New Weather Institute

FIFA's Climate Blind Spot

the men's world cup in a warming world

In association with

Scientists for Global Responsibility

Environmental Defense Fund

cool down – the sport for climate action network

Contents

Executive Summary

Governing the world's greatest game, FIFA has a huge responsibility but shows a fatal climate blind spot in its duty of care to fans, players and the future of the sport. When it should be taking urgent steps to protect all of these from global heating, its actions reveal a reckless disregard for their climate consequences. These are the key insights of this report that reveal how FIFA, whether consciously or not, with the 2026 Men's World Cup set to be the most polluting ever, is fuelling a dangerous fire:

- The expansion of the World Cup Finals from 32 to 48 teams – from 2026 onwards – will lead to a huge increase in GHG emissions. In particular, we estimate air transport emissions will rise by between 160% and 325% for each of the three tournaments in 2026, 2030 and 2034 – compared with average levels for the recent Finals.
- We estimate that the 2026 World Cup Finals in North America will be responsible for at least 9.0 million tonnes of carbon dioxide equivalent (tCO_2e), the Spanish-led 2030 Finals will lead to 6.1 million tCO_2e, and the 2034 Finals in Saudi Arabia will be responsible for 8.6 million tCO_2e, under conservative assumptions. This is compared with an average of 4.7 million tCO_2e for the previous four Finals, 2010-2022. These levels are increases over the previous finals of 92% for 2026, 29% for 2030, and 82% for 2034.
- Following recent academic research on the increased global heating potential of air travel (see Appendix 2), we further estimate that the tournament emissions could be as high as 15.0 million tCO_2e for 2026, 9.8 million tCO_2e for 2030, and 12.2 million tCO_2e for 2034 – 40%-70% higher than our basic estimates.
- We estimate that the FIFA-Aramco sponsorship deal for the men's World Cup Finals in 2026 will induce additional emissions of about 30 million tCO_2e due to increased sales for the fossil fuel company.

Table ES-1. Estimated GHG emissions for World Cup Finals, 2026-2034, involving 48 teams, compared to 'typical' tournament, 2010-2022

Million tCO_2e	2010-2022: 'Typical'	2026: North America	2030: Spain-led	2034: Saudi Arabia
Air transport	1.82	7.72	4.78	4.75
New stadium construction	1.89	0.00	0.27	2.97
Other sources	1.00	1.30	1.04	0.83
Totals	*4.71*	*9.02*	*6.09*	*8.55*

- The Climate Emergency Risk Assessment conducted by the Environmental Defense Fund covering heat stress, flooding and extreme weather risks across all 16 stadiums hosting matches at the 2026 World Cup found that:

- Half (8 out of 16) of the 2026 World Club stadiums require immediate environmental intervention, with 4 deemed to require critical intervention.
- Six of the stadiums face extreme heat stress (Wet Bulb Globe Temperature (WBGT) >26.67°C (80°F)).

Table ES-2. Estimated GHG emissions of World Cup Finals, 2026-2034, expressed in equivalent numbers of average cars (UK and US).[1]

Million tCO_2e	2026: North America	2030: Spain-led	2034: Saudi Arabia
Totals (air travel standard estimate)	9.02	6.09	8.55
Equivalent number of average cars driven for a year (UK)	6,440,000	4,350,000	6,110,000
Equivalent number of average cars driven for a year (USA)	1,960,000	1,320,000	1,860,000

Acronyms

FIFA – Fédération Internationale de Football Association

GHG – greenhouse gas

HVAC – heat, ventilation, and air conditioning

BTU – British Thermal Unit

tCO_2e – tonnes of carbon dioxide equivalent

WBGT – Wet Bulb Globe Temperature

Introduction

The FIFA Men's World Cup Finals (hereafter 'World Cup') is international football's biggest prize. Every player wants to win it, and every fan wants to see their national team lift the iconic trophy.

In many ways, it is so much more than just a sporting event – it's a global phenomenon that unites people across cultures, languages, and borders. Held every four years, it captures the imagination of billions, making it the most watched and celebrated tournament on Earth. Approximately 1.42 billion people watched the 2022 Final[2] – an epic battle between Argentina and France – and an estimated 5.9 billion people – nearly three-quarters of the world's population – engaged with the tournament, digitally or physically.[3]

The World Cup has produced some of the most memorable moments in sporting history, from Maradona's hand to Zidane's final bow. The footballing spectacles that take place at these tournaments go on to shape national narratives and inspire generations. Its rotating host nations bring the spectacle to new regions, blending local culture with global excitement to ensure that each tournament is a festival of cultural identity, passion, and pride.

But the World Cup is heating up – and FIFA seems intent on fueling the fire. The climate crisis is bearing down on this festival of football, driving extreme heat that puts players and fans at risk and floods that threaten the stadiums that have staged World Cup epics. It is not just the extremes. A hotter, more unpredictable world will put the World Cup on an increasingly precarious footing, with the conditions in stadiums and host countries in no way conducive to the game.

Some of this has already come to pass. FIFA's Club World Cup 2024 has seen matches taking place in some of the stadiums that will host fixtures in the 2026 World Cup and fans, players and managers have all highlighted the impact of heat stress and perilous conditions. Temperatures at some of the matches have touched 41°C (106°F) and sat in the mid-30°Cs (86+°F), even in cooler cities like Seattle. The experience of fans and players at these matches will become increasingly widespread.

Instead of confronting the existential threat the climate crisis poses to the World Cup, FIFA is actively deepening it. By expanding the tournament from 32 to 48 teams, FIFA is locking in a sharp rise in air travel for fans and players – one of the largest sources of tournament-related greenhouse gas emissions (GHGs). Awarding hosting rights to nations with limited or no football infrastructure further compounds the problem, as it drives carbon-intensive construction. As this briefing shows, the next three World Cups will generate substantial GHG emissions. The expansion marks a decisive escalation in the tournament's contribution to a crisis that threatens the future not only of football, but of wider society. Make no mistake, the 2026 World Cup is shaping up to be among the most polluting sporting events in history

Adding insult to injury, FIFA continues to cozy up to the very companies that are fuelling the climate crisis. The major global sponsorship partnership announced with Aramco, the Saudi Arabian state-owned oil company, which is the largest polluter on Earth, is further evidence that FIFA is intent on cashing in on the status quo rather than securing a thriving future for football.

This briefing has been prepared by Scientists for Global Responsibility (SGR), led by Dr. Stuart Parkinson, in collaboration with Samran Ali of the Environmental Defense Fund (EDF) and Cool Down – the Sport for Climate Action Network. The briefing's purpose is twofold. First, it estimates the GHG emissions attributable to the next three FIFA Men's World Cup Finals and the emissions induced through FIFA's high-carbon sponsorship deals. Second, the briefing assesses the climate impacts that can be expected by players and fans at the upcoming 2026 World Cup taking place across the USA, Canada and Mexico. Through this, we argue that FIFA must take its contribution to the climate crisis seriously and step-up to protect the future of football in a warmer world.

1. Big Talk, No Game

FIFA has made a number of bold and ambitious claims on sustainability and climate action. But serious action has yet to materialise.

Launched at COP26 in 2021, FIFA's climate strategy pledged to cut its organisational GHG emissions 50% by 2030 and reach net zero by 2040 through 18 targeted actions. But on closer analysis, only 2 actions have so far been completed, 2 have made only limited progress, and 14 have seen no visible progress – an 11% delivery rate in three years. Furthermore, its GHG targets do not cover the tournaments that it co-ordinates. This failure cannot be due to a lack of resources. FIFA has $11 billion budgeted for 2023–2026. Instead, it is reflective of deep governance and accountability gaps as well as inconsistent and ad hoc engagement on matters pertaining to sustainability.

Despite promising regular updates, FIFA has published no bi-annual climate reports, nor the 2022 World Cup sustainability follow-ups or the 2026 World Cup sustainability strategy. This lack of transparency weakens confidence and falls far short of UN climate commitments, such as the Sport For Climate Action Framework.

FIFA exemplifies a wider crisis in climate governance across sports mega-events, where the incentives and imperatives push governing bodies and organisers towards **high emissions, low ambition, and poor accountability.** The 2026 World Cup will make this already vast gap between commitment and delivery even larger.

2. The World Cup's Climate Impact

The 2026 FIFA Men's World Cup Finals in North America will mark a decisive turn in the future of the tournament, both in terms of its size and its contribution to the climate crisis.

To highlight this, we have estimated the total GHG emissions associated with each of the planned World Cup Finals in 2026, 2030, and 2034, compared with a baseline of the average of the previous four tournaments between 2010 and 2022. Our estimates are shown in Table 1, with figures for two key components – air transport (mainly by spectators) and new stadium construction – together with an estimate for other sources (including stadium renovation and energy use, surface transport, accommodation, merchandise, and catering). As we identified in a previous report,[4] air transport and new stadium construction are the largest contributors. The methodology we used to estimate these figures is a simplified version of those used in previous FIFA-commissioned reports, and we give more details in the appendices. However, we note here one particularly important difference, which is that the total emissions of new stadium construction are counted in full – in line with the methodology now used for the Olympic Games[5] – but not yet adopted by FIFA.

Our results show that, compared to the baseline of 4.71 million tonnes of carbon dioxide equivalent (tCO_2e), the next three World Cup Finals will lead to GHG emission increases of between 29% and 92%. It should be noted that we have used conservative assumptions in making these estimates, including a steady decline in emissions from 'other sources' due to international progress towards climate commitments, such as the deployment of low carbon technologies.

A key factor driving the climate impact of these future tournaments is the increase in the number of teams playing – which FIFA has decided will rise from 32 up to 48 at the 2026 tournament. This means the number of matches is increasing from 64

Table 1 Estimated GHG emissions for World Cup Finals, 2026-2034, involving 48 teams, compared to 'typical' tournament, 2010-2022

Million tCO_2e	2010-2022: 'Typical'	2026: North America	2030: Spain-led	2034: Saudi Arabia
Air transport	1.82	7.72	4.78	4.75
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Other sources	1.00	1.30	1.04	0.83
Totals	*4.71*	*9.02*	*6.09*	*8.55*
% increase compared with 2010-2022 'Typical'		+92%	+29%	+82%

Notes
FIFA estimated the GHG emissions of the Qatar World Cup Finals in 2022 to be 3.63 million tCO_2e, but this figure did not include new permanent stadium construction. With such construction included, the total for that tournament would be approximately 5.25 million tCO_2e (see footnote 4)

to 104 – i.e. by 63% – which we estimate will lead to a large rise in transport emissions given the World Cup's extensive reliance on air travel.

As such, we estimate air transport emissions will rise by between 160% and 325% for each of the three World Cup Finals in 2026, 2030 and 2034 – compared with average levels for recent World Cup tournaments.

However, those figures are based on using standard GHG emission factors for air transport. As discussed in Appendix 2, recent academic research suggests that the indirect heating effect of aircraft emissions in the upper atmosphere is significantly higher than previously thought. Applying this new research to our data yields higher estimates for the equivalent GHG emissions of air travel, and thus higher total figures for each of the tournaments.

Table 2 summarises the estimates for the total GHG emissions for each of the three World Cup Finals, 2026-2034, for both the standard and higher cases for air travel emissions. To assist in understanding the scale of the problem, we have also included figures for an equivalent number of average cars driven for one year (both US and UK, as the size of cars between these countries varies greatly).

Table 2 Estimated GHG emissions of World Cup Finals, 2026-2034, expressed in equivalent numbers of average cars (UK and US).

Million tCO_2e	2026: North America	2030: Spain-led	2034: Saudi Arabia
Totals (air travel standard estimate)	9.02	6.09	8.55
Equivalent number of average cars driven for a year (UK)	6,440,000	4,350,000	6,110,000
Equivalent number of average cars driven for a year (USA)	1,960,000	1,320,000	1,860,000
Totals (air travel higher estimate)	14.97	9.77	12.21
Equivalent number of average cars driven for a year (UK)	10,690,000	6,980,000	8,720,000
Equivalent number of average cars driven for a year (USA)	3,250,000	2,120,000	2,650,000

Notes
One British car with average fuel consumption and CO_2 emissions, driven for an average mileage per year, emits $1.4tCO_2e$. p.70 of: Parkinson and Simms (2025). https://www.newweather.org/wp-content/uploads/2025/01/Dirty_tackle_The_growing_carbon_footprint_of_football.pdf
One US car with average fuel consumption and CO_2 emissions, driven for an average mileage per year, emits $4.6tCO_2e$. US EPA (2025). https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
All figures are rounded.

2.1 2026 World Cup – North America

The 2026 FIFA Men's World Cup is scheduled to kick off on June 11, 2026, at the historic Estadio Azteca in Mexico City, a venue that has already hosted two World Cup finals. This edition of the tournament will be the first to span an entire continent, with matches held across the United States, Canada, and Mexico – three countries with vast geographic distances between host cities. While FIFA frames this North American co-hosting model as a celebration of regional unity and football's global reach, it presents significant logistical and environmental challenges.

With fixtures spread across four time zones and thousands of kilometers apart – from Vancouver to Miami, Guadalajara to Toronto – the 2026 tournament will be heavily dependent on air travel for teams, officials, media, and millions of fans. Unlike in parts of Europe or Asia, there is a notable absence of low-carbon alternatives such as high-speed rail networks connecting major host cities. As a result, air transport, the most emissions-intensive forms of travel, will be the default transport choice. This not only increases the tournament's contribution to the climate crisis, but also highlights the gap between FIFA's climate commitments and the practical realities of tournament planning. In a decade that demands urgent emissions reductions to prevent climate catastrophe, the 2026 World Cup is shaping up to be among the most polluting sporting events in history.

Our data found that for the 2026 World Cup Finals:

- Total emissions will be approximately 9.02 million tCO_2e, which is almost double the historical average attributable to World Cup Finals tournaments.
- Air transport will make up 7.72 million tCO_2e of the total. This is over four times the size of the typical World Cup Finals between 2010-2022 mainly due to the higher number of matches (and therefore spectators) and the vast distances between host cities across the three countries.
- As no new stadiums are being built for the 2026 World Cup, there will be no additional GHG emissions from this activity, although some renovations to existing stadiums are taking place.
- Other sources of emissions will be responsible for about 1.30 million tCO_2e, an increase from the baseline due to the scaled-up size of the tournament.
- Our upper estimate for air transport emissions for this tournament is 13.66 million tCO_2e.

2.2 2030 World Cup – Spain, Portugal and Morocco, with 3 games taking place in South America

The 2030 FIFA World Cup will mark a historic first: the tournament will be jointly hosted by three countries across two continents – Morocco (Africa), and Portugal and Spain (Europe) – signaling FIFA's continued push toward more complex and expansive hosting arrangements. In an unprecedented move, Argentina, Paraguay, and Uruguay will also each host a single opening match, bringing the total number of host nations to six. This symbolic gesture is intended to commemorate the centenary of the first World Cup, held in Uruguay in 1930, and to honor the tournament's South American roots. However, this fragmented, intercontinental format raises serious concerns about the climate impact of long-distance travel between venues, especially in the opening stages. It also signals a growing trend within FIFA to prioritise political spectacle over sustainability and simplicity, with potentially profound consequences for the carbon footprint of the world's most-watched sporting event.

Our data found that for the 2030 World Cup Finals:

- Total emissions will be approximately 6.09 million tCO_2e
- Air transport will be responsible for at least 4.78 million tCO_2e, which is still very high. We have conservatively assumed that there will be no extra intercontinental travel between South America and Europe/North Africa due to the three opening matches. We have also assumed that all travel during the tournament between Spain, Portugal, and Morocco will be by surface transport.
- Emissions associated with stadium construction will be small at around 0.27 million tCO_2e, due to only one new venue being built in Casablanca.
- Other sources of emissions will be responsible for about 1.04 million tCO_2e, smaller than in 2026 due to increased adoption of low-carbon technologies.
- Our upper estimate for air transport emissions for this tournament is 8.45 million tCO_2e.

2.3 2034 World Cup – Saudi Arabia

The 2034 FIFA Men's World Cup Finals will be hosted by Saudi Arabia, a country with little existing football infrastructure and the world's leading oil producer. Awarded unopposed after a rushed and opaque bidding process, the tournament is set to be one of the most controversial in FIFA's history, which is already saturated with controversies. While Saudi Arabia has framed the World Cup as a symbol of its modernization and global ambitions under their Vision 2030 strategy, the environmental cost of staging a mega-tournament in a climate-vulnerable desert nation is immense.

Given the country's extreme summer temperatures, the tournament is expected to be held in November and December, following the precedent set at the 2022 Qatar World Cup Finals. This is expected to require the construction of 11 new stadiums, extensive transport infrastructure, and accommodation for millions of visitors – much of it reliant on carbon-intensive materials and activities. With cities spread out across a vast, arid landscape and no rail network capable of serving fans sustainably, the 2034 World Cup will depend heavily on air conditioning, desalination, and domestic flights, driving up emissions across all phases of the event.

Saudi Arabia has pledged to deliver a "sustainable" tournament, but such claims ring hollow given the country's ongoing expansion of fossil fuel production, lack of binding climate commitments, and limited transparency. The 2034 World Cup Finals risks becoming a case study in sportswashing where a global spectacle is used to launder reputations and deflect criticism, while making a significant contribution to the very crisis that threatens the future of football.

Our data found that for the 2036 World Cup:

- Total emissions are estimated to reach approximately 8.55 million tCO_2e, which is only slightly lower than the 2026 World Cup in North America despite being a single-country host. This is due to both the huge scale of stadium construction, as well as high levels of air travel.
- Air transport emissions will remain elevated at 4.75 million tCO_2e.
- Emissions associated with new stadium construction are projected to be very large, at 2.97 million tCO_2e, which is the highest of any of these three tournaments, even surpassing the average across World Cup Finals between 2010-2022 (1.89 million tCO_2e).
- Our upper estimate for air transport emissions for this tournament is 8.40 million tCO_2e.

2.4 Polluting sponsors at the World Cups

Alongside match-related emissions, FIFA's commercial partnerships and sponsorship deals are a major source of 'induced' GHG emissions. As we discussed in a previous report,[6] this is due to the increase in sales and consumption that results from the extremely visible sponsorship of the World Cups, which billions of people engage with around the world. Sponsorship is a form of advertising with typical returns expected in line with general business investment principles.

These commercial partnerships remain a key source of funding for FIFA and several of the most lucrative deals have been with companies in high-carbon sectors, not least the fossil fuel sector.

Based on a newly developed methodology for estimating these emissions that looks at the typically expected returns from investing in advertising an sponsorship – see Appendix 3 – we have estimated these emissions for the top fossil fuel sponsors for the World Cup Finals of 2018, 2022, and 2026, based on the available information on the value of sponsorship deals, which are outlined in Table 3.

As can be seen, the highest estimate is for the 2026 tournament due to its sponsorship by Aramco, based in Saudi Arabia. Aramco is the world's largest oil and gas company in terms of current and historical CO_2 emissions, while Gazprom – sponsor of the 2018 competition – is fourth.[7] Our estimate for sponsorship emissions is even larger than the match-related emissions above.

Another major sponsor of the 2026 competition is Qatar Airways. We estimate that their sponsorship deal could induce GHG emissions of at least 3.3 million tCO_2e, but possibly as much as 5.8 million tCO_2e,[8] if the upper estimate for aviation heating effects is used (see Appendix 2).

Table 3 Estimated GHG emissions associated with top sponsorship deals by fossil fuel companies for World Cups, 2018–2026

Sponsor ('Partner')	World Cup Finals	Estimated sponsorship spend in year of Finals ($m)	Company GHG emissions ($MtCO_2e$)	Company revenue ($bn)	GHG emissions per unit sponsorship ($kgCO_2e/\$$)	GHG emissions of sponsorship (tCO_2e)
Gazprom	2018, Russia	110	1,407	119	170	18,650,000
Qatar Energy	2022, Qatar	119	241	53	65	7,770,000
Aramco	2026, North America	119	1,867	106	252	29,950,000

3. Climate Impacts at the 2026 World Cup

Our comprehensive climate emergency risk assessment categorizes venues based on the severity of climate threats they face, using three critical climate risks: Critical Heat Stress expressed in terms of Wet-Bulb Globe Temperature; flooding vulnerability, and extreme weather exposure. The results reveal a troubling pattern of environmental vulnerability across the tournament infrastructure that demands immediate intervention.

Tier 1 venues require critical intervention. These four stadiums face life-threatening conditions that could transform FIFA's celebration into a public health emergency. AT&T Stadium in Dallas experiences 37 days annually with temperatures above 95°F (35°C), including a July WBGT of 83.54°F (28.63°C). This, combined with extreme energy consumption demands, creates a feedback loop of climate impact. Furthermore, NRG Stadium in Houston operates under the highest July WBGT of 84.12°F (28.96°C), alongside a flooding risk and wildfire exposure, representing a triple threat that exceeds any reasonable safety threshold.

Meanwhile, SoFi Stadium in Los Angeles must manage heat stress reaching dangerous levels while facing wildfire risks that can rapidly compromise air quality across the entire region. Concurrently, Hard Rock Stadium in Miami is subject to critical flood projections with an 8.1 property risk score combined with heightened hurricane exposure during peak storm season. These stadiums are not the only ones that must adapt before the World Cup; rather, they are the ones that pose the greatest danger to fans and players.

Tier 2 venues demand high-priority mitigation. These four stadiums face serious but manageable risks with proper intervention. Levi's Stadium in San Francisco must address both heat stress and wildfire threats in California's increasingly fire-prone landscape. Simultaneously, Mercedes-Benz Stadium in Atlanta confronts significant heat stress conditions requiring enhanced cooling infrastructure. In parallel, Arrowhead Stadium, home of the Kansas City Chiefs, experiences extreme heat episodes, with an average of 27 days annually above 95°F (35°C).

Similarly, Estadio BBVA in Guadalupe must manage heat stress while addressing concerns about carbon intensity in Mexico's energy grid. These glaring issues highlight the tournament's inherent unsustainability and the critical need for FIFA to prioritize environmental responsibility over expansion and profit.

The geographic distribution of these risks exposes the fundamental flaw in FIFA's venue selection process. The organization has effectively designed a climate vulnerability tour across North America's environmentally stressed regions during their most dangerous season.

TIER 1 CRITICAL INTERVENTION REQUIRED (4 venues):

- **AT&T Stadium (Dallas)**: Extreme heat + high energy consumption
- **NRG Stadium (Houston)**: Extreme heat + flooding risk + wildfire risk
- **SoFi Stadium (Los Angeles)**: Heat stress + wildfire risk
- **Hard Rock Stadium (Miami)**: Critical flood risk projection + Higher risk of hurricanes

TIER 2 HIGH PRIORITY MITIGATION (4 venues):

- **Levi's Stadium (San Francisco)**: Heat stress + wildfire risk
- **Mercedes-Benz Stadium (Atlanta)**: Heat stress
- **Arrowhead Stadium (Kansas City)**: Extreme heat episodes
- **Estadio BBVA (Guadalupe)**: Heat stress + carbon intensity

3.1 Critical Heat Stress Assessment

The 2026 World Cup's heat stress crisis threatens to transform what should be football's greatest celebration into a public health emergency. Table 4 reveals the stadiums and cities that will encounter the highest heat, which surpasses FIFA's established safety thresholds and creates hazardous conditions for both players and fans. Houston's NRG Stadium presents an even more alarming scenario with the highest July WBGT at 84.12°F (28.96°C), forcing mandatory cooling breaks and enhanced medical monitoring that could fundamentally alter match dynamics.

The American College of Sports Medicine has established clear guidelines for these temperature thresholds, recommending the cessation of athletic activities when the WBGT exceeds 82°F (27.78°C). Multiple venues will regularly exceed these limits during the tournament period, forcing FIFA into impossible choices between player safety and tournament integrity.[9]

For the fans, the heat stress index readings in Table 4 translate into real physiological danger: prolonged exposure to these conditions can trigger heat exhaustion, dehydration, and heat stroke, particularly for older supporters and those with pre-existing health conditions who may struggle with the extreme temperatures during outdoor festivities and stadium approaches.

Host cities must collaborate with FIFA to institutionalize Heat Action Plans[10] for events held during warmer months, as local populations will bear the brunt of increasingly hot summers, necessitating urban preparedness initiatives. In any major sporting event, especially one as globally significant as the World Cup, the paramount concern must always be the well-being of both the participating athletes and the vast audience. This principle extends beyond immediate physical safety on the field to encompass environmental factors that can significantly impact health and performance.

As the world grapples with escalating climate change, the selection of host nations and tournament schedules must increasingly prioritize the safety of players and the public, mitigating risks associated with extreme heat, poor air quality, and other climate-related hazards. Ignoring these vital considerations not only endangers individuals but also compromises the integrity and success of the event itself.

The environmental implications compound these human health risks, creating a vicious cycle that undermines FIFA's already failed climate commitments. Venues operating under the extreme conditions documented in Table 4 will require massive energy consumption for cooling systems. AT&T Stadium (Dallas) and NRG Stadium (Houston) already rank among the most energy-intensive sports facilities globally. The additional cooling demands to maintain safe conditions will push their carbon footprints to unprecedented levels, creating a vicious pattern where climate change drives energy consumption, which in turn accelerates climate change.

FIFA faces a dilemma due to extreme heat: either risk player safety by sticking to regular match schedules or introduce cooling breaks and modified protocols, which highlights the tournament's inherent unsustainability.

Moreover, the anticipated heatwave will strain local power grids, increasing air conditioning demand in host cities and potentially causing brownouts that could disrupt match broadcasts and stadium operations. Despite these challenges, FIFA maintains its claim to carbon neutrality, which these conditions render mathematically unachievable.

WBGT	Risks/impacts
65.1–72.9	Risk of heat stress and other heat illnesses begin to rise. High risk individuals should be monitored or not compete
72.1–78.0	Risk for all competitors is increased
78.1–82.0	Risk of unfit, non-acclimatized individuals is high
82.1–86.0	Cancel activity/ competition

American College of Sports Medicine (ACSM) guidelines for continuous activities or competitions

Critical Heat Stress Summary:

- **AT&T Stadium (Dallas)**: 37 days annually above 95°F (35°C) with July WBGT of 83.54°F (28.63°C), which exceeds FIFA safety thresholds.
- **NRG Stadium (Houston)**: The highest July WBGT reading of 84.12°F (28.95°C) mandates a need to establish a player safety emergency, requiring mandatory cooling breaks.
- **Player Safety Protocol**: WBGT >82°F (27.77°C) mandates enhanced medical monitoring and potential match modifications to reduce health risks.

Table 4 Stadium heat stress index

Stadium	City	Days with max temp above 95°F (35°C)[11]	Days with max temp above 104°F (40°C)	June Avg WBGT °F (°C)	June Avg Heat Index °F (°C)	July Avg WBGT °F (°C)	July Avg Heat Index °F (°C)
AT&T Stadium	Dallas	36.76	27.43	80.12 (26.73)	83.52 (28.62)	83.54 (28.63)	88.93 (31.62)
NRG Stadium	Houston	27.70	4.47	81.10 (27.28)	82.02 (27.78)	82.83 (28.23)	84.12 (28.95)
Hard Rock Stadium	Miami	5.44	0.27	80.79 (27.11)	84.34 (29.07)	82.65 (28.13)	87.60 (30.88)
Arrowhead Stadium	Kansas City	27.63	18.19	75.95 (24.41)	75.94 (24.41)	80.31 (26.83)	81.66 (27.58)
Estadio BBVA	Guadalupe	N/A	N/A	80.79 (27.11)	81.52 (27.51)	80.18 (26.76)	81.78 (27.65)
Mercedes-Benz Stadium	Atlanta	17.48	4.78	76.06 (24.47)	77.16 (25.08)	78.94 (26.07)	80.17 (26.76)
Lincoln Financial Field	Philadelphia	6.50	0.65	72.62 (22.56)	72.14 (22.3)	77.56 (25.31)	78.25 (25.69)
MetLife Stadium	New York, New Jersey	2.93	0.24	69.84 (21.02)	70.84 (21.57)	75.45 (24.13)	76.08 (24.48)
Gillette Stadium	Boston	1.64	0.18	68.27 (21.15)	66.65 (19.25)	74.03 (23.35)	73.39 (22.99)
SoFi Stadium	Los Angeles	14.48	8.06	68.89 (20.49)	72.71 (22.61)	73.65 (23.13)	76.67 (24.81)
BMO Field	Toronto	N/A	N/A	65.44 (18.57)	63.40 (17.44)	72.22 (22.34)	71.40 (21.88)
Estadio Akron	Guadalajara	N/A	N/A	73.02 (22.78)	70.61 (21.45)	72.06 (22.25)	67.05 (19.47)
Levi's Stadium	San Francisco	23.51	7.56	68.73 (20.40)	64.05 (17.80)	71.78 (22.1)	67.64 (19.8)
Lumen Field	Seattle	6.13	1.20	61.95 (16.63)	59.75 (15.41)	67.94 (19.96)	65.68 (18.71)
BC Place	Vancouver	N/A	N/A	61.20 (16.22)	57.96 (14.42)	67.22 (19.56)	63.72 (17.62)
Estadio Azteca	Mexico City	N/A	N/A	62.94 (17.18)	58.62 (14.78)	62.19 (16.77)	56.65 (13.69)

3.2 Additional Climate Vulnerabilities

The 2026 FIFA World Cup represents a convergence of mega-event logistics and North America's intensifying climate crisis, with extreme weather threats intersecting across the tournament's continental footprint during the peak summer months.

FIFA's decision to schedule matches across 16 venues spanning three countries from June through July places the world's most-watched sporting event directly in the path of hurricane season, wildfire peaks, and extreme heat episodes that have grown more frequent and severe due to climate change. Unlike previous World Cups held in more climatically stable regions, the 2026 tournament faces a perfect storm of simultaneous weather hazards: coastal venues are threatened by hurricane storm surges and flooding, southwestern stadiums operate under severe drought and wildfire conditions, and interior locations are vulnerable to tornado activity and extreme precipitation events.

The convergence of millions of international visitors, players, and local communities in climatically vulnerable regions of North America during its dangerous weather season manufactures geographic and temporal exposure to compound climate risks. This scenario suggests that traditional emergency planning protocols may be insufficient to protect those involved.

Table 5 Flooding and Wildfire Risk

Stadium	Flooding Risk to Roads	Flooding Risk to Properties	Wildfire Risk to properties
Hard Rock Stadium (Miami)	3.10	**8.1**	**4.00**
MetLife Stadium (New York, New Jersey)	3.49	0.9	2.00
Levi's Stadium (San Francisco)	5.65	0.4	**3.00**

3.2.1 Flooding Risk and Heavy Precipitation

The 2026 World Cup is vulnerable to critical flooding risks that could disrupt tournament operations and endanger millions of fans across multiple venues. Hard Rock Stadium in Miami must manage a severe flooding threat with an 8.1 property risk score, indicating that over 8% of surrounding properties will face increased flood risk, according to First Street Foundation data.[12] This vulnerability coincides with South Florida's peak hurricane season, when storm surge and heavy precipitation create compounding flood risks during the June-July tournament window. Levi's Stadium (San Francisco) presents equally alarming road flooding risks, rated 5.65 on a 10-point scale, which threaten to strand fans and emergency responders during Northern California's increasingly unpredictable precipitation patterns.

The operational implications extend beyond individual venues to encompass regional transportation networks, which are critical for tournament logistics. Though moderate compared to other venues, MetLife Stadium's 3.49 road flooding risk is set within the New York metropolitan area. Here, flash flooding can quickly overwhelm subway systems and major highways, impacting hundreds of thousands of daily commuters and international visitors.[13]

A comprehensive study published in the Weather and Climate Extremes Journal highlights a troubling trend in the Northeast United States: an alarming increase in the frequency of extreme precipitation events. The research indicates that a significant shift occurred in 1996, when the region began experiencing a marked uptick in these heavy rainfall occurrences. Between the years 1996 and 2014, the average extreme precipitation recorded was 53% greater than the average from 1901 to 1995.[14] This drastic increase not only underscores the changing climate patterns but also poses heightened risks for flooding, leading to potential impacts on infrastructure, ecosystems, and public safety in the affected areas.

The risk of flooding presents a cascade of potential failures, simultaneously impacting venue accessibility, emergency evacuation routes, and regional transportation infrastructure during tournament operations. This could lead to fans being stranded in hazardous situations while also hindering emergency response efforts.

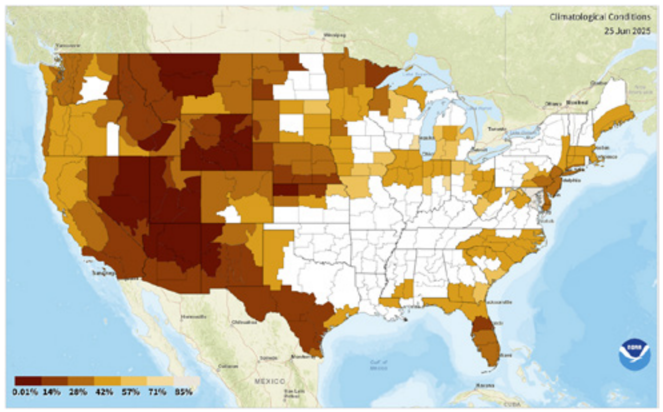
3.2.2 Wildfire and Drought Conditions

The National Interagency Wildfire Center's outlook projects significant fire potential above normal for June 2025 across portions of the Southwest, southern Great Basin, Inland Northwest, and Idaho Panhandle, which could directly threaten air quality and transportation networks serving multiple World Cup venues.[15] These conditions are expected to continue and worsen as they have in previous outlooks. Levi's Stadium (San Francisco) grapples with wildfire risks while operating in California's increasingly fire-prone landscape, where megafires can rapidly deteriorate air quality across the entire Bay Area region.

The drought map highlights severe to extreme drought conditions persisting across southwestern venues, creating a dangerous convergence where water-stressed infrastructure must simultaneously manage extreme heat, increased fire risk, and millions of additional visitors during peak summer conditions. The probability of precipitation occurring in the darker areas is low, leading to more extended drought periods and an impact on venues in those locations.

Drought conditions compound these wildfire risks by limiting emergency response capabilities precisely when they're most needed for tournament operations. According to the U.S. Drought Monitor,[16] persistent droughts across California, Nevada, and portions of Texas have reduced reservoir levels and strained municipal water systems that venues depend on for cooling operations and emergency responses.

Probability of Ending Drought Conditions in 12 Months



Based on the PHDI. PHDI is a primary measure of long-term drought but may not apply to all areas, including those with heavily managed surface water. No additional precipitation is needed for white areas.

The combination of drought-weakened infrastructure and elevated wildfire potential shapes scenarios where venues like Levi's Stadium could face simultaneous air quality emergencies from smoke infiltration and water supply constraints that limit the effectiveness of cooling systems. NOAA's Climate Prediction Center[17] indicates that La Niña conditions, which increase wildfire risk and reduce precipitation across the southwestern United States during summer months, may persist into the 2026 tournament period, suggesting these compound risks could intensify throughout June and July operations.

3.2.3 Hurricanes, Tropical Storms, and Other Extreme Weather Events

The 2026 World Cup's June-July schedule coincides with the early peak of the Atlantic hurricane season, creating potentially catastrophic scenarios for venues along the Gulf Coast and Eastern Seaboard. Hard Rock Stadium in Miami operates in one of the nation's hurricane-vulnerable regions, where Category 1-2 storms can generate storm surge flooding that would overwhelm the venue's 8.1 property flooding risk with additional coastal inundation.[18] The period from June to July marks the onset of historical storm activity in the Atlantic Ocean, during which rapid intensification events become increasingly common due to warmer temperatures.

Additional extreme weather threats span the tournament's geographic footprint, from severe thunderstorm complexes across the Great Plains to heat dome events that could push temperatures beyond safe operational thresholds. NRG Stadium in Houston faces dual threats from tropical storm surge flooding and the region's notorious severe thunderstorm activity, which produces damaging hail, tornadoes, and flash flooding that can rapidly overwhelm urban drainage systems.

The Climate Prediction Center indicates that June represents the peak severe weather season across portions of Texas, Oklahoma, and Kansas, creating scenarios where venues like Arrowhead Stadium (Kansas City) could experience tornado warnings or severe hail events during tournament operations.[19,20] These compound weather risks, combined with climate change-amplified extreme events, fabricate operational scenarios that FIFA's current emergency planning appears inadequately prepared to address, potentially forcing match cancellations or evacuations that would compromise both tournament integrity and public safety.

4. What FIFA must do

The risk posed to the 2026 Men's FIFA World Cup Finals and all future World Cups demands urgent action from FIFA. This briefing categorizes its recommendations into tournament limits and requirements, governance changes, operational interventions, and infrastructural enhancements to protect both players and fans.

4.1 Tournament Limits & Requirements

The growing climate impact of the FIFA Men's World Cup Finals amid a deepening climate crisis demands immediate action to reduce attributable GHGs. To do this, FIFA must:

- **Drop high-pollution sponsors and commercial partners.** FIFA continues to allow some of the largest polluters on the planet to use the World Cup to promote emissions-intensive products and improve their reputations. As this briefing illustrates, the sponsored emissions attributable to FIFA are significantly larger than those generated by the tournament itself. Cutting all ties with polluting companies would not only reduce emissions but also demonstrate that FIFA is serious about addressing the climate crisis.
- **Reverse the recent tournament expansion and implement a binding limit on the amount of teams that can compete in the Finals.** Such a measure would reduce the World Cups' overreliance on air travel and therefore would deliver deep and immediate reductions in attributable GHG emissions.
- **Lower minimum stadium capacity requirements so that less building of new stadiums is required.** The construction of new stadiums, which are often underutilised post-tournament, is a major contributor to the World Cup's climate impact. By lowering the threshold for new stadium construction, host nations could make use of more existing infrastructure and significantly reduce the overall emissions generated by a Finals.
- **Encourage more use of 'fan zones' in home nations to reduce travel to tournament.** Again, by reducing requirements to travel by air, FIFA could substantially cut the overall GHG emissions associated with tournaments.

4.2 Governance Establishment

FIFA's governance structure isn't just flawed, it is designed to fail. The organization's climate commitments exist in a vacuum, disconnected from any meaningful accountability mechanisms that could enforce environmental standards. FairSquare's 174-page investigation exposes how FIFA remains "structurally resistant to internal reform," with co-director Nick McGeehan bluntly stating that "this system makes effective self-regulation impossible and is at the root cause of the social harms that flow from FIFA's misgovernance."[21] This is not about tweaking policies; it's about confronting an institutional framework that actively sabotages its own stated environmental goals.

FIFA has overlooked its environmental stipulations for World Cup bidding.[22] The organization has shown a preference for host countries and nations that have made significant contributions to environmental degradation. That decision alone guarantees FIFA will miss its 50% emission reduction targets by 2030, making their climate commitments little more than expensive marketing copy.

The implementation of objective standards demands that FIFA abandon its current governance model in favor of mandatory multi-stakeholder oversight committees that mirror UEFA's supervisory approach.

Host countries cannot simply promise sustainability. To achieve its goal of sustainability, FIFA must be legally bound to establish mitigation and adaptation plans in collaboration with external partners, local communities, and independent verification bodies. This means creating dedicated sustainability roles with actual authority, not ceremonial positions that issue press releases while emissions skyrocket.

The December 2024 FIFA Congress decisions on hosting the 2030/2034 World Cups represented a fork in the road: either FIFA would commit to binding environmental standards with real enforcement mechanisms, or it would continue to pretend that voluntary measures will somehow deliver results it has never produced before. FIFA chose the latter path.

The organization awarded the 2030 tournament to a tri-continental spectacle spanning Portugal, Spain, and Morocco, with three centenary matches in South America, while handing 2034 to Saudi Arabia. These hosting choices virtually guarantee that the organization will exceed every emission reduction target it has ever set. FIFA's climate commitment remains subordinate to political theater and financial considerations; implementing binding standards is not only necessary but also the only viable path for an organization that cannot regulate itself.

a. Standards Implementation:

The implementation of rigorous international standards represents a fundamental shift from FIFA's current voluntary approach to mandatory, legally binding environmental compliance. The Swiss Commission for Fairness's June 7, 2023, ruling against FIFA's claims of carbon neutrality for the 2022 Qatar World Cup establishes a legal precedent for the climate accountability of sports organizations.[23] The Commission determined that FIFA made "false and misleading statements" under Article 3(1)(b) of the Swiss Federal Act on Unfair Competition, finding that FIFA **failed to provide proof of calculation accuracy** during regulatory proceedings.

Critical legal standards emerged from the ruling, which requires environmental claims to be supported by "generally accepted methods" for accurate CO_2 emission calculation and measurement, complete and permanent atmospheric CO_2 removal for offset claims, and verification that compensation measures meet applicable standards. The Commission rejected FIFA's argument that statements represented transparency efforts rather than commercial communications, establishing broad applicability to sports marketing activities.

The comprehensive standards framework must integrate multiple international protocols simultaneously. GHG Protocol[24] compliance becomes mandatory across all three emission scopes, with a particular emphasis on Scope 3 emissions, which account for the majority of the tournament's impacts.

The Science-Based Targets initiative (SBTi) alignment ensures compatibility with the 1.5°C pathway through verified interim milestones and sectoral decarbonization approaches explicitly developed for mega-sporting events.

ISO 20121 Sustainable Event Management[25] certification becomes a requirement for all venue operations, establishing systematic stakeholder engagement protocols and legacy planning integration that extends beyond the tournament's conclusion.

Third-party verification transforms from an optional transparency measure to a mandatory compliance requirement. Independent verification bodies with specialized sports auditing experience conduct baseline assessments 18 months before tournament commencement, yearly reviews during preparation phases, daily monitoring during operations, and comprehensive post-tournament audits within six months of the conclusion. For verification, complete transparency is needed in the methodology, along with validation of primary data sources. Statistical uncertainty must be quantified, and compliance with offset registry requirements is essential, using only verified carbon credits from recognized international standards.

Enforcement mechanisms include graduated financial penalties, ranging from $1 million to $5 million for minor reporting violations to $10 million to $50 million for systematic non-compliance, with ultimate sanctions including the revocation of tournament hosting rights.

Public accountability measures mandate real-time emission data transparency through public dashboards, annual compliance scoring systems, and quarterly media briefings on sustainability progress, ensuring continuous stakeholder oversight of environmental performance.

b. Assessment Expansion:

Comprehensive assessment expansion addresses these gaps through three critical additions: infrastructure lifecycle impacts, induced economic effects, and complete supply chain mapping. This expanded boundary condition acknowledges that mega-sporting events trigger cascading environmental impacts far beyond direct operational emissions.

Infrastructure assessment encompasses the complete lifecycle of venue modifications, temporary structures, and supporting systems. Beyond direct construction emissions from concrete, steel, and equipment, the evaluation includes embodied carbon in materials, transportation impacts during construction phases, operational infrastructure for enhanced security and telecommunications, and end-of-life disposal planning.[26]

Induced effects recognition addresses the economic multiplier impacts that hosting a tournament triggers across regional economies. Secondary emission sources arise from accelerated urban development driven by tourism infrastructure, transportation networks, and commercial real estate, encompassing the construction of hotels, the expansion of restaurants, and increased airport capacity.

Regional economic multipliers of 1.6-2.2× direct tournament investment generate corresponding induced emissions through construction activity, energy consumption, and material flows that current FIFA methodologies ignore entirely.[27, 28]

Supply chain impact assessment extends beyond direct Tier 1 suppliers to encompass the entire production network. Food and beverage supply chains include agricultural production impacts, land use change, fertilizer application, livestock emissions, processing energy consumption, packaging material production, and comprehensive transportation from farm to venue. Merchandise supply chains incorporate textile production, manufacturing facility operations, global transportation networks, and retail distribution systems. Technology and broadcast equipment supply chains encompass mining for rare earth elements, electronic component manufacturing, equipment transportation, and the management of end-of-life electronic waste.

Extended assessment boundaries encompass a cradle-to-grave lifecycle analysis, with temporal boundaries spanning pre-tournament preparation (3 years), tournament operations, and post-tournament legacy phases (2 years). Geographic boundaries encompass global supply chain impacts, local operational effects, and regional development consequences. Social and environmental co-impacts integration addresses water consumption, land use change, biodiversity impacts, and social equity effects, providing a comprehensive understanding of the tournament's ecological footprint.

c. Monitoring Deployment:

Real-time monitoring infrastructure transforms sustainability management from reactive reporting to proactive operational control. Smart sensor networks deployed across all venues, transportation systems, waste streams, and energy infrastructure provide continuous data collection, enabling immediate response to threshold breaches and systematic optimization opportunities. This technological integration promotes transparency and accountability in managing the environmental impact of mega-events.

Energy monitoring systems track consumption patterns every 15 minutes across venue-level operations, equipment-specific usage for HVAC (heating, ventilation, and air conditioning) and lighting systems, renewable energy integration, including solar panel output and grid feedback, and energy storage system performance.[29]

Transportation monitoring integrates fan travel tracking through public transit system integration, measuring ridership, capacity utilization, and emissions in real-time, as well as fuel consumption reporting.

Adaptive management protocols implement threshold-based response systems with graduated intervention levels.

- Green zone performance within targets is maintained through standard monitoring intervals, with weekly dashboard updates and preventive maintenance protocols in place.
- Yellow zone performance approaching thresholds triggers increased hourly monitoring, daily executive briefings, stakeholder notifications, and the implementation of corrective actions.
- Red zone performance exceeding thresholds activates continuous real-time tracking, immediate alert systems, emergency response protocols, and operational modifications, including schedule adjustments and capacity management.

Legacy system integration ensures the permanence of monitoring infrastructure beyond the tournament conclusion, with host cities adopting operational systems for ongoing urban sustainability management. Open-source platform development, international training certification, and academic research collaboration are all components of technology transfer programs. These programs transform temporary tournament monitoring into permanent tools for industry transformation, ultimately elevating global standards for the sustainability of mega-events.

4.3 Operational interventions and infrastructural enhancements

Across the three climate risks assessed – heat stress, flooding, and extreme weather management; there are immediate interventions required from FIFA and other stakeholders.

a. Heat Stress Response

The venue investment matrix (Table 6) indicates that stadiums facing the most extreme heat conditions require significant financial commitments. AT&T Stadium's $59.4 million price tag reflects both its massive 94,000-capacity and Dallas's notoriously hot summers, which regularly exceed 100°F (37.77°C). The calculations factor in cooling infrastructure needs, which require approximately 18 tons of additional capacity per 1,000 occupants, as well as enhanced HVAC networks capable of managing extreme heat events. These estimations are explained in more detail in Appendix 4.

What's striking is how geography drives investment priorities: the two Texas venues (AT&T and NRG) require over $105 million combined, while stadiums in traditionally cooler climates, such as Arrowhead (Kansas City), require significantly less infrastructure enhancement.

The investment pattern exposes a troubling trend in modern sports infrastructure: venues built for mild climates now face thermal stress as extreme weather becomes the norm rather than the exception. Mercedes-Benz Stadium's (Atlanta) relatively modest $17 million requirement leverages its existing LEED Platinum certification and rainwater cooling systems, demonstrating how forward-thinking sustainable design pays dividends during climate adaptation.

The substantial $21 million investment in Levi's Stadium in San Francisco underscores the imperative for contemporary venues to anticipate and mitigate compound climate risks, factors not accounted for during their initial architectural design. This significant expenditure directly addresses the dual threats of extreme heat and wildfire smoke.

These infrastructure improvements will transform fan safety from reactive emergency response to proactive health protection. Enhanced HVAC systems with 40-50% additional cooling capacity ensure that spectators will not face the dehydration and heat exhaustion risks that plague outdoor events during extreme weather conditions.

For players, improved air quality systems and climate-controlled areas provide recovery spaces that maintain performance levels while preventing heat-related injuries.[30]

The $171 million investment is not just about infrastructure; it's about creating a new standard where attending or competing in sporting events does not require risking your health in extreme temperatures.

Protecting human health is not just a moral imperative but also a financially sound strategy, as evidenced by the World Resources Institute's 10.5:1 return ratio. Adequate climate preparation helps avoid substantial costs associated with medical emergencies, lawsuits, and event cancellations that inadequate preparation would otherwise incur.[31]

Table 6 Venue-Investment Matrix

Stadium	Heat Risk Level	Investment Required	Implementation Priority
AT&T Stadium (Dallas)	Extreme	$59.4M	IMMEDIATE (12 months)
NRG Stadium (Houston)	Extreme	$46.4M	IMMEDIATE (16 months)
Mercedes-Benz (Atlanta)	High	$17M	HIGH (15 months)
Levi's Stadium (San Francisco)	High	$21M	HIGH (18 months)
Arrowhead Stadium (Kansas City)	Medium	$15M	MEDIUM (20 months)
Estadio BBVA (Guadalupe)	High	$12M	HIGH (18 months)

Total Heat Stress Infrastructure Investment: $171M across six highest-risk venues

Table 7 Multi-Hazard Risk Management Requirements

Stadium	Primary Hazard	Secondary Hazard	Emergency Response Investment
Hard Rock Stadium (Miami)	Flooding	Hurricane	$25-35M
NRG Stadium (Houston)	Heat	Flooding	$20-30M
AT&T Stadium (Dallas)	Heat	Severe Weather	$15-25M
Levi's Stadium (San Francisco)	Heat	Wildfire	$15-25M

b. Flooding and Extreme Weather Event Management

The multi-hazard investment matrix (Table 7) indicates a sobering truth: modern stadiums were not built for the climate reality we're facing today. Hard Rock Stadium's $25-35 million flood protection requirement reflects Miami's position as ground zero for sea-level rise and hurricane intensification, where traditional drainage systems simply cannot handle the volume of water that modern storms dump on South Florida. The calculations draw from federal flood protection standards, showing that every dollar invested saves between $5 and $8 in damages.[32]

Mercedes-Benz Stadium's (Atlanta) successful integration of a 680,000-gallon rainwater cistern system demonstrates how comprehensive water management can be achieved within the budget of a major venue.[33] What's particularly striking is how these are not single-threat scenarios. Hard Rock attempts to defy both regular flooding and hurricane storm surge, creating compound risks that demand sophisticated engineering solutions rather than simple drainage upgrades.

The geographic clustering of heat and flooding risks reveals how climate change is reshaping the priorities for sports infrastructure across different regions. NRG Stadium's dual-threat profile has extreme heat as the primary concern. Flooding, as a secondary consequence, reflects Houston's position in a climate convergence zone where 100°F+ temperatures coincide with Gulf Coast storm systems that can dump feet of rain in a matter of hours.

Levi's Stadium represents the West Coast's new reality, where heat events now trigger wildfire conditions that can blanket venues in dangerous smoke, requiring advanced air filtration systems that cost $12-15 million per facility. The investment calculations factor in not just immediate protection but operational continuity, ensuring games can proceed safely even when external conditions reach dangerous levels.

These infrastructure improvements will fundamentally transform how fans and players experience extreme weather events at sporting venues. Enhanced flood protection systems, including automated barriers and emergency drainage, prevent the catastrophic scenarios seen in other sports facilities, where rising water has trapped local communities and necessitated evacuations. For dual-threat venues like NRG, integrated systems provide climate-controlled refuge areas that can handle both heat emergencies and flood evacuation simultaneously, essentially creating fortress-like environments that remain safe regardless of external conditions.

The escalating environmental risks posed by climate change, including extreme heat, flooding, and severe weather events, present an undeniable and growing threat to the FIFA Men's World Cup. As evidenced by the detailed assessments for the 2026 tournament, these hazards not only endanger the health and safety of players and fans but also undermine the very integrity and operational viability of the event. FIFA's current strategies, including expanded tournaments and high-carbon sponsorships, exacerbate these issues and reveal a significant gap between its stated sustainability objectives and actual operations. The World Cup's future, along with its global appeal and lasting legacy, is at risk without a drastic shift towards strict environmental regulations, strong governance, and significant infrastructure investments.

The climate, a lifeblood of our world, and the beautiful game of football, a passion in our souls, belong to the people and the planet.

Appendix 1: Tournament GHG emissions: methodology, key data and equations

Estimates for the GHG emissions of each of the World Cup Finals were compiled in three main categories:

1. **Air transport (mainly spectators);**
2. **New stadium construction;**
3. **Other sources, including stadium renovation and energy use, surface transport, accommodation, merchandise, and catering.**

The first two categories were found to be the largest in a previous in-depth report on the carbon footprint of football, including World Cups.[34]

The main data used for the three tournaments 2026-2034 is provided in Table A1. This is sourced either directly from official information released in advance on each event,[35] calculated from that information, or extrapolated from data on previous comparable World Cup Finals.[36] For example, for the 2034 tournament to be held in Saudi Arabia, we have used data from 2022 Qatar (on international travel) and 2010 South Africa (on inter-city travel).

Total attendance is the average attendance per match (based on the capacity of the tournament stadiums) multiplied by the number of matches. An individual spectator may attend several matches in a tournament, but are assumed to take only one return journey from their home nation to the host nation(s). Hence, attendance figures for the tournament – based on tickets sold – are converted to numbers of spectators to calculate GHG emissions. The figure for the average number of tickets per spectator is that used for the 2022 Qatar World Cup Finals, i.e. 3.

For all air transport, we have estimated flight patterns for international (and, where appropriate, host nation) spectators based on previous tournaments, adjusted for local conditions. For example, for simplicity, we have used typical flight distances between the host nations and the continents of the participating teams, weighted according to the proportions of teams from those continents. For the 2026 World Cup in North America, all spectators travelling by air are assumed to travel between venues by air (short-haul) due to the large distances, with an average of two flights

	2026: North America	2030: Spain-led	2034: Saudi Arabia
Number of teams	48	48	48
Number of matches	104	104	104
Average attendance per match	70,900	60,400	51,800
Total attendance (A_c)	7,375,000	6,280,000	5,385,000
Average number of tickets per spectator (n_t)	3	3	3
Proportion of spectators by air (f_a)	75%	65%	80%
Number of venues	16	20	15
Number of new venues	0	1	11

Note All figures are rounded.

per spectator. For the 2030 Spain-led World Cup, spectators are assumed to travel between venues by surface transport only. (This is an especially conservative assumption.) For the 2034 World Cup in Saudi Arabia, inter-match travel patterns are estimated based on those in the 2010 World Cup in South Africa, which is a nation of similar size – and so a mix of domestic air travel and surface travel is assumed. These assumptions are reflected in the proportions of spectators travelling by air, which is lowest for the Spain-led World Cup (65%) – as more fans are likely to travel to the tournament by surface travel – and highest for the Saudi Arabian competition (80%) where flying will be more dominant.

The basic calculation for air travel emissions is as follows:

$$E_a = (A_c/n_t) \times (f_a \times 2 \times \Sigma(d_c \times f_c) \times e_s \times e_h)/1000 \quad (1)$$

E_a – total GHG emissions due to air travel by fans in order to attend tournament matches (tCO_2e)

A_c – total attendance at all matches of tournament

n_t – average number of tickets per spectator

f_a – fraction of spectators travelling by air to host cities

d_c – typical travel distance between home nation and host cities (km), which is averaged for each continent

f_c – typical fraction of air travellers from each continent

e_s – emissions conversion factor for flights ($kgCO_2e$/km/passenger)

e_h – additional heating multiplier due to high altitude impacts of air travel (see Appendix 2)

Note that we have used conservative figures for e_s, the GHG emissions conversion factors for air travel – as discussed in Appendix 2.

For new stadium construction, we have used the latest information available – that no new stadiums will be constructed for the 2026 Finals, one for the 2030 tournament, and 11 for 2034. Emissions for construction of a single stadium are assumed to be 270,000tCO_2e, in line with an earlier estimate for Qatar.[37] Note that we have included the total construction emissions for stadiums in our totals, rather than just a small fraction as previous official FIFA assessments have done. This is in line with the official practice now used for assessing the GHG emissions of the Olympics, although FIFA has yet to switch to this methodology.[38]

For other sources, for the 2026 Finals, we have used an average total from the previous four World Cup Finals, scaled up in proportion to the higher number of matches. This seems reasonable in terms of accommodation, surface transport, stadium energy use, catering, and merchandise – which are all strongly affected by attendance levels. Then, for 2030 and 2034, we have assumed a 20% reduction in this level compared to each previous tournament to account for improved climate measures. Over time, emissions per head is expected to fall as economies decarbonise and FIFA mandates increased climate action. However, the pace should be set against the increased energy use per head that will likely arise due to greater cooling requirements for tournaments taking place in a rapidly heating world, and resistance to climate action in oil-producer nations, for example, Saudi Arabia, the host nation for the 2034 competition.

Emissions from new stadium construction will be markedly lower for 2026 and 2030 – as the host nations chosen already have many large World Cup-sized venues, although significant renovation work will still be required. However, these reductions are very unlikely to offset the increases in air transport and other emissions. The 2034 tournament in Saudi Arabia fares poorly in all emissions categories.

A further point is that we estimate that GHG emissions due to future World Cup qualification are unlikely to change a great deal over the next decade. The number of matches required is likely to be similar and air transport emissions are unlikely to fall significantly due to major technological obstacles.[39] One thing that could change, however, is that the number of national entrants may fall, as smaller and more climate vulnerable nations decide that they do not have the resources to enter the competition.

We have also carried out additional calculations of air travel emissions, and the associated tournament totals, based on higher figures for the emissions conversion factors – see Table 2. The scientific explanation of the use of different emission factors is explained in Appendix 2. Based on this, we think there is a strong case for using the figures in Table 2 to guide policy decisions.

Appendix 2: Methodology for aviation GHG emissions

Recent scientific research has concluded that the heating effect of non-CO_2 emissions from aviation in the upper atmosphere make up the majority of the total heating effect due to air travel. Specifically, “aviation emissions are currently warming the climate at approximately three times the rate of that associated with aviation CO_2 emissions alone”.[40] However, we note that the value for the multiplier published most recently by the UK government[41] is 1.7 in line with an older ‘GWP’ methodology (for a 100-year timeframe). Hence, we have used the 1.7 figure in our basic calculations. However, for the ‘upper’ estimates, we have used the factor of 3, in line with the revised ‘GWP*’ method for a 100-year timeframe.[42]

We think the UK government should revise their figures in light of the latest research.

We also note that in our previous report,[43] we used a multiplier of 1.9, which was the best estimate available at that time. Hence, we now think that these earlier estimates for football emissions related to air travel were also very conservative.

Appendix 3: Calculating the GHG emissions of a sponsorship deal

The size of the GHG emissions induced by a sponsorship deal – which we label ‘E_s’ – are affected by four main factors:

- the value of the sponsorship (or investment) deal (V_s);
- the annual revenue (gross) of the sponsoring company (V_c);
- the annual GHG emissions (scopes 1, 2 and 3) of the sponsoring company (E_c); and
- a measure of the financial return that the sponsor expects from the deal (r).

Researchers have used common economic theory and practice to combine these variables into the following equation (2):[44]

$E_s = E_c \times V_s / (V_c \times r)$ (2)

The financial return required by the sponsor is in this instance called the Weighted Average Cost of Capital (WACC). It is affected by numerous factors, but is often in the region of 7%,[45] so this is the factor we use in this analysis.

Appendix 4: Stadium HVAC Load Calculations and Cooling Capacity

When calculating the necessary HVAC cooling capacity for large assembly venues, industry-standard load factors are applied. These factors consider multiple heat sources, including sensible heat from occupants, latent heat from moisture generation, and operational loads from lighting systems and equipment.

The calculations factor in cooling infrastructure needs, which require approximately 18 tons of additional capacity per 1,000 occupants, based on established engineering standards for high-density assembly venues. This calculation incorporates an estimated 400 BTU per occupant for peak loading conditions in auditoriums and high-density venues.[46]

The conversion to cooling tons uses the standard refrigeration ton equivalency of 12,000 BTU/hr, with additional safety factors incorporated for peak event conditions and equipment redundancy requirements.

The Wembley Stadium engineering analysis provides real-world validation of these theoretical calculations. Wembley demonstrates 6,200 tons of total cooling capacity for 90,000 peak occupancy in a 190,000 square foot conditioned space.[47]

Occupant Load Analysis: Using Wembley's documented 300 BTU/hr per person load factor, the occupant-specific cooling requirement equals 2,250 tons (36.3% of total capacity). This translates to 25 tons per 1,000 occupants, which validates our conservative design factor of 18 tons per 1,000 occupants as appropriate for preliminary planning.

Complete Load Distribution: The Wembley analysis reveals that building envelope loads significantly contribute to stadium cooling requirements. The horizontal radiation load from the large roof area creates the largest single heat gain, demonstrating why total stadium cooling capacity significantly exceeds occupant-only calculations.

Our conservative factor of 18 tons per 1,000 occupants provides an appropriate design margin for preliminary calculations, whereas Wembley's actual performance demonstrates 25 tons per 1,000 occupants under full-load conditions.

Report credits

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Cool Down – the sport for climate action network

Cool Down is a global movement mobilising athletes, fans, and sports institutions to demand climate action within and beyond sport.

cooldownclimate.org

Environmental Defense Fund (EDF) is a leading international advocacy organisation focused on tackling climate change through science, economics, and policy.

edf.org

Badvertising

'Badvertising' is a campaign to stop adverts and sponsorships fuelling the climate emergency. This includes, amongst others, ads and sponsorships for cars, airline flights and fossil fuels.

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