, known as 'tip-up seats', help to ensure the safety of the facility and compliance with local and international evaluation regulations, particularly in stands that hold large numbers of people.

The folding function of these seats also facilitates maintenance and cleaning, as they allow easy access to the floor, thereby helping to ensure compliance with all cleaning and safety guidelines. In the interests of sustainability, all seats should be made from recyclable plastics,

ensuring that they can be recycled into new materials at the end of their life. Unfortunately, with today's technology, seats made from 100% recycled plastics range around 40% of recycled plastics.



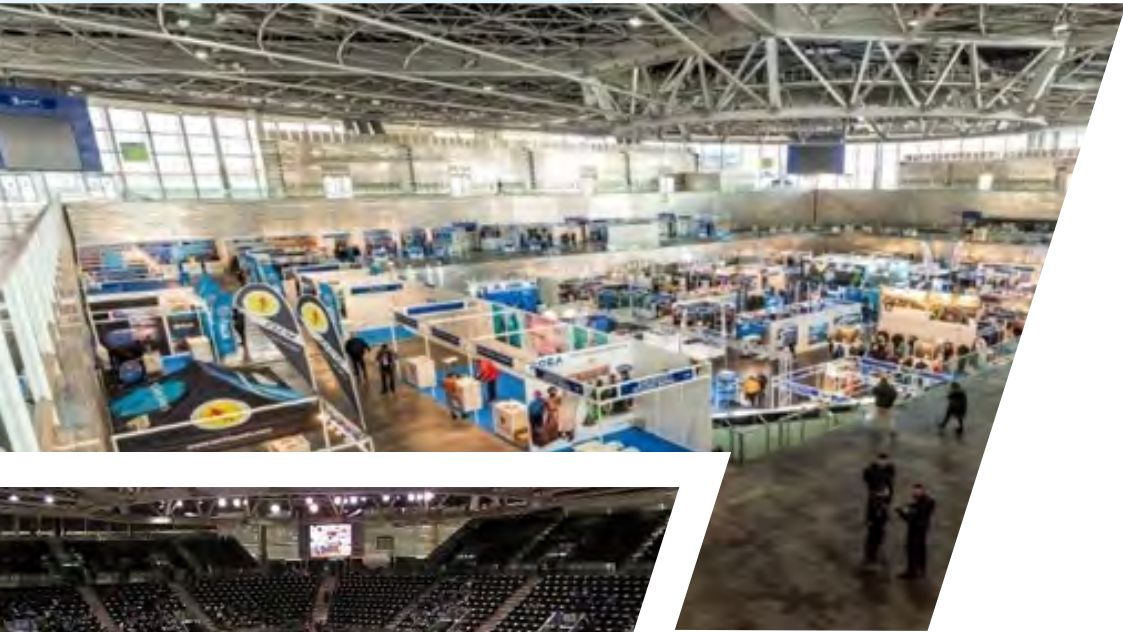
Tip-up seats in the Netto Arena, Szczecin, Poland

CASE STUDY

MADRID ARENA, SPAIN

The Madrid Arena in Spain is a fully versatile sports venue whose seats are all fully retractable, enabling it to host various sporting and non-sporting events.

It has a maximum capacity of 10,248 spectators for basketball, and 12,000 for boxing, and offers a surface of 30,000m² for fairs and exhibitions. It is an extremely flexible multipurpose space that can be used throughout the year, offering excellent business opportunities.



- ▲ The Madrid Arena, with the seats fully retracted for a fair on the left
- ◀ The Madrid Arena, shown in its basketball format

DISABLED SPECTATORS

Special seating arrangements must be provided for disabled spectators. This includes wheelchair users, who should be given an open space for their wheelchair with a clear view of the pitch next to a standard seat for someone accompanying them.

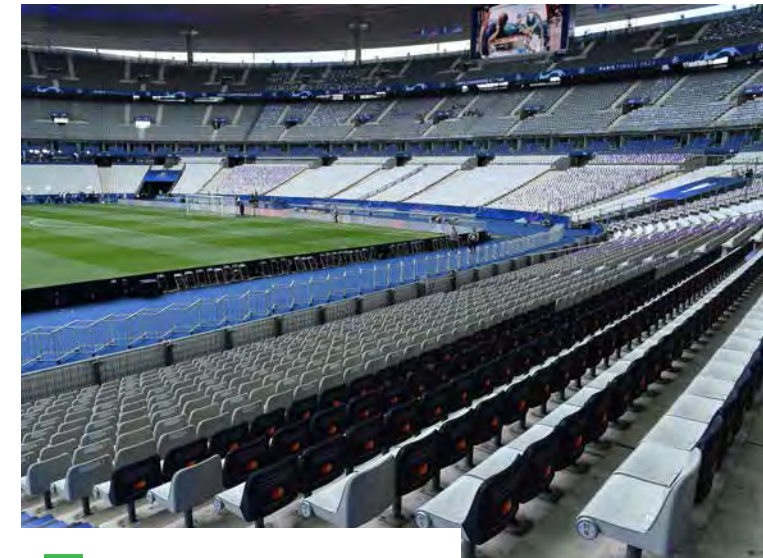
Modern stadiums must provide access to all, regardless of disabilities, and the CAFE and UEFA [Access for All](#) guide provides further details on this.

SEAT COMPOSITION

The installation of new seats comes towards the end of the construction or refurbishment of a stadium, so it is not uncommon to have budget constraints when this stage is reached.

Seats are plastic, to ensure the durability of the colour and to provide enough resistance to any force applied (through normal use or through vandalism), so seats can be made at least partially from recycled plastics. Choosing partially recycled materials to produce new seats increases the cost marginally but has massive environmental benefits throughout the supply chain and the product's life cycle.

Unfortunately, with today's technology, seats made from 100% recycled plastics cannot comply with European standards in areas such as colour retention, fire prevention, and safety and security. At the time of writing, recycled plastic can only account for around 40% of the seat material if these standards are to be complied with.



Mastercard partner seats at an UEFA Champions League match



The roof of the Stade de Bordeaux covers the whole of the stadium bowl thanks to its many supporting columns

ROOF AND FACADE

The roof and the facade are the main elements that can ensure human comfort within a sports facility, as they are the main barriers between the inside spaces and the outside environment, which may be hot, cold, rainy or windy. The design of the roof and facade requires careful consideration to ensure comfort inside the stadium. They should use both active and passive sustainable and energy-efficient measures to guarantee a good temperature in all seasons.

THE ROOF

The roof is one of the most important areas of a modern football stadium and has many functions, regardless of whether the stadium is in a hot or cold climate. It primarily brings comfort to the spectators. Indeed, by keeping them safe from rain and sun,

it makes their seats a more valuable commodity. But the roof can also be used to house solar panels, and it can harvest rainwater for future use. The roof's design must also provide ventilation and light for the stadium and minimise shade on the pitch to facilitate grass growth.

SHADE

Shade is tremendously important in hot climates, and the roof (or any equivalent architectural feature such as a screen or colonnade) provides shade, passively protecting the stadium from the heat of the sun. Shade massively reduces energy consumption in the spaces inside the stadium, as less energy is needed for cooling. In hot climates, there must be shade for walls and windows, and there must be a full roof. Nonetheless, as mentioned previously, the roof needs to be designed carefully to ensure sufficient sunlight

at pitch level and avoid the need for lighting or active energy systems to allow the grass to grow. Achieving the right balance between sufficient shade and light is a complex task for designers, but it is essential in order to minimise energy consumption.

COLLECTION OF RAINWATER

In rainy climates, the roof acts as a major collection area for rainwater, allowing it to be harvested and channelled to storage tanks below, instead of allowing it to run back into the ground. That can then be used to water the pitch, as well as being used in toilet blocks and other grey water activities (such as cleaning).

The harvesting of rain is proving very effective in many countries where the cost of water from the mains supply is increasing. It not only helps to cut costs but also contributes to preserving potable water for human

consumption instead of using it in toilets, for watering pitches and other grey water uses.

Water harvesting is a sustainable solution that requires very little energy, possibly only to run the pumps required to move the stored water to other areas. Rainwater is usually clean and free from harmful chemicals, but it is not drinkable unless filtering and purification systems are used.

SOLAR PANELS

Stadium roofs are very large, sometimes spanning tens of thousands of square metres. They are therefore an excellent place to install solar panels, which can generate electricity for use at the stadium or for sending back to the grid. In some stadiums with extensive car parking, solar panels can be placed on the roofs of the car park's sunshades.

Depending on the scale of the car park, the energy produced can be substantial.

Solar panels and their supports are heavy. Ensuring that the roof can support them can entail extra costs, but a stadium that generates its own electricity can save money in the long run. In addition, the sustainability benefits are excellent, as solar panels reduce the need for traditional electricity use.

More and more stadiums are looking to place solar panels on their roofs, or in their car parks, as the inclusion of solar energy is both a financially advantageous, as well as offering sustainability benefits.

NOISE CONTAMINATION

It is very important for both new and old sports facilities to contain noise to avoid affecting the health and well-being of people in the surrounding area. Sports facilities located in residential areas need to take great care to contain excessive noise within the facility, especially on game days, since fans can make a lot of noise when supporting their teams. It is essential that sports facilities become a friendly part of society rather than creating ill will by becoming an unwelcome source of noise, even in urban and suburban locations.

If correctly positioned, angled and insulated, a roof can become a passive way of helping to contain noise. The best designs can even reflect noise from the spectators onto the pitch, creating a vibrant effect and giving a boost to the teams.

LIGHT POLLUTION

Avoiding light pollution from a sports facility is important to ensure that it interacts with its local community in a socially and environmentally responsible way.

Light emanating from a stadium can be disturbing and even harmful to people in urban areas, and even in suburban districts strong light emitted into the surroundings can harm the local fauna and ecosystems.

Roofs can be designed to ensure passively that the least amount of light from within the facility escapes to the surrounding areas. In most stadiums, the lights can be mounted on the roof and directed down into the bowl rather than being placed on masts or light posts, which cause significant light pollution as they are visible from a great distance.

In modern, enclosed stadiums, the emission of light can be controlled and focused on the pitch.

ROOF-MOUNTED LED LIGHTS

Roofs that cover all the seats in the stadium usually have substantial structural elements that support a catwalk where LED lights can be hung above the bowl and below the roof.

LED lights are located all around the pitch and angled to illuminate the pitch to the level required to play and for broadcasting on television. In this scenario, the lights are all around the pitch, which avoids the problem of shadows created by the older solution involving two or four towers of lights.

In addition, other devices such as loudspeakers and security cameras can be mounted on the same structures if required.



The roof of Olympique de Marseille's Stade Vélodrome allows substantial natural light to reach the pitch

ROOFS FOR NATURAL LIGHT

While stadium roofs offer good protection against excessive sun exposure, they also need to be designed to allow sufficient natural light to reach the pitch, both for visibility during matches and to

promote the growth of natural grass, thereby reducing the need for grow lights. Roofs can be made of translucent materials that provide either shade or light as required. To maximise the amount of light reaching the pitch at all times, consideration needs to be given to how the translucent parts of the roof can be cleaned.

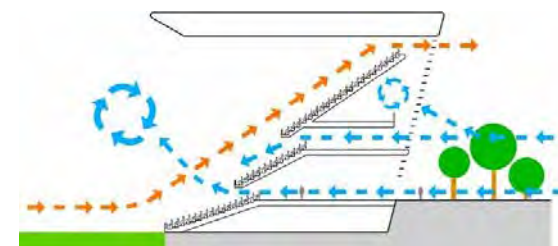
Designs must take into account the sun path in the area for maximum exposure. Consideration needs to be given to how the translucent material can be cleaned, to continually maximise the amount of light getting to the pitch.

ROOFS FOR NATURAL VENTILATION AND COOLING

Stadium roofs should be designed to allow air movement and extraction to ensure the effective natural ventilation of the bowl.

Since hot air rises, the roofs of facilities in hotter climates may need to be positioned in such a way as to allow air to leave the stadium.

Both the roof and the facade need to facilitate adequate natural ventilation, an essential sustainability measure that will reduce the need for energy consumption. A suitable design will allow hot air to escape between the bowl and the roof while drawing in cool air in to circulate around the areas where there are people, both in the bowl and in interior spaces.



Natural ventilation through air circulation

BLUE-GREEN ROOFS

Blue-green roofs are landscaped roofs that can be used to store harvested rainwater for later use and relieve pressure on drains during periods of excessive rain, thereby helping to protect against the increasing number and intensity of storms as a result of climate change. These roofs also enhance the area's biodiversity.

Blue roof technology aims to increase the volume of water stored and control the amount of rainwater released, while a green roof is one where plants grow and water is normally discharged. A blue-green roof combines the two.

THE FACADE

The facade is one of the most important parts of the skin of a building where heat can be gained or lost, potentially leading to high energy

consumption in order to maintain the desired temperature.

The facade is the vertical element of the building separating the interior and exterior and facing outwards. The correct treatment of a sports facility's facade is therefore essential to minimise internal heat gain or cooling loss. It provides the ability to control the environment inside the facility (in terms of light and acoustics as well as heat) and therefore ensure the physical comfort of those inside. A sustainable facade will consider many factors in order to create the best possible internal environment and reduce heat gain and loss, including having larger or smaller areas of glass.

The main purposes of a sustainable facade are to:

- allow daylight to enter the stadium;
- prevent heat from the sun from entering the stadium;

- store heat in the mass of the walls;
- use insulation to prevent heat transfer from inside to out, and vice versa;
- prevent air or moisture from passing through;
- allow natural ventilation where possible.

The facility's facade must be designed to do all these things in a cost-effective manner, and must, in particular, ensure people's comfort by passively mitigating heat and cold, which will in turn ensure reduced energy use by active systems such as air conditioning and heating.

Sustainable facades will need to be designed differently according to the local climate. Climates can be divided into three main types: heating-dominated, cooling-dominated, and mixed. In heating-dominated climates, it may be necessary to:

- collect the sun's heat in the building's envelope to provide passive heating,
- store heat in the mass of the facade in order to dissipate it to the interior in a controlled manner,
- keep heat inside the stadium using insulation,
- allow light to enter through large, glazed areas, while nonetheless minimising the amount of heat that escapes.

In cooling-dominated climates, it may be necessary to:

- keep heat out of the stadium using excellent insulation systems in the skin, thereby keeping the interior cool in a cost-effective way,
- provide natural cooling through natural ventilation, ideally cross ventilation,
- allow light to enter while nonetheless minimising the amount of heat that enters, perhaps using shading or high-efficiency glass.

SHADE ON THE FACADE

Shading systems to protect the facade from direct solar radiation are excellent passive measures to reduce heat gain in hot climates. Shading systems have been used as part of sustainable architecture for centuries. They allow the circulation of air between the shading elements and the facade.

Deep overhangs or cornices can also be incorporated to shade windows from the sun. Shading systems should be included in designs if the local climate so requires, and always considering the path of the sun at different times of year, especially during the summer.

INSULATION

Insulation in any building is a relatively cost-effective way to reduce energy loss or gain. An effectively designed roof or facade should include sufficient insulation to reduce heat

and cold transfer both from the outside to the inside and vice versa.

Buildings are one of the main sources of energy consumption in the world, and according to the EU's [Energy Performance of Buildings Directive](#) issued in 2010, the building sector is continuously expanding and currently accounts for 40% of total energy consumption within the EU. It is therefore essential to take action to ensure energy efficiency in buildings, and the better the efficiency of the barrier between the outside and the inside of any building (i.e., the roof and the facades), the less energy is consumed within. The use of insulation in both existing and new buildings can lead to a radical reduction in energy consumption, and strong insulation measures are easy to implement since insulation materials are among the most economical of building components.

B7. PITCH AND LANDSCAPING

The pitch is the main area of the stadium and the primary focus on matchday. It is of paramount importance that the pitch is always in optimal condition, so the stadium must be designed to provide the correct amount of natural light and ventilation. Furthermore, the most sustainable landscapes adapt to the surrounding environment, incorporate suitable species, contain water, and ensure that recycled water is used on the pitch and other green areas. This section will cover the following topics:

PITCH COMPOSITION

MAXIMUM LIGHT AT PITCH LEVEL

AIRFLOW

WATER

FERTILISER

PITCH COMPOSITION

The pitch is the primary focal point, both for spectators within the stadium and for those watching on television. The condition of the pitch can influence the quality of the football being played, as well as the risk of injury to players and officials. It is important that sustainability is considered throughout the design and construction of the pitch, without compromising the quality of the playing surface.

The pitch is the main area of the stadium and the primary focus on matchday. It is of paramount importance that the pitch is always in optimal condition, so the stadium must be designed to provide the correct amount of natural light and ventilation.



Stade de Reims, whose roof design allows light to reach the pitch

Football may be played on a fully natural surface, artificial turf or a hybrid. The latter refers to a turf reinforcement system containing a mixture of both natural and artificial materials, which offers better durability but poses problems in terms of the end-of-life disposal

of the plastic elements. When considering the sustainable design and construction of a pitch, as well as sustainable pitch management after construction, the following key points should be considered:

FULLY NATURAL OR HYBRID PITCHES

The species of turf should be carefully selected to ensure that it is suitable for the stadium's location and climate. Attempting to manage a species of turf which is not suited to that specific environment will require unsustainable inputs. Water, light, and nutrient requirements should all be considered when making sustainable choices about turf selection.

Typically, fully natural or hybrid pitches are constructed using a combination of free draining materials (including an imported sand-dominated rootzone) overlying an aggregate or geocellular sub-base. In some cases, the sand-

dominated rootzone can be created by mixing selected sand with organic amendment materials to improve the physical properties of the surface layer.

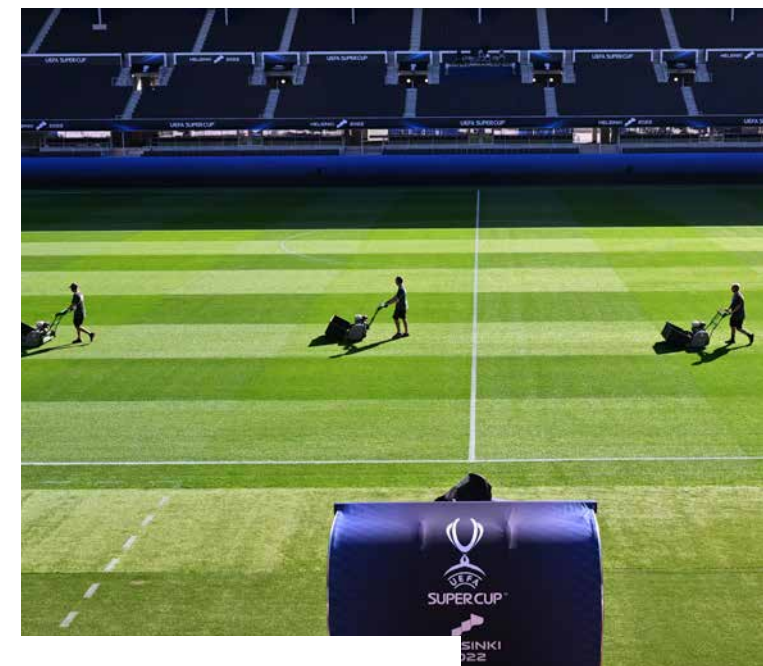
Turf reinforcement systems – also known as 'hybrid' pitches – attempt to combine the playing quality benefits of natural turf with the practical strengthening and engineering advantages of artificial materials. Turf reinforcement systems can be grouped into three broad categories:

- Intact fabrics or artificial turf carpet placed into or a little below the surface, filled with a sand-based material in which natural turf is grown. This type of system lends itself to being used as part of a big roll turf system for the immediate establishment of a playable surface or rapid repair of damaged areas on an existing surface.

- Individual strands of artificial turf fibres, usually 200mm long, stitched vertically into the sand-dominated profile to a depth of 180mm and very close together (typically just 20mm apart), leaving 20mm of the artificial turf fibres above the surface like blades of grass. This type of system is particularly good for maintaining surface smoothness and the appearance of turf once the natural turf has worn away.
- Randomly oriented elastic material or plastic (e.g., polypropylene) fibres or mesh elements that are incorporated into the upper layer of the sand-dominated profile, usually before it is laid but sometimes in-situ. These systems are profile stabilisers and may increase the load-bearing strength and shock absorbency properties of the rootzone.

Key considerations when deciding whether to install a turf reinforcement system in a sand-dominated rootzone and which system to install include:

1. The cost of the system
2. Specific features of the system in relation to the intended use of the playing surface
3. The intended management/maintenance requirements of the playing surface
4. The species of turf grown
5. The longevity of the system (can it be easily renovated?)
6. The cost of disposal (is the product classified as hazardous waste?)



The pitch gets prepared by greenkeepers for the UEFA Super Cup Final 2022

Locally sourced materials should be utilised where possible to reduce transport distances and minimise the overall carbon footprint of the imported materials. Consideration should be given to the choice of amendment materials to ensure that they are from a sustainable source with a low environmental impact.

The design of the pitch profile should be carefully balanced to ensure that the profile is well drained, while at the same time providing a degree of water and nutrient retention to reduce the requirement for water and nutrient inputs and the risk of washing nutrients through the pitch profile. Laboratory analysis of all materials (sand, gravel, etc.) used to build any pitch is essential to ensure that materials with the right particle sizes are used. Specialist advice should always be sought.

ARTIFICIAL PITCHES

Artificial pitches are typically constructed using a combination of aggregates, binding materials, specialist artificial turf products, infill materials and, in some cases, shock-pads. Care should be taken to ensure that the suppliers of the specialist materials are embracing improved technologies around sustainability.

Where possible, materials should be sourced locally to minimise their carbon footprint and environmental impact. The use of recycled aggregates should be promoted, as they will often be processed close to the stadium and their reuse will prevent them from going to landfill.

The specialist infill products used in the construction of artificial pitches, which are designed to provide suitable playing characteristics,

have historically been comprised of polymeric materials (rubber and plastic) which are classified as microplastics and are harmful to the environment.

Such materials are currently under scrutiny at EU level, with a ban on the use of polymeric materials such as styrene-butadiene rubber derived from end-of-life tyres and other intentionally added particles falling under the definition of a microplastic.

There are various recycled and sustainable organic infill products on the market, including cork, olive stones, coconut husk and grated tree bark. Consideration should be given to those alternatives, depending upon the intended use of the pitch. The industry is also working on 'non-filled' systems in order to eliminate all infills where possible.

These systems currently exist on the market, but do not yet meet the playing quality criteria required to achieve a FIFA Quality or Quality Pro certificate, which is currently used as a benchmark for many competitions, including UEFA's flagship competitions.

When considering the use of hybrid or artificial pitches, the end-of-life disposal requirements should be considered from the outset. End-of-life options should be evaluated to determine the most sustainable and environmentally considerate options available.

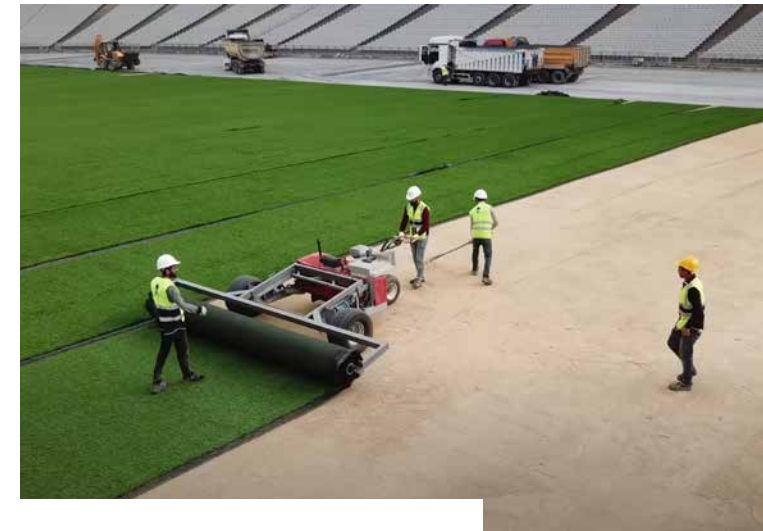
Artificial turf carpets and the fibres used in some hybrid systems are made from a mixture of plastics and polymers, and these materials can potentially be recycled.

Most commonly, this takes the form of mechanical recycling; however, new technologies around chemical recycling can be used in conjunction with mechanical recycling to produce recycled products for a wider range of applications. Ultimately, the aim is to be able to produce recycled polymers of sufficient quality to be used in new sports surface products.

As regards the infill, the sand can be separated from the artificial turf and other infill materials. It can then be washed and sieved, before being reused either for artificial pitches or other applications.

Non-organic performance infill materials such as end-of-life tyre granulate can be reused in some situations; however, their suitability for reuse should be assessed on a case-by-case basis.

In most instances, organic infill materials are biodegradable and can be disposed of through composting. There are various end-of-life options for shock pad materials, including recycling and recovery.



Hybridgrass Implementation for the UEFA Champions League Final 2020

MAXIMUM LIGHT AT PITCH LEVEL

(ROOF DESIGN) AND POWER SUPPLY

The best solution for a grass pitch is to have no roof limiting the amount of natural light that reaches the grass. However, most stadiums have full roofs to ensure the comfort of spectators in both cold and warm weather. A roof that fully covers all the seats in the stadium will always result in the grass getting less natural light.

With this in mind, rigorous studies are needed to design a roof that allows more light to reach the pitch. Roof materials need to be selected with light transfer in mind, and designers may consider translucent roof materials to allow maximum light penetration and ensure the least shade on the grass in the daytime.

The need for lighting is heavily dependent on the geographical location of the facility; for example, the number of hours of sunlight each day differs greatly between northern European and Mediterranean countries.

Where natural sunlight is limited and active supplementary lighting measures are required, consideration should be given to the power requirements of the technology utilised. Careful planning regarding the procurement of the grow-light system and its usage should be carried out based on detailed light modelling via HemiView Analysis. This will determine the exact light requirements in each area of the pitch.

Education of the end user and attention to detail is critical. Proper and planned use of supplementary light systems will provide significant

cost savings and environmental benefits relative to non-targeted deployment. Traditional grow lights contain high-pressure sodium (HPS) lamps, whereas more modern versions are based on LED, which are more energy efficient. However, LED lights are not appropriate for certain climates due to the lack of heat produced. Professional and independent advice should be sought before investing.



National Stadium, Warsaw

POWER SUPPLY

A stadium pitch will require power for various infrastructure elements, including supplementary lighting systems, undersoil heating systems and vacuum and ventilation systems. In many instances, these infrastructure elements are necessary and cannot be replaced by passive alternatives.

When designing and building a stadium, careful consideration should be given to ensuring that these technologies are as efficient as possible.

For example, supplementary lighting systems using LED technology can be a good alternative to HPS lamps, helping to reduce energy usage.

AIRFLOW

Airflow is required at pitch level to ensure the health of the turf and help reduce the risk of turf diseases.

Natural ventilation should be encouraged wherever possible to reduce the requirement for energy-intensive ventilation systems and supplementary technologies such as pitch side fans.

Where natural ventilation is limited, there will be a need for active measures to promote pitch-level airflow to reduce the risk of turf diseases, as well as a need for chemical plant protection products, which may be harmful to the environment.

WATER

Water is the essence of plant growth and is an essential source of life for any landscaped development. Responsible and controlled use of water is the main sustainability requirement to ensure high-quality landscaped areas with reduced water use.

Successful sustainable landscapes can be designed, installed, and managed to conserve water, lower the rate and volume of run-off water from rain and snowmelt, and reduce the number of pollutants reaching surface water. Water is a scarce commodity, even in countries with adequate rainwater, and society needs to be educated from an early age to ensure respect for water and responsible use of water.

When it comes to sports facilities, we are not just looking at the pitch itself; we are thinking about all the surrounding areas, such as the gardens, trees and shrubs which are designed to enhance the facility and create a comfortable environment.

For fully natural and hybrid pitches, water is critical to maintain healthy grass, stabilise the pitch profile and moderate playing conditions. Water is also required on artificial surfaces to moderate playing conditions and, in certain circumstances, cool the surface and infill materials.

Consideration should be given to an integrated sustainable water management strategy as part of a precinct-wide approach to reduce water usage and optimise efficiency. Wherever possible, water draining from the stadium's precinct should

be captured for reuse, including pitch irrigation. Many stadiums around the world now incorporate geocellular crate systems instead of a conventional aggregate sub-base layer. These can provide water storage and passive irrigation from below, which can be up to 40% more efficient than pop-up sprinklers alone.

RAINWATER HARVESTING

Surface rainwater can be collected using harvesting systems like those deployed on stadium roofs, with the water being collected and taken to holding tanks around the stadium. This will allow the water to be used for non-potable requirements.

Reusing water can help the stadium to meet some of its water demand, delivering sustainability and climate

resilience benefits, reduce the volume of water leaving the area and reduce the volume of attenuation storage required. Reused rainwater from trafficked areas (i.e., car parks) and water that will be atomised as its end reuse (i.e. irrigation) will need to be treated to the appropriate level.

More sustainable designs will look to strike a balance between collecting water and allowing it to drain naturally into the subsoil (thereby enhancing the local water table below ground).



CASE STUDY

STADE DU MOUSTOIR, LORIENT, FRANCE

At the time of writing, there is only one stadium in France whose pitch is equipped with a system for recovering drainage water from the pitch (thanks to an investment of €100,000 at the time of construction in 2016) – the Stade du Moustoir, home of FC Lorient.

This water is analysed, reprocessed, and reused for the pitch or sanitary facilities.



IRRIGATION

Irrigation involves watering the pitch, and the correct level of irrigation ensures that the field of play is in optimal condition. There are various ways to reduce, or optimise, the use of irrigation water and prevent overwatering. Not only

is overwatering unsustainable, but also detrimental to the health of the turf. The use and source of the water must ensure sustainability, with the harvesting and storage of rainwater representing a good way of reducing reliance on the mains water supply.

The key first step is to understand how much water the turf requires, and to monitor soil moisture content in the rootzone to ensure it is in the optimal range. Thereafter, it is possible to reduce water usage by a combination of techniques, including:

- Reducing the frequency of heavy watering to reduce the amount of water on the leaves that is lost via evaporation
- Programming irrigation cycles to take place early in the morning to minimise evaporation loss

FERTILISER

Fertilisers can be harmful to the environment when surface run-off occurs or if nutrients are washed through the pitch profile into local water systems. Their production can also result in significant CO₂ emissions being released into the atmosphere. The aim of a sustainable fertiliser programme is to produce the healthiest turf possible with the minimum nutrient input possible. A pitch fertiliser programme should be continually reviewed and adjusted in response to soil analysis and as experience is gained in the management of that turf surface.

The frequent application of small quantities of fertiliser on intensively managed turf prevents unwanted flushes of growth, but also significantly reduces the risk of fertiliser leaching into the water system or running – off the surface. To prevent overuse, precise application should be carried out in response to detailed soil testing and surface analysis.



CASE STUDY

CLERMONT FOOT FC,
CLERMONT FERRAND,
FRANCE

Clermont Foot FC's main pitch was re-laid in the summer of 2021 following the club's promotion to Ligue 1. The club opted for 100% natural turf, which is unique in Ligue 1.

The pitches at the training ground are also 100% natural grass. Across all pitches – both the main pitch and those at the training ground – no fertilisers or pesticides are used, and no heating or light therapy is used.

0. SUSTAINABILITY MANAGEMENT

SUSTAINABILITY REFERS TO THE CHALLENGE

OF MEETING THE NEEDS OF THE
PRESENT WITHOUT COMPROMISING
THE ABILITY OF FUTURE
GENERATIONS TO MEET THEIR OWN
NEEDS.

→ **MANAGING FOOTBALL
INFRASTRUCTURE IMPACTS
ACROSS SOCIAL, ENVIRONMENTAL
AND FINANCIAL SUSTAINABILITY
THEREFORE REQUIRES SOUND
MANAGEMENT SYSTEMS TO BE
PUT IN PLACE.**

**THE CORRECT USE AND MANAGEMENT
OF A STADIUM OR SPORTS FACILITY**

Stadiums must not only be sustainable in their design; over 70% of sustainability is in the development and implementation of requirements for the sustainable use of the stadium throughout its lifetime. Potentially the most important aspect of a stadium's sustainability is the way in which it is managed on a day-to-day basis and for the stadium operator to enact the correct protocol on all issues where sustainability can be implemented.

The objective of this guide is to make stadium operators aware of the need to implement a wide spectrum of actions on the issues of reducing water use, energy savings, waste management and the appropriate maintenance and cleaning of the stadium. The use of non-plastics, the recycling of paper and a genuine circular economy in relation to the life cycle of certain items in the stadium also need to be taken into account.

RESPONSIBLE MANAGEMENT

The day-to-day management of stadiums and sports facilities is an area where there is potentially a fundamental need to integrate and manage sustainability guidelines.

Stadiums and sports facilities can be said to be green buildings when they apply environmentally responsible

processes throughout their life cycles. This requires these processes to be implemented not only in design and construction, but crucially in operation, maintenance, renovation and, finally, demolition.

The main aspect of the environmental sustainability of any building, including stadiums and sports facilities, is the management of its operation and maintenance.

The close monitoring of the use of water and energy will ensure efficient, sustainable functioning on a day-to-day basis.

C1. BUILDING MANAGEMENT SYSTEM

A building management system (BMS) or a sustainable facilities management (SFM) approach allows a facility manager to implement operational and architectural changes to reduce the negative impact of their buildings on their occupants and the environment.

This section will cover the following topics:

EDUCATION
IN MANAGEMENT

ENERGY REDUCTION
IN BUILDINGS

WATER REDUCTION IN
BUILDINGS

One of the main decisions sports entities need to make is to establish a coherent management policy towards sustainability application in their buildings and facilities. Entities need to develop facilities management manuals that introduce all possible sustainable systems to reduce energy and water consumption.

The final objective of any facility manager is to define the procedures whereby buildings will, both in the short and long terms, have a reduced or even neutral impact on the environment. This may require structural changes to everyday work methods, and even adaptations of the structure and format of the buildings themselves. Managers of sustainable facilities will look to construct a place for work and play that is healthy for people and the planet, striving to achieve a positive impact on the environment. This is achieved by creating a more energy-efficient workplace through reducing, recycling or reusing resources which will, in the long run, create a reduced carbon footprint.

EDUCATION IN MANAGEMENT

Stadium and sports facility managers need to implement consistent educational strategies to introduce the latest sustainability approaches for buildings and campuses.

Facilities management should aim to provide specialised training and education for all staff and even suppliers and visitors. The essence of sustainability must infuse all aspects of the management of buildings.

Individuals must understand the need for sustainable low energy and water consumption levels at stadiums and campuses to achieve carbon-zero objectives over the long term.

ENERGY REDUCTION IN BUILDINGS

Facility managers will be required to define an analytical process to evaluate the existing status of their buildings with respect to energy consumption and the sources of energy use, whether lighting, heating or air conditioning. From this analysis a series of strategies to boost energy efficiency in the building can be proposed, whether through the installation of low-energy lighting (LED) in all areas or the installation of new, more energy-efficient appliances, whether for air conditioning, heating or kitchen use.

Steps can even be taken to self-generate energy using solar panels or even wind turbines. These measures would reduce consumption or could even lead to a net generation of energy.

WATER REDUCTION IN BUILDINGS

Facility managers must endeavour to reduce water use by introducing sustainable practices by means of appliances with low water consumption. In some cases, appliances that do not use water can be used, such as urinals.

Buildings can even utilise water harvesting systems to collect rainwater from the roofs. This is stored in tanks and used for the building's grey water systems and for watering landscaped areas and plants.



CASE STUDY

GALATASARAY AŞ NEF STADYUMU, ISTANBUL

Galatasaray AŞ have installed a solar roof on their stadium to cut energy costs, even generating surplus electricity.

The club management strategy to reduce energy costs has been a success with the system generating up to 4.2 megawatts from 10,404 PV solar panels, leading to savings of hundreds of thousands of euros per year.

C2. LANDSCAPED AREAS & SMART TECHNOLOGY

This section will cover the following topics:

LANDSCAPED AREAS

SMART TECHNOLOGY

LANDSCAPED AREAS

Sustainable landscape management looks to ensure that all areas outside the buildings are maintained in a manner which ensures low energy and water consumption, both on a day-to-day basis and during events.

The facility manager will need to implement low-energy resources for landscaped areas, for example by introducing LED solutions for paths and pitch floodlighting. Irrigation systems can reduce consumption by ensuring proper drainage and introducing water recovery systems such as rain harvesting and storage. Sustainable fertilisers that are as organic as possible should be used for plants and pitches.

SUSTAINABLE VEHICLES IN SUSTAINABLE SPORTS FACILITIES

Managers of sustainable facilities can lower the carbon footprint of their campuses by reducing or eliminating vehicles which use fossil fuels, resorting to sustainable electric or even hydrogen-powered vehicles.

A sustainable sports campus aims for the comprehensive use of electric or sustainable vehicles, both for movement on the campus and outside. The use of sustainable vehicles can even extend beyond the limits of the sports facility by requiring players and employees to resort to more sustainable means of transport. Many areas of business impose the need to use sustainable forms of transport. Clubs or companies may wish to adopt a sustainable way of life and set an example to society.

MAINTENANCE MACHINERY AND EQUIPMENT

Historically, mechanical pitch maintenance machinery and equipment has been heavily dependent on the use of petrol engines. There are now various electrical alternatives that can be considered, ranging from electric mowers to tractors.

The use of electric equipment is encouraged to reduce carbon emissions, noise pollution and the risk of harmful fuel spills. The most ecological stadiums ensure that all maintenance equipment is electric, avoiding the use of petrol or diesel.

ARTIFICIAL INTELLIGENCE (AI) AND PRECISION TURF MANAGEMENT

Innovative technologies that automatically test a natural turf surface are becoming available.

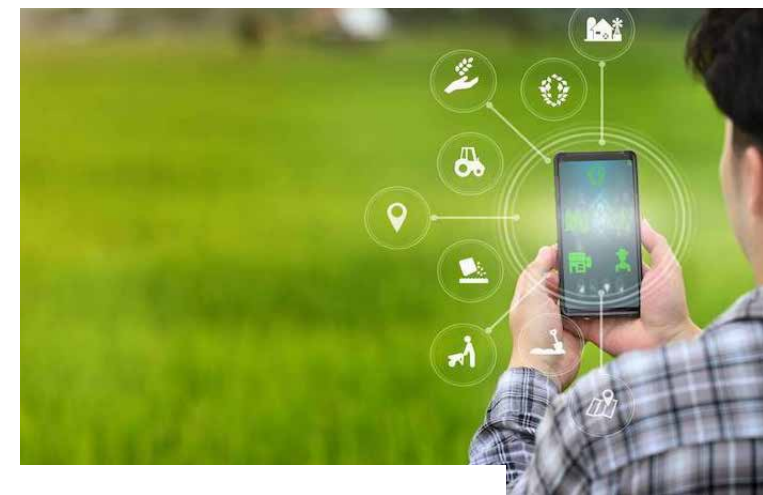
These develop management programmes based on the specific needs of each area. This focused automation should reduce any element of human error and result in significant cost savings and environmental benefits. The pitch is the centre of the stadium and needs specific sustainable treatment using less water, fewer organic fertilisers etc.

DISEASE AND PEST MANAGEMENT

The aim of sustainable disease and pest management is to produce high-quality turf while minimising the use of chemical pesticides which may be harmful to humans and the environment.

Legislation on pesticide use in Europe is becoming increasingly stringent with many traditional products being withdrawn from the market. Integrated pest management (IPM)

is centred around the use the sound horticultural practices, coupled with the use of well adapted grasses to offset the requirements for chemical intervention. Where chemical products are required for plant protection, proper selection and use is essential while ensuring that local legislation is observed.



Artificial Intelligence technology for turf management



CASE STUDY

TOTTENHAM HOTSPUR STADIUM, LONDON

The Tottenham Hotspur Stadium is fully committed to widescale sustainability. The club's ethos is to be "passionate about our planet" and it has set out a strategy which covers areas such as landscaping by planting hundreds of trees and shrubs, waste management and the reduction of single-use items in the stadium. The stadium is seeking to enhance accessibility by using more sustainable alternative forms of transport and non-fossil fuel vehicles.

The club also backs educational initiatives to inspire young people in local communities to embrace sustainable principles. The club has joined the UN Race to Zero campaign and is a founding partner of Count Us In, a movement to mobilise 1 billion people to act on climate change. The club is a member of the British Association for Sustainable Sport (BASIS) which is the sustainability hub for sport in the UK.

SMART TECHNOLOGY

This section will provide a high level overview of existing technology, however due to the speed of development of new technology, it may quickly feel outdated.

- Objectives of a smart technology
- Main characteristics
- Inmotics and home automation
- Internet of Things (IoT)

OBJECTIVES OF A SMART BUILDING

The objectives of a smart building are as follows:

Architectural objectives

Meeting the present and future needs of the building's occupants, owners and operators. Buildings need to respond to the user's needs. However, occupants may change the way they use the building over a relatively short space of time.

Changes in the density of occupation or the reorganisation of floor plans can affect both the architecture and the building's mechanical systems. Smart systems allow this flexibility and will ensure that the new format still maintains the correct level of information management. Flexibility, both in the structure and in the systems and services is the essence of smart buildings. The ability to respond to change is paramount.

Technological objectives

Technology is the essence of smart buildings. Facility managers need to be aware of the latest telecommunications solutions and advances in controlling and managing facility automation. Smart buildings seek to always ensure the availability of accurate information on the comfort of the building (temperature, humidity, solar gain and sunscreens) as well as building security (access control and security zones).

Smart buildings monitor comfort and hygiene systems (HVAC, temperature control, air quality, filters, etc.). Technological solutions can monitor spectator entry and exit counts, analyse crowd movement and forecast possible risk situations. Smart buildings provide information for analysis by managers. Accurate data facilitates decision-making on the efficient, sustainable operation

of the stadium or sports facility and support facilities managers to reach their objectives in terms of:

- Environmental objectives

Smart buildings offer systems to ensure healthy environments and reduce carbon emissions. Smart technology analyses and controls how buildings and facilities react to the environment and monitors the efficiency of all systems in order to achieve energy savings for day-to-day operations and event-day use.

- Economic objectives

Smart buildings seek economic and management benefits by reducing operating and maintenance costs. Information on the building's costs can be analysed in real time with mitigation measures introduced if certain aspects of the installations do not offer the client any economic benefits. Accurate data from smart

systems can be used to ensure the correct and efficient use of the building's systems, in this way extending the facility's useful life.

- Smart building materials

There must be consideration of what materials to use in the construction of a smart building. These materials must respect the environment and be recyclable (e.g. aluminium). Constructions known as 'green buildings' not only feature integral automated systems but are also designed to reduce negative impacts on human health and the environment in which they are built. The structures of green buildings and the processes involved are environmentally responsible; they ensure the efficient use of resources throughout the life cycle of the buildings. The cost savings in the property's maintenance and management must justify the initial investment. The following

features make a building intelligent and respectful of the environment:

- Rainwater collection systems for sanitary use,
- Waste recovery and waste treatment programmes,
- Resource conservation systems,
- The use of environmentally friendly materials,
- The use of plants on facades and roof gardens.

MAIN CHARACTERISTICS

Be efficient in consumption. A smart building features energy and water saving systems. These control supply based on information on consumption. The control system must be fully integrated into the building, centrally automated to optimise operation and administered electronically.

Be safe. Smart buildings are extremely safe and incorporate the most

innovative security systems. Smart technology is now very sophisticated and offers many levels of safety and security for all areas of a stadium or sports facility. Movement monitoring, cameras and even night vision equipment can ensure that the facility management and security staff have full control over possible risks, especially on event days where these risks are most prevalent.

Be flexible. Smart buildings are highly adaptable and allow the implementation of continuous technological improvements over time. Technology is advancing at a very fast rate and smart criteria allow adaptation to ensure the latest systems and programmes are always applied to buildings and landscaped areas.

Be ergonomic. Smart buildings must be comfortable; one of their main

objectives is to make life easier for their occupants. Applying ergonomic considerations can improve the lifestyles of users of the building which encourages an improved and more efficient work ethos in staff.

INMOTICS AND HOME AUTOMATION

A smart building's facilities and systems are controlled and managed by means of inmotics or building automation. Building automation allows the building's general operation to be monitored. It also offers optimal access control and continuous monitoring of individuals entering the building, with the aim of reducing energy consumption and increasing occupants' comfort and safety. A building's operational state and alarms can be monitored and controlled through the centralisation of data and measurement parameters. Building automation

integrates internal home automation features with a networked structure.

INTERNET OF THINGS (IOT)

The Internet of Things describes physical objects (or groups of such objects) with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. 'Internet of Things' has been considered a misnomer because devices do not need to be linked to the public Internet but merely be connected to a network and be individually addressable. The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems and machine learning.



CASE STUDY

STADE VÉLODROME, MARSEILLE

The Stade Vélodrome is the first major infrastructure to be connected to 5G and have a full network of connected sensors that can be managed centrally thanks to IoT technology.

03. EVENT MANAGEMENT

UEFA ESG EVENT MANAGEMENT SYSTEM

UEFA is currently developing a so-called ESG Event Management System, with the objective to: define football sustainability standards based on best practices in football events; to align expected levels of maturity achieved with the UEFA Football Sustainability Strategy 2030; to progressively deploy system in all UEFA events and monitor improvement; and to encourage its adoption by all football event organisers such as national associations, leagues and Clubs.

→ The system is being defined through an extensive consultation, identifying sustainability criteria applicable to football events. It includes the following areas of analysis, each divided into six levels of maturity:

ENVIRONMENTAL

Climate Action;
Circular Economy;
Sustainable Infrastructure;
Spectator Mobility; and
Organiser Mobility

SOCIAL

Human Rights;
Anti-Discrimination;
Equality & Inclusion;
Child & Youth Protection;
Accessibility;
Catering; and
Health & Wellbeing

GOVERNANCE

Good Governance and
Economic Impact

In practice, each football event will be assigned in advance a level of maturity to achieve, ranging from Level 1 (Base) to Level 2 (Established), Level 3 (Advanced) and Level 4 (Excellence). In addition, an aspirational level aims to provide incentives for best-in-class performance. Each level is analysed for compliance with defined criteria, with the verification process taking place at the end of each event.

The FSR division will identify pilot events in which to test the system together with the respective host National Associations, in view of its first formal deployment at UEFA EURO 2024.

The management of a sports facility or stadium becomes a massive challenge when a major event is hosted. Event-day management procedures can be much more intense than the day-to-day management of a building due to the need to establish sustainable criteria for the event protocol as well as considering the many health and safety issues when spectators, possibly in their tens of thousands, arrive for an event. The objective is to ensure that sustainable measures are always implemented when spectators arrive, use and leave the facility as well as for the associated clean-up and maintenance of the facility after the event.

TICKETING AND PAYMENT SOLUTIONS

Ticketing and payment solutions have traditionally used considerable amounts of paper. This is an unsustainable approach for modern

stadiums and sports venues where the use of paper for thousands of tickets, menus, game schedules etc. must be curbed. There is increasingly less need for a spectator to have a physical ticket. Digital solutions reduce the need for paper and the trend is to encourage digital options for both payment and ticketing. Digital tickets are compatible with electronic entry scanners for quick, easy controlled access.

TICKETLESS

Tickets are required to allow access to most sports events, but the use of paper and plastic for tickets and passes is not sustainable. Recent technologies ensure that events can become ticketless to eliminate the need for paper in tickets to gain access. Entrance checks can be done using personal telephones and QR and other digital barcode readers. The information can be

read and processed by the venue operator in many ways. Ticketless access is also more efficient, reducing queueing and improving crowd flows as technology can read and confirm tickets immediately. This also reduces the occurrence of ticket forgery compared to using printed tickets.

CASHLESS

Stadiums and sports venues are increasingly introducing cashless payment systems. Cashless payments are not only technologically efficient but also more hygienic. Cashless solutions are set to revolutionise sports venues. Cashless transactions are convenient for both the user and recipient; they save time and payment apps allow both parties to track the movement of funds in real time. Security is also enhanced as digital payment is always encrypted or validated and it is much safer for individuals not to carry cash.

Various options for payment are available through e-wallets, mobile banking apps, cards and other local systems in different countries.

ADVERTISING

A major source of income for stadiums and sports facilities is active and passive advertising at the venue. Advertising and promoting the main stadium sponsors are vital components of the economics of many clubs and associations.

Good advertising is not only beneficial commercially for a venue but can also address social issues such as education and can even enhance goodwill. In the long run, advertising helps to pay stadium operating costs, support the teams and keep ticket prices lower for fans. Advertising is one of the main financial pillars of sports events and therefore the location and quality of advertising

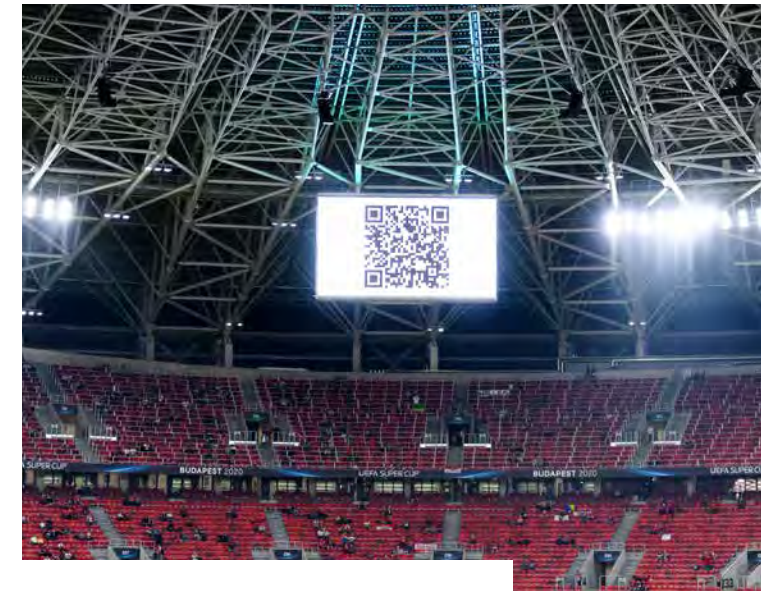
media should be carefully considered in modern venues. This extra revenue improves the economic sustainability of clubs and associations.

BIG SCREENS

LED screens are an integral part of all stadium and sports venue projects. They are key to providing spectators with the information they need at the correct time. The overview of the event at the stadium or sports venue can help to reduce energy use.

LED screens feature advanced digital technology that offers stadium owners many options. The screens display very high-quality images but with very low energy consumption; this makes them extremely environmentally friendly over a very long lifespan. LED screens are programmable to show different content, either as moving images or data and information.

LED screens are perfect for advertising and providing information, including in emergency situations, as they can catch the spectators' attention with their bright, dynamic displays.



Tactical line-ups QR code is displayed on giant screen prior to the match

Content can be developed for different times of the match, with information, messages and displays tailor-made to each venue, allowing the stadium owner complete control over the messages. Content can be controlled remotely from any location, even different cities or countries. Sustainability is enhanced by the long life and low maintenance requirements of digital screens, offering reduced running costs.



Perimeter boards

PERIMETER BOARDS

Perimeter boards are located around the pitch in accordance with precise regulations to ensure the players' safety.

The height of perimeter boards is restricted to ensure optimal visibility for spectators, especially those in the rows of seats nearest the pitch. Perimeter boards are possibly the most popular form of advertising around football stadiums as they can be seen from all camera angles and follow the game in real time.

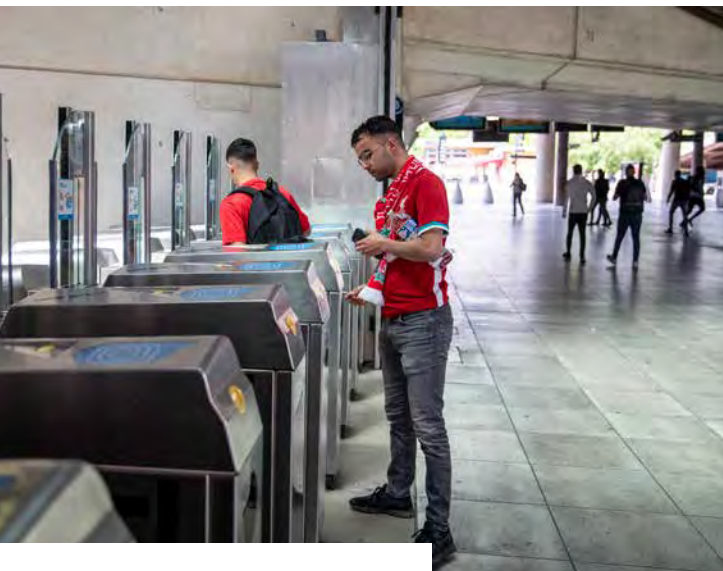
Modern boards not only display static images but can include movement and video content. Perimeter boards can also be used for safety and emergency protocols to inform and direct the public in the event of an emergency.

MOBILITY MANAGEMENT

Mobility management is also often referred as Travel Demand Management (TDM). Public transport is still the most sustainable option for the mass movement of spectators and visitors to stadiums and sports venues. When selecting the site and developing a major sports facility, it is essential to take into account access to bus and rail infrastructure.

Stadium and sports facilities operators must consider access to the venue from public transport, namely from the stations and terminals closest to the venue.

Drop-off areas for taxis and other public transport systems need to be controlled directly and integrated with shuttle bus services from park and ride locations.



Football fans at a train station before the match

TDM criteria need to be developed by the stadium operator and local government to encourage spectators onto public transport and out of their motor vehicles. TDM can be defined as “any action or set of actions aimed at influencing people’s

travel behaviour in such a way that alternative mobility options are presented and congestion is reduced”. The main elements of TDM include the following actions:

- Ensuring the efficient use of road space by traffic management, affording preferential treatment to public transport users, making good provision for cyclists and pedestrians, and implementing parking inspections.
- Reducing the number of vehicles in congested areas.
- Improving public transport infrastructure.

The main challenge for stadium and sports facility managers is to make access by public transport as convenient and efficient as possible, while discouraging the use of private motor vehicles.

THE ULTIMATE OBJECTIVE: SELF-SUSTAINABILITY

Self-sustainability is achieved when a venue becomes fully autonomous of outside supply. This means when all energy is self-generated from sustainable, clean energy sources, (wind, PV panels etc.) and when water is sourced from the site rather than the mains supply, by rainwater harvesting and storage or the use of natural wells treated in the vicinity of the venue.

Sports venue management can develop further concepts of self-sustainability, even extending to the production of food and self-sufficiency in terms of healthy food storage and sales. A self-sustainable entity can also develop waste management to produce fertilisers for the pitch and even biomass energy generation. A truly circular, 360 degrees option is certainly difficult to achieve but could be a goal for future years.

04. CROWD MANAGEMENT

Crowd management involves planning and directing the way the public gathers together at an event and moves at and around the event terrain. Once a facility or a stadium has been constructed, very large numbers of people will gather at the venue on event days, mostly in very short time frames. When designing new facilities, experts must analyse the flow of crowds over different time periods, ensuring that spectators' routes are correctly mapped in view of ensuring a safe and efficient flow of people.

Crowd management and safety issues are often correlated. Reference to the [UEFA Safety and Security Regulations](#) are recommended for specialists readers This section will cover:

FLOWS OF CROWDS

RISKS MINIMISATION

LIMITING THE NUMBER OF
FIRST AID INCIDENTS AND
OUTBREAK OF VIOLENCE

QUEUE MANAGEMENT

SIGNAGE AND WAYFINDING

FLOWS OF CROWDS

The main objective of a responsible facility manager is to ensure safety. This entails managing people through measures which directly or indirectly limit their behaviour, especially at peak times.

An essential part of the design of any stadium or sports facility lies in the correct dimensioning of spaces to ensure optimal flows of people. Facility managers need to put in place the correct people movement protocols to ensure the health and safety of the large groups of people who gather for a sports event.

Creating a steady flow of crowds is paramount. The architecture of the facility must always permit the steady movement of people when coming to and going from the venue.

This may be achieved by correctly dimensioned spaces, barriers which limit the movement of people, and active staff who monitor and adjust the flows accordingly.

Preventing excessively dense crowds from a management point of view means keep a constant check on the movement of people to ensure that the number of fans in any one place at any given time is manageable. The denser the crowd gets, the more difficult it is to manage, and the more likely that emergency measures will be required. Management policies can define how to control and reduce the size of crowds at any time, whether by staggering entry and exit times, managing mid event timings or ensuring that the building has correctly dimensioned spaces for circulation and meeting to ensure a low density of people at all times.

Sports facilities need to implement appropriate measures to monitor and count the flow of people at the venue. Trained personnel should manage this information in real time to ensure the correct flow values and react if limits are exceeded.

RISKS MINIMISATION

Risks should be removed completely where possible. However, if this is not possible, then other mitigation measures should be put in place to minimise negative actions.

Many accidents have occurred due to the inappropriate management of crowds and spectator flows.

Stadium and sports facility managers must ensure that their staff have the best education and training to minimise the risks both for day-to-day operations and on matchdays.

Risk implies that something may occur despite management preparations, hence the need to not only reduce risks as much as possible but also to develop mitigation systems and protocols in the event there is an accident or other dangerous situation.

From the first days of planning, stadiums and sports facilities should implement the correct systems to reduce on-site risks. Steps should be taken to identify all potential risks and hazards, then the probability of the risks occurring should be assessed and the consequences evaluated. Crowd managers will then apply risk ratings and decide on the correct priorities, which enables them to apply the appropriate actions to eliminate or reduce the risk. Responsibility for the different protocols needs to be assigned to specific personnel in the facility,

who will have to manage and train their staff to handle the situations, set deadlines for the action to be completed, and finally record the status of the action until it is completed, hence learning from different experiences.

LIMITING THE NUMBER OF FIRST AID INCIDENTS OR OUTBREAKS OF VIOLENCE

The biggest threat to a facility is physical harm or injury to individuals, either by accidents or the violent actions of visitors to the facility. Sports facilities need to have appropriate areas for the emergency services to deal with safety issues and incidents of injury. Stadiums should have full medical areas incorporated into their designs, fitted out with equipment and staffed adequately to address first aid needs in the event of injury. Furthermore, emergency vehicles

must be able to gain access to manage possible fires or structural issues, and ambulances should be able to attend to treat and transport more serious injuries to hospitals or medical facilities when required.

QUEUE MANAGEMENT

A queue is a line of people waiting for access to an event or to receive a product. It is a moment in time where the demand for access exceeds the capability of access, or a period of waiting before the opening of an event. Queues tend to be perceived as a loss of time or an annoyance while not accessing the desired venue.

Queue management is the implantation of a system which can control and order the customer flow and mitigate the negative effects of time on the visitors. In principle there are two main parameters which

queues administer, on the one hand is the number of channels or lines, and on the other, the number of phases of service. There are therefore four possible types of queue management, where the parameters can take one of two values: single or multiple, such as:

- **Single channel, single phase** implies that there is only one server, and the users have only one queue to wait in. The efficiency of the queue depends on the efficiency of the server and the means they have to be available to serve.
- **Single channel, multiphase** is a one server with a multistep servicing process.
- **Multichannel, single phase** is where there is one service, but with multiple channels, or servers with a one-step servicing process.
- **Multichannel, multiphase** has several servers to the queues and a multiphase serving process.

Each of these queueing systems is available in the access and egress of most sports facilities and sales points, from simple kiosks for merchandising to the access of spectators to different gates. The ideal of queue management is the elimination of queues. However, queues are a common phenomenon so there needs to be a controlled way to enhance the spectator experience in queues while minimising the time spent waiting.

The formation of queues depends on four main aspects, namely the customer population, the number of spectators arriving at the venue and the method of arrival, which can be in groups or individually.

The next element is the service mechanism which means the number of servers available at any one time, and their ability to reduce the queue

times. Finally, there are the queue characteristics, which refers to the queue discipline and behaviour of the customers.

In modern facilities there is a need to consider the latest ways to manage queues, both by active and passive systems, and taking advantage of the latest technology available on the market. Time is the most important consideration to customers, and the shorter the queue and better organised the queue management, the better will be their experience at the venue. The objective of a queue management system is to afford access or service as quickly as possible with seemingly minimal effort while avoiding any stress.

A successful queue management system seeks to reduce the actual and even perceived waiting time, endeavouring to eliminate the

possibility of joining the wrong queue, informing visitors of their real-time status in the queue and allowing them to use their queueing time productively.

SIGNAGE AND WAYFINDING

It is vital that the public who access a sports facility or stadium have the correct information to move around the venue and get to their destination without trouble. They also need information in order to access other areas of the venue, such as toilets, restaurants etc., and clear indications of safe evacuation routes in the event of an emergency. This is managed by clear signage and wayfinding systems.

Effective signage and wayfinding systems will ensure that visitors will be correctly directed towards any destination, from the very beginning of the spectator experience to the final location. It will also serve to

develop a brand or a spectator perception of the sport venue individuality, through graphics and logos to individualise the stadium or the facility. Obviously the most important benefit of wayfinding is letting people know where to go, and not get lost. People need to feel the comfort that they are being led clearly to their destination in the best and safest manner possible. It also brings the need for customer familiarity, where visitors need to feel comfortable in their purchasing journey, and to understand how to engage different spaces.

Good wayfinding can also develop and extend the facility's brand. Signage can be graphically pleasing and enhance the individuality of the venue, offering accurate, easy-to-follow guidelines in an appealing design format.

Finally, wayfinding is essential for health and safety especially where there are large crowds. A system is required to indicate directions to disperse people in a safe and orderly manner.

Modern wayfinding can be static or digital, where the latest technologies offer facilities a way to interact with the spectators, and even change instructions or directions in real time to improve the information on movement offered to people at the venue better the quality of the need to indicate to people the directions or way to move.

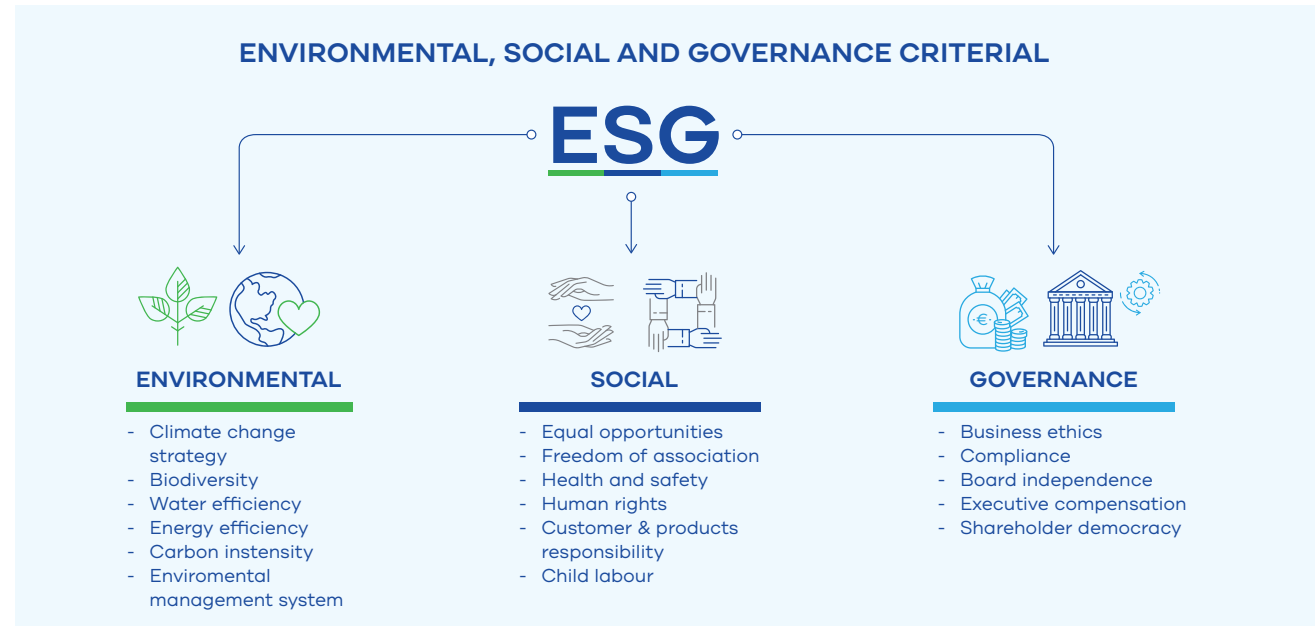


Stadium map signage

C5. AUDITING

Sustainability auditing is used to compare a stadium or sports facility's sustainability protocol with best practices for sustainability. The audit can be relatively simple, but regular monitoring of the sustainable features of the venue will show the real value of savings in water, energy and even social matters and behaviour.

Audits can be carried out monthly and made public to illustrate that the venue is embracing sustainability, with the publication of real figures showing how sustainable it is, and how, through long-term sustainability actions, these figures become even better over time, right up to obtaining



the desired zero-carbon status. Audits can be carried out internally, by external registered auditors or even by official government entities. They can focus on different aspects of sustainability, such as environmental compliance, environmental management and functional environmental issues, and can also be extended to social and safety aspects.

There are several benefits of regular sustainability audits for a stadium or sports facility. These include having an overview of water and energy savings or production, enhancing appeal to customers, presenting better social values, building up employee and staff loyalty and pride in the venue and ensuring compliance with local and national regulations.

06. CIRCULAR ECONOMY AND WASTE MANAGEMENT

Circular economy is a concept that has interconnected ramifications on climate change, biodiversity, pollution, conflict minerals and socioeconomics.

For more information and guidance about the circular economy, refer to [UEFA Circular Economy Guidelines](#).

In this section we will focus on:

CIRCULAR ECONOMY CONCEPT

4R FRAMEWORK:
REDUCE-REUSE-RECYCLE-
RECOVER

FOOD & BEVERAGE

CIRCULAR ECONOMY CONCEPT

The objective of a circular economy is to radically reduce:

- the use of raw materials for the manufacturing process of products;
- the amount of plastic discharged, and food wasted;
- the impact on nature.

Society has traditionally followed what is now commonly known as the linear model – Take, Make, Waste – which is not sustainable within a finite environment. Natural resources have for too long been believed to be infinite; as Sir David Attenborough said: “Anyone who believes in indefinite growth on a physically finite planet is either mad, or an economist”.

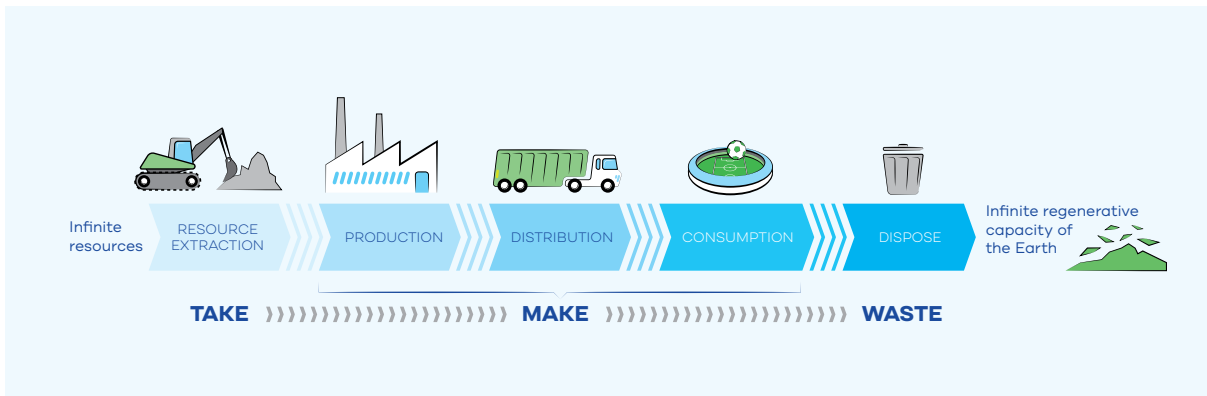


Diagram illustrating the linear economy

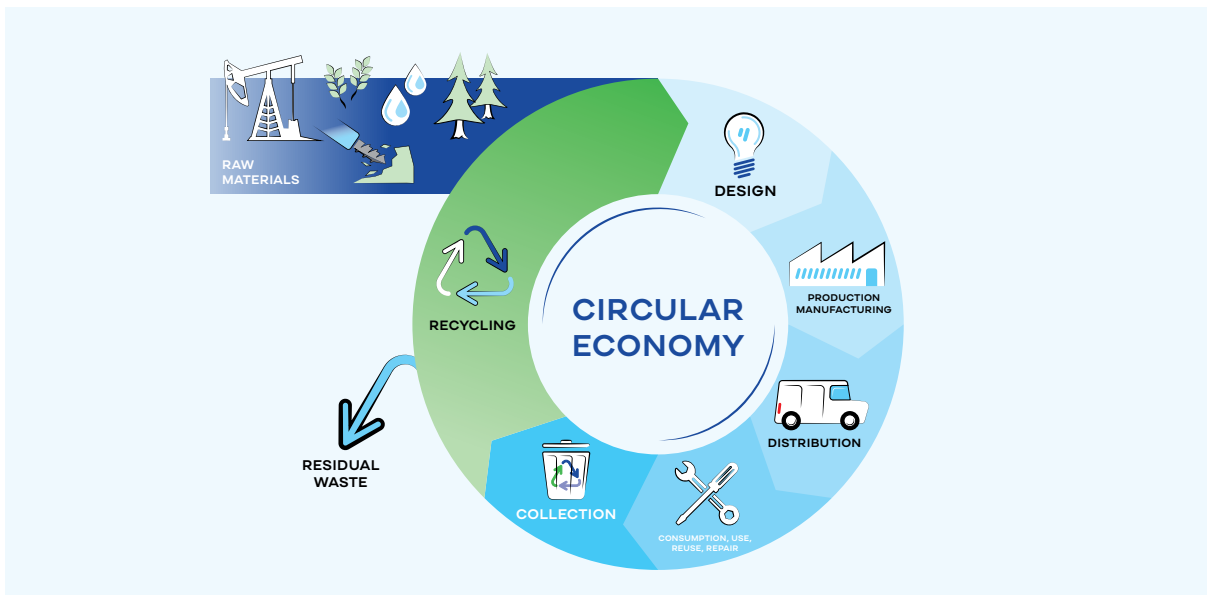


Diagram illustrating the circular economy

Circular economy is one of the 11 policies deployed by UEFA's FSR team in its Strength Through Unity strategy, whose mission is to inspire, activate and accelerate collective action to respect human rights and the environment within the context of European football in line with UEFA's fifth strategic pillar, 'Responsibility'.

In contrast, the 4R methodology – Reduce, Reuse, Recycle, Recover – addresses efficient waste minimisation, one of the pillars of the circular economy. Education is needed to create a new awareness in society whereby the disposal of any element is questioned and reviewed at every stage of the value chain.

In this model, an unwanted product may become a resource that can be given new life by being reused or transformed into a new product. Innovative designs and recycling techniques make it possible to separate the components of unwanted products for transformation and reuse.

4R FRAMEWORK:

REDUCE - REUSE - RECYCLE - RECOVER

Stadiums produce massive volumes of waste and must adopt various strategies to manage this waste and ensure that it is recycled. Sustainable waste management is one of the pillars of the circular economy, so it is essential for each sports facility to put in place a sustainable protocol for all waste produced.

This means ensuring that waste is collected, sorted, treated and recycled correctly so that as much as possible is reused, thereby extending the life of the constituent materials. It can also entail a reduction in the amount of waste produced, for instance by using less packaging for items sold in the facility and in particular using less plastic, opting instead for more easily recyclable alternatives. Responsible waste

management benefits both society and the environment, and it can also offer economic benefits.

EXAMPLES OF THE 4R FRAMEWORK IN PRACTICE

Reducing the use of paper

Sports facilities should try to reduce their reliance on all kinds of paper, for example by eliminating paper copies of documents and sharing information digitally. Some ways of reducing paper waste are to stop print physical tickets and brochures, provide electronic receipts for payments, and reduce the quantity of paper cups and packaging used in concessions.

Reusable items

Efforts should be made to use reusable items in catering areas rather than single-use paper or plastic cups, forks and plates. Even though cleaning reusable alternatives implies water consumption, it is essential to avoid disposable single-use items.

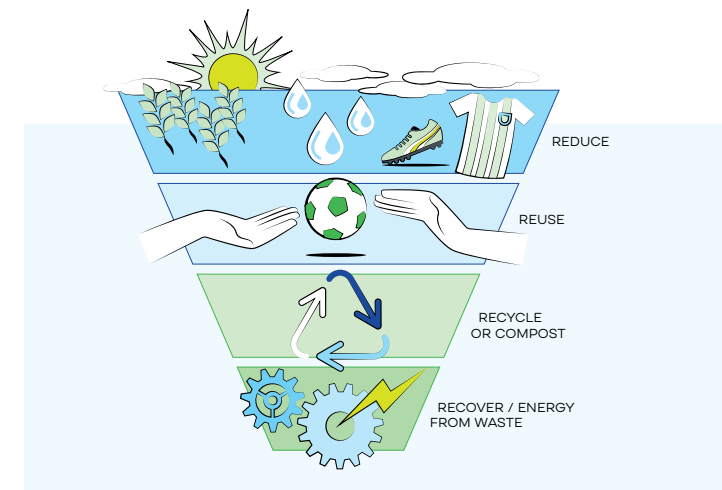


Diagram illustrating the 4R inverted pyramid

Organic waste and compost

Events often generate great amounts of organic and non-organic waste (e.g. packaging). Facilities may be able to develop processes to compost organic waste from food and landscape maintenance on-site. Composting is a microbial process that converts organic material into an organic soil compost that can then be reused as fertiliser on landscaped areas, or even on the pitch. Composting, which has been done for many centuries, is a natural and sustainable way of bringing organic nutrients to the facility's plants and shrubs.



CASE STUDY

THE PARC DES PRINCES, PARIS

Paris Saint-Germain FC's stadium, the Parc des Princes, uses organic waste to produce compost for the pitch. Some of its food waste is also used as chicken feed, and the club even has a beehive and vegetable garden used by employees, residents and neighbouring schools.

Recyclable products and packaging

In modern stadiums for which concessions and the sale of products are major sources of revenue, many products are sold in packaging made from plastics or other unsustainable materials. Controlling the waste from packaging is essential in a sustainable management system. The objective of recyclable packaging needs to lie in the resourcing of new packaging systems which are made from materials which can be used again, either directly or after certain processing systems.

Sustainable packaging can be made from such recyclable materials as glass, metal, card, paper and certain new types of plastic. The most common form of recyclable packaging is corrugated cardboard. It is advised to include labelling showing how the packaging should

be recycled to increase the chances that it is done. The main objective is zero waste, which is where all the materials are utilised, reused, or recycled, leaving no waste product. This can be achieved by using various innovative solutions to make the process of packaging into a zero-waste system.

Food banks

Stadiums and sports facilities produce and prepare great amounts of food for spectators and visitors. The food is usually produced on-site, and sometimes surplus food remains after the event. Food banks are usually non-profit organisations that will arrange to collect the donated food and will then distribute it to people in need, either in the local community or on a national level. It is recommended to adopt such a solution so that excess food is not

thrown away but rather goes to less fortunate people who do not have easy access to our main food sources. However, local regulations will need to be checked as in some countries it may not be permitted to donate food for health and safety reasons.

Single-use plastics and reusable materials

It is extremely important to reduce or eliminate the use of single-use plastics and other similar packaging systems. The waste that these materials generate is highly contaminating and difficult to eliminate. Many major users of plastics are now looking to revert to reusable products or alternative materials that can easily be recycled, such as paper plates and cups. Single-use plastics are one of the main contaminants of the land and sea and take many hundreds of years to break down.

WASTE MANAGEMENT AND RECYCLING

Sustainable waste management means controlling waste and implementing the most effective methods of collecting, transporting, sorting and disposing of different waste elements in order to achieve a system that does not jeopardise the environment or human health and to provide a better world for future generations.

Sports facilities can reduce and manage their waste in many different ways. One method is to consider the number of materials used in the stadium, choose a few to focus on, reduce that waste, and try to reuse as much as possible. The most popular types of waste management are recycling, incineration, landfill, biological reprocessing and animal feed. Donating waste to support local sustainable agriculture is also an option, as is donating leftover food products after matchdays.

Recycling bins

In recent years, recycling bins designed to promote waste sorting have become commonplace in all areas of consumption, from residential to offices.

We all need to get used to identifying types of waste and processing them correctly. This requires a number of different bins to be installed to ensure that the specific content of each bin is then taken to the correct specialist installation in order to be recycled.

The main bins available in most commercial and institutional facilities:

- **E-waste:** for any waste from electronic appliances and systems
- **Plastic:** for any waste manufactured from the different types of plastic
- **Metal:** for any metal objects and any elements made solely from different metals, such as tin
- **Glass:** for glass bottles, jars, etc.
- **Paper:** for all types of paper and cardboard, especially packaging
- **Organic:** for waste from food or other organic sources, which could even be used for compost



FOOD AND BEVERAGE

All major events in stadiums and other sports facilities involve offering the spectators food and beverages (F&B). Management the supply and recycling of these elements needs to become a substantial part of the matchday protocols applicable to all events.

The sustainable management of F&B in any sports facilities requires a detailed analysis of the sources of all products and an understanding of their production and growth processes, the use of fertilisers or organic and sustainable products to aid growth. F&B suppliers should pay attention to their carbon and environmental footprint and should make efforts to reduce waste, pollution and emissions to minimise their impact on the environment.

In recent years, the public has become more aware of the need to purchase organic and sustainability-controlled products, even though they may cost more.

The main objective of sustainable food production and distribution lies in the responsibility of society to monitor the production, the supply and the consumption of safe and nutritious food within an economically viable industry that protects and enhances our natural environment and betters quality of life, both now and in future years.

One of the UN's SDGs is to ensure food for all people, and hence producers need to maintain the correct conditions to ensure fertile land and a steady supply of clean and non-contaminated water while using sustainable and organic fertilisers and minimal energy and water.

USE OF ORGANIC FOOD

The use of organic food in stadiums is recommended as this ensures low energy consumption, low water consumption, and low or no use of fertilisers during production.

Moreover, organic food is often produced locally, which reduces the carbon footprint associated with its transportation. Care needs to be taken to ensure the correct supply of organic food to the stadium and to raise awareness of the benefits of organic food among the community.

USE OF LOCAL PRODUCTS

A policy of using locally produced food wherever possible has many advantages and reduces the need for transportation. Local products can also enhance the perception of stadium among the local community, because the food is delivered locally and produced by local neighbourhood

partners. This is even more beneficial if the food is produced using organic methods, with fertiliser-free compost and accompanied by a certificate of sustainability.

HEALTHY FOOD POLICIES

Good food policies are certainly needed in sports facilities. There are many different approaches to nutrition that can help to ensure healthy and high-quality F&B. The nutritional needs of sportspeople must be carefully studied and meal plans must be tailored to each individual and the requirements of their sport.

All facilities should establish a healthy food policy with a view not only to ensuring that people eat well, but also to reviewing the source of the food and being sure that it has been developed sustainably. The use of organic waste, of any fertilisers

and of unnatural additives should be disclosed on packaging to ensure that athletes are able to understand the content of the food and be aware of any additives that may be harmful to their bodies or may even violate national or international rules.

Eating habits and diets are often culture-specific, but in most countries there is a healthy local diet that could inspire the food choices offered in sports facilities.

CATERING

Catering is widely used in modern stadiums and sports facilities to supply staff and spectators with food, and it is an area where sustainability and healthy eating can be promoted, for example by making use of eco-friendly menus.

Catering can be a source of energy use, either gas or electricity, and

more importantly it is a generator of food waste. Sustainable catering involves the production of the food on-site as well as menus that require low energy consumption.



Staff Bistro Area



"Just Eat" packaging during the UEFA Women's Champions League Final 2021/22

CARE IN PACKAGING

Packaging is a key element of circular economy policies. In recent years, both consumer and political perceptions have focused on the need for responsible packaging and the concepts of reducing, reusing, and recycling have become embedded in sustainable societies.

Sustainable packaging starts from the correct design of the package to be recycled. Although some studies have found that the use of energy and resources required to reuse a package is more than in the case of non-reuse, these issues are being resolved, and developing a closed loop system is still preferred.

The emphasis should be on reuse and avoiding the single-use concept as much as possible. Sports facilities should look to employ reusable items

such as cups, bags, bottles and other containers that can be cleaned and fully reused many times.

New materials are being developed to steer away from fossil fuel derivatives (plastics) into new areas such as bioplastics, although producing a sufficient supply to meet the demand for packaging may be an issue. Sustainable paper packaging is increasingly being used as a substitute for plastic and it is fully recyclable, but care is needed to avoid excessive forest or wood reduction.

One of the simplest ways to ensure packaging sustainability is to eliminate the need for a product to be packaged altogether if it is not required to protect the food or keep it fresh.



CASE STUDY

STUTTGART ARENA, GERMANY

Stuttgart Arena in Germany has implemented a new catering concept to offer healthy food, in particular by cooperating with vegan brands such as Veganz. The emphasis is on regionality, innovation, freshness and sustainability, with a clear commitment to reducing carbon.

Meat will be reduced to 30% of available options by 2030 and the club is developing a product portfolio of more vegetarian and vegan food. All packaging materials will be 100% renewable, biodegradable or recyclable.

Food sharing and a protocol to reduce food waste are also being studied and implemented in the stadium.



CASE STUDY

PARKEN STADIUM, COPENHAGEN

(F.C. COPENHAGEN AND THE
DANISH NATIONAL TEAM)

Few soccer grounds can boast a restaurant with a Michelin star, but Geranium, located on the eighth floor of Parken Stadium, has two. Not only that, but chef Rasmus Kofoed won the gold medal at the Bocuse d'Or in 2011, and his restaurant was named 45th on the [World's 50 Best Restaurants](#) list in 2013.

Appropriately for a restaurant with such a glittering array of honours, Geranium shares its home with F.C. Copenhagen, one of Denmark's most successful club sides, as well as the Danish national team, which won the UEFA European Football Championship in 1992.

07. CASE STUDY OF A TRAINING FACILITY



INF training facilities,
Clairefontaine, France

There are many examples of good practice in stadium management, especially during events, that consider the consequences for crowd and waste management. In contrast, training facilities are used 365 days a year by many teams, from professional to academy and youth.

The case study below offers an extensive examination of the **French National Football Institute (INF) at Clairefontaine**. It is a good example of a sports facility, large campus, landscaped areas, training pitches and buildings for use by national football squads. The Campus has effectively considered sustainability issues, including:

CONSTRUCTION

Construction of a low-energy building

The intensity of office lighting varies according to outside luminosity in line with High Environmental Quality guidelines. Modern smart systems monitor the light levels in buildings and adjust the lighting at different times of day and in the darker seasons. This system reduces the energy consumption in offices, only using what is required at any given time.

Garage for recharging the electric golf carts used at the centre

The facility has special storage and recharging areas for the golf carts used at the site. This ensures that all sustainable transport is fully charged and ready for use.

Change to LED lighting (outside paths, buildings and covered areas)

The change from conventional lighting fixtures to low consumption units has resulted in a considerable reduction in energy consumption. The INF training centre has made cost savings as a result.

Installation of water flow reducers

In line with sustainability guidelines for reducing water consumption, the facility has introduced fixtures and fittings to reduce water usage, keeping consumption as low as possible.

SERVICES

Energy consumption reduced through awareness campaigns (staff and public)

The INF facility has sought to implement educational measures to embed sustainable issues in the staff ethos, in this way encouraging

measures to avoid excessive or unnecessary energy consumption.

Major reduction of the use of plastic bottles in the restaurant with replacement by filtered water jugs

The centre has reduced the use of disposable plastic bottles. Filtered water jugs are now used instead.

Replacement of single-use cups with 100% reusable cups

The facility has reduced the consumption of non-reusable paper items with the introduction of fully reusable cups.

Acquisition of a fleet of electric golf carts and reduction of the use of petrol vehicles to a strict minimum

The introduction of a sustainable mobility strategy has led to the use of electric vehicles at the facility, in this way reducing the carbon footprint for day-to-day on-site transport.

Recycling and recovering coffee pods

An educational campaign to encourage the recycling of coffee pods has been a successful aspect of the facility's waste management policy.

Management of food waste

(awareness campaign + monitoring average weight of food waste with objectives + use for biofuel production)

The implementation of educational strategies in the facility to ensure the better management of food waste, has also brought health and wellness benefits to the facility's users and staff of the facility.

The use of natural cleaning products whenever possible

Sustainable cleaning policies involve chemical products that are less environmentally harmful, in this way reducing water pollution and waste.

The use of autonomous electric mowers for pitches and grass areas

These mowers have a reduced carbon footprint and do not require human intervention. Robot electric mowers can be programmed to cut the grass when no one is in the facility.

Replacing individual shower gel sachets with a bulk system

This measure reduces the quantity of shower gel used and eliminate the need to dispose of packaging.

Beehives for local honey production

This is a very unusual strategy for the sustainability of a sports facility. However, this self-production policy is a valid approach.

Honey is an excellent product and requires a healthy surrounding environment for the bees to gather nectar. While the honey is not a major product, the statement

of having beehives implies a significant commitment to social and environmental sustainability.

MANAGEMENT

Installation of electricity submeters for each building and the use of software to oversee electricity consumption by zone

The use of electricity submeters allows the facility to monitor each building's power consumption and ensure optimum electricity use.

Programming the BMS for lighting in administrative buildings

Energy savings can be achieved by introducing schedules for the facility's lighting. Different dawn and dusk times can be set and lights turned off when not required late at night. The centralised management of both internal and external lighting can

result in substantial cost savings. Heating set points are defined for each building (maximum temperature)

Installation of movement detectors to activate the lighting in the common areas of the accommodation buildings

This system switches on lights only when people are in the area and can be detected by their movement. The lighting is not used if there is no movement of people in the vicinity of the lights. The removal of the need to turn off lights manually means that areas are only lit when people are moving through the building or landscaped area.

Timed programming of external walkway lights

Lights are switched on and off depending on the time of day, outdoor luminosity and movement sensors triggered by passers-by.

1. HEALTH AND SAFETY

HEALTH AND SAFETY AT ALL FOOTBALL FACILITIES IS OF PARAMOUNT IMPORTANCE

UEFA WORKS WITH ITS PARTNERS
TO ENSURE SAFE, SECURE AND
WELCOMING CONDITIONS FOR
ALL FOOTBALL MATCHES HOSTED
ACROSS EUROPE.

More information is available via UEFA's website detailing the [Stadium and Security Strategy and Development Programme](#). Please also refer to the [UEFA Safety and Security Regulations](#) for further information on this topic. The content of this section is targeted at a more general audience than health and safety specialists.

D1. HEALTH & WELL BEING

All sustainable projects aim to produce a much healthier society, one which cares for people and the environment. Sustainability in architecture requires buildings and facilities to be developed following optimal health guidelines, ensuring that not only the building, but the perception of the buildings is that of 'healthy architecture'. This section will cover:

GOOD HEALTH AND WELL-BEING
EMERGENCY HEALTH MEASURES
FACILITIES MANAGEMENT
PROTOCOL
VERTICAL CIRCULATION
NO TO SMOKING

GOOD HEALTH AND WELL-BEING

To provide positive health measures, the design of stadiums must take health issues into account, incorporating healthy design measures. Toxin-free materials must be used to reduce the risk of health problems, such as asthma and cancer. Green stadiums also go through a commissioning process that reduces other safety hazards, such as fire risk.

Architecture, and especially sports architecture, needs to develop new ways of expression to adapt to contemporary society and create healthy buildings. In this updated approach, architecture, and the implementation of healthy methodologies and protocols, ensure that the perception of the facility or building is that of a healthy environment. Architecture has always been an expression of the time in

which it is developed. In many cases, there is evidence of how modern architecture has adapted to change, even in the event of illness and plague. In this process where we need to adapt to new dangers, we should not lose sight of the fundamental requirement to bring groups of people together in society and the need for major leisure destinations, such as stadiums.

Healthy materials: The correct selection of construction materials is an important consideration in counteracting germs and viruses. Certain materials discourage the persistence of viruses and can be easily cleaned while other materials allow germs and virus to linger and even propagate. A fundamental part of modern stadium design is the selection of suitable materials and the addition of appropriate cleaning actions to facility management protocols.

EMERGENCY HEALTH MEASURES

The solutions brought to the table should not be detrimental to human relationships and the population's use of public and private spaces. There should also be acknowledgement of the need for leisure and one of society's favourite pastimes, namely going to a stadium to support one's team or country.

The experience of movement restrictions in response to the COVID-19 pandemic illustrated the need to maintain social communication between different services and to ensure delivery to the final consumer.

Stadiums need to respond promptly to the new needs of society, adapting their constructions to make them safe, healthy destinations. This is extremely difficult in spaces where tens of thousands of people gather, but there are many common-sense measures that

can be implemented at a reasonable cost. These will bolster the perceptions of the public and players that great care is being taken to keep them safe from all forms of infection.

The owners of both new and old stadiums need to implement healthy architecture measures, especially where major national and international events are to be held.

FACILITIES MANAGEMENT PROTOCOLS

Sports facilities have to ensure that all areas are cleaned in such a way as to eliminate all germs and viruses between games or events.

The cleaners must use sustainable environmentally friendly cleaning products that are highly effective in eliminating health risks. These protocols apply to:

Catering and food

New social criteria will need to be developed for catering areas and concessions. The issue of queueing and the gathering of people in the concourse at half-time should be resolved. This can be achieved by new queueing and sales techniques within the stadium to reduce the exposure of people to health risks. Catering options could include delivery to the seat for spectators with health risks spectators, or specific queues away from the crowds.

Food can be ordered by phone and delivered. Entry and exit can be facilitated by means of instructions issued to spectators' phones.

Technology will be a major tool when using modern buildings and can allow touch-free access to most facilities in stadiums.

The need for distance

Health has a great effect on people's psychology. There has been a considerable increase in what people consider to be their 'comfort zone'.

One of the main considerations of healthy architecture is a change to the ratio of 'closeness', i.e., the distance at which one feels comfortable. This is one of the main issues necessitating adjustments to the healthy architecture of stadiums and sports facilities. Spaces must not only be healthy but also be perceived to be healthy.

Keeping a distance between people will influence architecture, the size and use of lifts, the width of stairs, the design of the stands – all of these considerations influence how close one is to a stranger, and hence how comfortable a person is. Architecture will need to adjust to

create the required comfort zone, or what could be described as the 'healthy zone' for each person.

The need to be clean

Cleanliness is a fundamental to a sense of safety and health comfort. Contact with surfaces in buildings is unavoidable, so the materials and finishes that people touch must be kept clean and safe. For a building to be healthy, careful cleaning is essential. Cleaning must be implemented under strict conditions to ensure the elimination of germs and viruses.

- Toilets

Are one of the main areas of the transmission of viruses and great care needs to be taken to avoid the need to touch. Washbasin taps and toilet flushes can be operated automatically. Lights can be turned on and off by presence detection

and self-opening doors installed; the technology already exists for these solutions.

- Gloves and masks

It is now not uncommon for people attending a mass spectator event at a stadium to wear a mask or gloves to enhance their personal protection. It has been proved that the use of a mask reduces the probability of airborne infection.

The attitude to those who wish to wear a masks and gloves has changed since the COVID-19 pandemic. Whereas a mask used to be viewed as unusual, it is now respected as a spectator's personal decision.

The stadium could even hand these elements out as part of a branding strategy to instil a sense of health and safety to personal comfort.



A microphone, in the flash zone, is sanitised during an UEFA Futsal Euro 2022 match

The need to touch

Health risks may be invisible; all surfaces and spaces are possible sources of contamination. The fewer things we touch the better; however, touching in buildings is inevitable.

Turning on a light, flushing a toilet, pushing the button in the lift, holding on to a handrail or opening a door all mean touching a surface that may be contagious. Architecture is about touching and feeling, and using a building involves a constant need to touch it. Reducing the need to touch is therefore of paramount importance for buildings, both actively (through technology) and passively (fewer doors, open areas). This is especially important in areas where the need to touch may involve an elevated risk.

Active ways of avoiding touching can be implemented by using technology to open doors, flush toilets, and even open washbasin taps. Touch-free access to stadiums using technology and mobile phones, automatic systems to remove the need to push open turnstiles, open concourses, and access to seats – all of these

approaches reduce touching. In terms of passive measures, stadiums can be designed with reduced numbers of doors and gates and open spaces that can be accessed without touching surfaces.

These are all good options to allow the healthy design of a sports facility.

VERTICAL CIRCULATION

Many thousands of people can cross over on stairs or in lifts. The risk of being contaminated by a virus or other bacteria in these enclosed areas is elevated and therefore the vertical movement of the public may require flow and crowd management strategies to avoid direct contamination.

Vertical communication options need to be reviewed; changes can be affected either by increasing the

width of the stairs, or by ensuring the one-way movement of people on each stair, either up or down, to avoid crossing. In smaller areas such as lifts the solution may be to increase the number of lifts or increase lift capacity. This may complicate building design and increase costs. An alternative is to dedicate specific vertical transport facilities (lifts and stairs) to people with compromised health, as is already done for disabled spectators.

The stands are the main element of a stadium and from where people watch the game. To improve health comfort, stadiums can slightly increase the distance between people in their seats, although this may cause a marginal reduction in the stadium capacity. An alternative is to create special areas for people with health risks, those aged over 65 and or individuals with other health

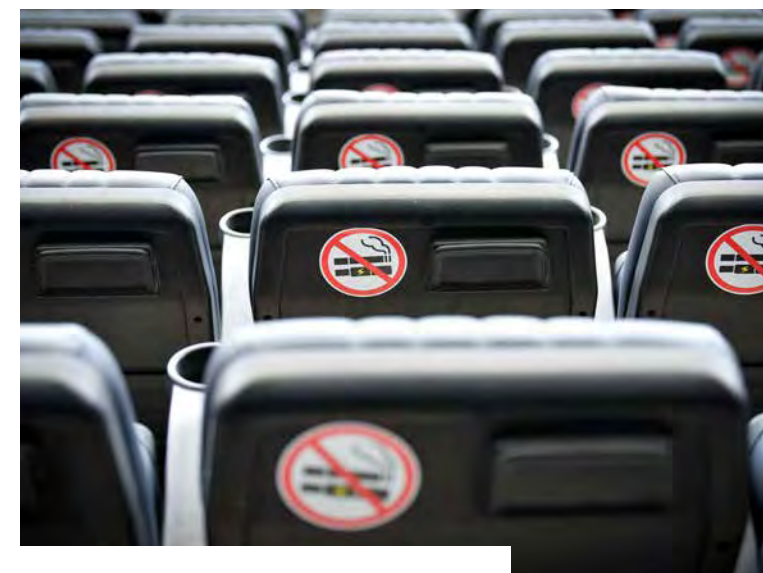
issues that are incompatible with crowds. A small area may need to be reserved in the stands, as is already done for disabled spectators, to create a 'healthy zone'. This could even be perceived as a commercial opportunity when marketing seating options.

NO TO SMOKING

As a part of creating a healthy infrastructure in sports facilities, actions can be taken to prevent unhealthy habits and behaviour such as smoking.

This means excluding smoking areas and fixtures such as ashtrays during the infrastructure planning and development stage. Smoking is a major health risk and sports facilities should ensure that players and spectators do not smoke in a stadium or football facility.

For more information on tobacco related topics, please refer to the [Tobacco-free Stadia Guidance](#).



No-Smoking signs during an UEFA Nations League Semi-Final match



CASE STUDY

STUTTGART ARENA, GERMANY

A stadium taking sustainable measures into account is Stuttgart Arena in Germany. Part of its approach has been the introduction of a strict no-smoking policy. Spectators and staff benefit from no-smoking areas and the sale of cigarettes and other tobacco products is only allowed in very limited areas.

- No-smoking blocks in every price category.
- Detailed procedures for security staff and stewards on issuing warnings and ultimately removing offenders from the stadium.
- Development of signage guide to help EURO 2024 stadiums to comply with the relevant regulations.
- Tobacco products only sold in hospitality areas.

D2. SAFETY

This section is extensively covered in the [UEFA Safety and Security Regulations](#), therefore we would advise the reader to access the provided link for ample description.

We will cover:

SAFETY REQUIREMENTS

ACCESS TO SPORTS FACILITY

SAFETY REQUIREMENTS VERSUS SUSTAINABILITY

Safety and sustainable design are fully compatible as both have the same aim – to conserve resources – and are focused on the environment in the case of sustainability, and on people in the case of safety.

There can be times when the values of safety and sustainability are contradictory, as has been seen in recent times during the COVID-19 pandemic. The strict implementation of individual isolation as a health precaution is incompatible with the use of public transport where close contact may increase the transmission of disease. Health considerations may need to prevail over sustainability concerns, but only as a temporary measure during critical health situations. The use of public transport is essential to a sustainable world. Lessons need

to be learned to introduce healthy approaches for public transport or to develop efficient individual means of transport for personal safety and comfort.

The production of food by sustainable means involves the use of packaging to ensure hygiene between production and the consumer. Sustainability requires reduced packaging and the observance of the principles of a circular economy. The balance between ensuring that the food is healthy for consumers and protecting the food is an area worthy of study to ensure the compatibility of the values of sustainability and safety.

No to smoking: Smoking is not only a risk to the smoker, as it also endangers those in the surrounding environment. The disposal of cigarettes is a waste management issue as a lit cigarette can cause a fire in a litter bin.

ACCESS TO A STADIUM OR SPORTS FACILITY

Access to stadiums should be staggered over time. Entry will be subject to health checks such as taking spectators' temperatures by means of temperature-sensitive cameras. It is commonly agreed that security is an essential part of the safety of any sports facility or stadium, and there is no social objection to security checks. This sentiment can therefore be extended to improved health controls such as a simple temperature check on entry to the stadium.

In addition to security personnel at entry points, a new role of 'health monitor' may be required to ensure safe access and to direct people to further health tests if required. This is a very simple, economic measure and can identify people who may be

ill when entering the stadium, in this way avoiding spreading infection if they were to enter the stands.

VIP and hospitality areas must be reviewed to allow safe, healthy comfort zones for the more expensive seats in the stadium. The main access control is by temperature monitoring on arrival. It may be advisable to install screening between certain seating areas and even reduce occupancy levels. VIP and hospitality areas for spectators and visitors in health risk groups may require screening to reduce the risk of possible health contamination.

Players and delegates need to be subject to better distancing through measures such as larger dressing rooms and individual toilets and showers. Stadiums can use two retractable tunnels onto the pitch

to avoid contact between opposing teams in enclosed areas, even though they may access the pitch if these are installed through the same permanent access tunnel.



Temperature check during the 2021 UEFA European Under-21 Championship

REFERENCES

→ UEFA STADIUM-RELATED PUBLICATIONS

- [UEFA Strategy 2019-2024 – Together for the Future of Football](#)
- [UEFA Football Sustainability Strategy 2030 – Strength through Unity](#)
- [UEFA Guide to Quality Stadiums](#)
- [UEFA Stadium Infrastructure Regulations](#)
- [UEFA Circular Economy Guidelines](#)
- [UEFA Best Practice Guide to Training Centre Construction and Management](#)
- [UEFA Pitch Quality Guidelines](#)
- [UEFA Stadium Lighting Guide](#)
- [UEFA Safety and Security Regulations](#)
- [UEFA and CAFE Access for All: Good Practice Guide to Creating an Accessible Stadium and Matchday Experience](#)
- [Tobacco-free Stadia Guidance](#)
- [UEFA Supporter Liaison Officer Handbook](#)

→ EUROPEAN COMMISSION PUBLICATIONS

- Sustainable Sport Infrastructure
(under development, to be released in 2023)
- Sustainable Sport Event
(under development, to be released in 2023)

F. GLOSSARY

UEFA

SUSTAINABLE INFRASTRUCTURE GUIDELINES



GLOSSARY

Active measures:

Measures which require the use of energy to change the users' comfort of in buildings.

Air flow:

The movement of air around or through a building or structure.

Artificial pitches:

A pitch with a playing surface made from synthetic fibres to emulate a natural grass surface.

Biodiversity:

The different kinds of life in any given area, whether animals, plants or even microorganisms.

Blue architecture:

The study of sustainable architecture for people, referring to their comfort, design to human scale and referring to local traditions and culture.

Carbon emissions:

The carbon dioxide produced when fossil fuels are burned in vehicles, for energy, in industrial processes etc.

Cashless:

The exchange of funds which does not involve the interchange of physical currency, mainly achieved by digital means.

Charging point:

An electrical power output to charge electric vehicles and other electrical appliances.

Circular economy:

A model of production and consumption that involves extending the lifecycle of products by reuse, refurbishment, recycling, sharing, and repairing, in this way reducing waste.

Climate change:

A long-term change of the average weather pattern which has substantial effects on global, regional, and local climates.

Co-sharing:

A system where travel or even accommodation may be shared by more than one user, in this way reducing carbon footprints.

Cogeneration:

The simultaneous generation of heat and electricity from one power source.

Concourse:

The public area in a stadium behind and below the stands, through which the public moves to access their seats, toilets, concessions, and other circulation points.

Contamination gases:

Gases which cause air pollution due to their harmful components and can lead to environmental damage and disease.

Cooling:

Cooling reduces the ambient temperature to a comfortable level for humans through either active or passive methods.

Cross ventilation:

A technique used in buildings to allow fresh air, wind, or a breeze to flow through an opening on one side where the air pressure is higher, travel through the interior space and exit through an opening on the opposite side where air pressure is lower, in this way creating a flow of cool air.

Decarbonisation:

The reduction of the output of carbon into the atmosphere. System economically reduces and compensates the emissions of carbon dioxide.

Demountable:

Buildings that are designed such that they can be deconstructed and either stored or moved to other locations.

Diversity:

The range of human differences which may refer to race, gender, ethnicity, age, social class, and national origin.

Eco-friendly transport:

A form of transport which relies on non-fossil-fuel propulsion, using sustainable forms of energy such as solar, wind or hydraulic.

Energy storage solutions:

Way energy can be held until required in accumulators or batteries for electricity or in reservoirs for water storage.

Environmental, social, and economic sustainability:

The assessment of sustainability in relation to the planet, the human realm and financial viability.

Environmental (biosphere) sustainability:

The sustainability of any area where life exists is defined as biosphere, whether on land or in the oceans.

Ergonomics:

Science dedicated to designing and arranging things for human comfort, safety, and efficiency.

Fertiliser:

Product which has natural or chemical elements to enhance plant growth and improve soil capacity.

Food banks:

Non-profit organisations which collect donated food for distribution to people or entities in need.

Fossil fuels:

Fuels made from the decomposition of plants and animals that contain carbon and hydrogen and can be burned to obtain energy.

Geothermal:

Heat energy which is naturally generated within the earth and can be harnessed for human use.

Green wall:

A vertical built structure that is covered by vegetation and irrigated to form a green wall.

Health and well-being:

A system or environment which supports a state of physical, mental, and social well-being.

Heat dissipation:

The movement of heat away from its source into the surrounding environment by conduction, radiation, or convection.

Heat gain/loss:

The ability of a cooling system to remove unwanted heat from a building to the outside, either actively or passively.

Heat generation:

The conversion of a form of energy (like an electrical, chemical, or nuclear energy) into thermal energy (heat energy).

Hybrid pitches:

A pitch which integrates both natural grass and artificial fibres to allow football to be played in safe, healthy conditions.

Insulation:

Materials which prevent the movement of heat, sound or electricity and are used to reduce energy consumption.

Irrigation:

SA system for the controlled application of water onto land to assist in the growth of grass or crops.

Land contamination:

The presence of hazardous materials in the soil, such as oil, chemicals, gases etc., in potentially dangerous amounts that may be a risk to human health.

LED:

Light emitting diode – Light sources that significantly reduce energy consumption.

LED boards:

Advertising screens made up of multiple LED diodes which can display images and text, either statically or in motion.

Light pollution:

This is when the bright external lighting of a sports facility's pitches has a negative effect on the surrounding area.

Linear economy:

A traditional model of production where products are made from raw materials and then used and discarded as waste with no concern for the environmental consequences or future use.

Low water consumption:

Systems which reduce the use of water in buildings or for landscaped areas.

Multipurpose stadium:

A modern stadium that can host many different sports and commercial operations.

Multi-sport:

A sports facility that can host many sports on its pitches.

Natural cooling:

A main element of sustainable design that allows facilities to cool naturally through passive architectural methods.

Natural ventilation:

The supply of fresh air into a building or room in a passive manner (with no energy use), harnessing the wind or pressure differences.

New build:

Stadiums or buildings constructed on sites where no previous buildings exist.

Noise pollution:

This occurs when stadiums or sports facilities produce excessive noise in an urban or suburban environment, negatively affecting the surrounding area

Organic food:

Food that is grown in soil without the addition of artificial or chemical substances such as fertilisers and pesticides. Naturally grown food products.

Organic waste:

Any material that is biodegradable, that comes from either plant or animal sources and that breaks down into carbon dioxide, methane, or other organic molecules.

Packaging:

A means of protecting or enclosing products when they are manufactured to ensure their safe and healthy distribution, sale, and use.

Park and charge:

A facility where electric vehicles, such as cars or bikes, can be parked and left to charge.

Park and ride:

A system to reduce traffic congestion whereby drivers park their cars in a car park on the outskirts of a city or town and travel to their destination on public transport or a shuttle service.

Passive measures:

Sustainability measures that do not themselves consume energy.

Photovoltaic (PV) panels:

A type of solar panel used to produce electricity from sunlight by means of small, interconnected cells within each panel.

Pitch:

The place where the game of football is played, made from natural or hybrid grass.

Porous surface:

A solid surface made from materials that allow the water to pass through.

Public transport:

Any form of transport for collective use by the public and run and owned by national or local corporations (e.g., bus, metro, train, etc.).

Queue management:

Processes applied to queues to reduce end user waiting times, increase productivity, etc.

Recycle:

Collecting and processing materials into new products instead of throwing them away as waste.

Recycling bin:

A container in which different categories of waste (e.g., plastic, paper, organic, etc.) are disposed before being transferred to recycling centres.

Refurbishment:

The process of renovating, cleaning, rebuilding, and implementing new equipment in a building to extend its life for the same or different uses.

Renewable energy:

Energy produced from infinite resources rather than from fossil fuels.

Shade:

A natural (e.g., trees) or artificial (e.g., pergola) means of reducing direct sun exposure in a buildings or urban area.

Single-use plastics:

Products made from plastic that are used for a short period of time and thrown away without being fed back into a circular economy.

Smart building:

One that features technical engineering systems that can regulate its environment and operations.

Soil quality:

The capacity of soil to function in a natural ecosystem to sustain plant and animal life in a healthy manner.

Solar panels:

Panels with integrated systems that generate energy from the solar heat or light that reaches them.

Sports facility:

An indoor or outdoor area designed for practising or playing sports.

Stadium bowl:

The centre part of a stadium surrounding the pitch and angled to allow all spectators to have a clear view of the pitch.

Stadium brief:

The list of requirements to enable the stadium to offer the correct facilities for both game days and non-game days.

Stadium orientation:

The direction in which the pitch faces, preferably north-south.

Stormwater harvesting:

The collection of stormwaters on a building's roof or other areas and its storage in tanks for future use.

Suburban:

Areas are on the edge of cities or towns and where people live, work and play.

Sun path:

The sun's arc through the sky from sunrise to sunset as the earth rotates.

Sustainable materials:

Materials used that can be produced without depleting non-renewable resources, thereby maintaining the correct equilibrium of natural resources, and materials that can be recycled or reused to extend their life.

Sustainable mobility:

Where the whole system of mobility is developed following sustainable design and maintenance formats.

Sustainable urban development:

Where society looks to move towards finding a balance between economic, social, and environmental needs.

Sustainable vehicles:

Vehicles powered by clean and sustainable forms of energy, and not relying on fossil fuels.

Ticketless facility:

One that has technology that enables the absence of paper tickets.

Toxin-free:

A product developed without the use of toxic or poisonous materials that could endanger the health and safety of human beings.

Transportable:

The ability to be moved from one location to another.

Urban heat footprint (UHF):

The impact of anthropogenic effects on the temperature of urban environments, such as heat created by people, cars, buses, roads and even buildings.

Urban utilities:

Sewage, electricity, gas, water, telephony, and any other services required to make buildings habitable.

Waste management:

The correct way to organise a strategy for the disposal, reduction, reuse, and waste prevention of any waste developed in the facility.

Wastewater:

Water that is used and sent into the sewage system of any facility.

Water harvesting:

Collecting water from the roof of any building or from roads and other flat areas and taking the collected rainwater to deposit tanks for storage and use when required.

Wayfinding:

Signage and other means to allow people to move around a facility with the correct information and guidelines.

Wind energy:

Sustainable energy produced by wind moving devices such as windmills.

DISCLAIMER

- The information in these guidelines is provided by UEFA alone and has not been independently verified. While the guidelines have been prepared in good faith, no warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability will be accepted, by any of the UEFA corporate group or its respective officers, employees or agents in relation to the adequacy, accuracy, completeness or reasonableness of any information (whether written or oral) or notice or document supplied or otherwise made available to any person in connection with UEFA or in connection with any user's involvement in the sustainability project. All and any such responsibility and liability are expressly disclaimed. The recipient acknowledges and agrees that no person has, nor is held as having, any authority to give any statement warranty, representation, assurance or undertaking on behalf of UEFA in connection with the project.
- No individual guideline is, on its own, sufficient to achieve completely sustainable football infrastructure. However, all the guidelines contribute to that vision, and collectively they constitute an important and necessary step forward. These guidelines should be considered a minimum threshold. All stakeholders are encouraged to take additional and more ambitious steps to contribute to achieving the goal. This minimum threshold will be reviewed regularly and may be raised where appropriate after consultation.



UEFA FOOTBALL SUSTAINABILITY STRATEGY

© UEFA, Nyon

Publisher: Union of European Football Associations

Executive: Michele Uva, Director of Football Social Responsibility, UEFA

Author: Mark Fenwick, Architect at Fenwick Iribarren Architects

Report coordinator: Vincent Reulet, Football Social Responsibility Environment Expert, UEFA

UEFA working group

- Thierry Favre, Deputy Director National Associations, Chief National Association Development
- Pietro Chiabrera, Senior Manager Stadium & Football Technology
- Filippo Veglio, Senior Football Social Responsibility Expert

UEFA support

- Nicola Luca, Head of National Governments & Global Institutions
- Lee Guerriero, Pitch & Football Technology Specialist
- Teodora Pletosu, EU Public Projects Specialist
- Andrea Santini, Responsabile Stadio Olimpico e Parco del Foro Italico

External Advisers

- John Beattie, Stadium & Football Director, Arsenal Football Club
- Sander van Stiphout, Director International/Program Manager, Amsterdam Innovation Arena
- Lee Penrose, Director, STRI Group
- Tiberio Daddi, Associate Professor, Institute of Management at the Sant'Anna School of Advanced Studies

In collaboration with:

- Emirates Stadium, Arsenal FC (London)
- Johan Cruyff ArenA, AFC Ajax (Amsterdam)
- Institut national du football, French Football Federation (Clairefontaine)
- Stade de Nice, OGC Nice (Nice)
- RCDE Stadium, RCD Espanyol FC (Barcelona)
- Eco Park, Forest Green Rovers (Nailsworth)
- Stuttgart Arena, VfB Stuttgart (Stuttgart)

Editorial, design and layout: Filipa Palmeirim

UEFA

SUSTAINABLE INFRASTRUCTURE GUIDELINES



UEFA
ROUTE DE GENÈVE 46
CH-1260 NYON 2
SWITZERLAND
TELEPHONE: +41 848 00 27 27
UEFA.COM

WE CARE ABOUT FOOTBALL

