

The Environmental Red Card: Sports, Carbon Emission and Climate Change

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(Received 18 July, 2025; Accepted 27 September, 2025)

ABSTRACT

The global sports industry, celebrated for its capacity to inspire and unite billions, is simultaneously a significant and under-scrutinized contributor to the global climate crisis. The primary sources of emissions are extensive, encompassing Scope 1 and 2 emissions from energy-intensive stadium operations, including electricity, heating, and cooling, as well as the immense Scope 3 emissions generated from global travel for athletes, staff, and fans. Major sporting events like the Olympics and World Cup exemplify this issue, producing emissions comparable to those of small nations through construction, logistics and international aviation. Beyond its direct contributions, the industry faces severe operational threats from the escalating climate emergency. Rising temperatures increase heat stress risks for athletes and spectators, wildfires and poor air quality lead to event cancellations and rising sea levels threaten iconic coastal venues. This creates a paradoxical cycle where sports events exacerbate the very phenomena that increasingly disrupt them. However, the industry's unique cultural influence also presents an unparalleled platform for climate leadership and public engagement. Thus, the paper employs the metaphor of "The Environmental Red Card" to critically evaluate the sector's substantial carbon footprint and its multifaceted relationship with climate change. By implementing authentic, ambitious and transparent policies, sports organizations can not only significantly reduce their own environmental impact but also leverage their massive media reach to educate fans, normalize sustainable practices, and advocate for broader climate action.

Key words: Carbon footprint, Sports sustainability, Climate mitigation, Athletic event logistics

Introduction

In the collective imagination, sports exist as a realm of pure endeavour, a thrilling spectacle of human potential seemingly detached from the grim realities of the world beyond the stadium walls. For ninety minutes or four quarters, fans are transported, united by a common passion, their cheers echoing under floodlights or beneath an open sky. This world of pristine pitches, slick asphalt parking lots,

and gleaming arenas has long presented itself as a temporary escape. Yet, the undeniable truth is that the world of sport is not an isolated bubble; it is deeply embedded within the global economic and logistical framework and consequently, it is a significant contributor to the very crisis that threatens its very existence: climate change (Bernard *et al.*, 2021; Mathew, 2024). The industry, from local tournaments to global mega-events, operates on a carbon-intensive model that leaves a formidable envi-

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ronmental footprint, drawing an urgent and unavoidable link between the games we love and the warming planet we inhabit (Xuan *et al.*, 2025; Su *et al.*, 2025).

The carbon footprint manifests across every facet of modern sport where the most visible impact comes from mega-events like the Olympics or the FIFA World Cup, which involve the construction of energy-guzzling new infrastructure, the influx of millions of spectators *via* air travel and the immense energy demands of hosting and broadcasting the event worldwide (Simon *et al.*, 2024; Bae and McCullough, 2025). The constant calendar of international fixtures, with teams and athletes crisscrossing continents on a weekly basis, generates a relentless stream of aviation emissions. The daily operations of massive stadiums, requiring vast amounts of energy for lighting, temperature control and concessions, further compound the problem. Even beyond the professionals, the carbon cost of amateur sports adds another layer to this complex challenge. Thus, the paper employs the metaphor of “The Environmental Red Card” to critically evaluate the sector’s substantial carbon footprint and its multifaceted relationship with climate change.

Sports and carbon footprint

The world of sport, celebrated for its capacity to inspire and unite, operates within a paradox where it promotes health and community while its modern incarnation is inextricably linked to a massive and multifaceted carbon footprint. This environmental impact is no longer a peripheral concern but a central challenge that threatens the very infrastructure and future of global athletics (Ceccon *et al.*, 2024). The footprint extends from the local pitch to the international mega-event, encompassing a complex web of direct and indirect emissions primarily stemming from energy use, travel and infrastructure. The most significant contributor to sport’s carbon ledger is undoubtedly travel (Vienapindienė *et al.*, 2023). The structure of elite competition, particularly for international leagues and global tournaments, necessitates a constant, relentless cycle of air and road travel. Teams, officials and crucially, millions of spectators crisscross the globe, generating a staggering volume of aviation emissions, which are among the most potent greenhouse gases. This is compounded by the energy required to power the vast arenas themselves. Massive stadiums, often running 24/7, consume enormous amounts of electricity for

lighting, giant screens, temperature control and concessions, frequently sourced from fossil fuel-powered grids. The FIFA 2022 Qatar World Cup carbon emissions estimated by FIFA to be around 3.6 million tonnes (Dufrasne *et al.*, 2022). Furthermore, the construction of new sporting infrastructure, especially for one-off mega-events like the Olympics or the World Cup, carries a immense embodied carbon cost from the manufacturing of steel and concrete, often involving the demolition of existing sites and development on greenfield land.

Beyond the professional sphere, the grassroots level also contributes significantly. The manufacturing and global distribution of sporting apparel and equipment, the travel of amateur teams to competitions and the maintenance of countless fields and facilities all aggregate into a substantial carbon sum. The irony is acute: the pursuit of physical activity and well-being is inadvertently accelerating an environmental crisis that poses profound risks to public health and outdoor life (Li, 2023). The industry now faces a critical imperative to mitigate this impact which requires a fundamental shift away from carbon-intensive practices through intentional strategies. Thus, the environmental impact of sports is vast and multifaceted, extending far beyond the playing field. Its carbon footprint can be broken down into several key areas, with some contributing far more than others.

The travel penalty: The single largest source of emissions in sports is travel which includes the constant flying of professional teams across continents for leagues and tournaments, the charter flights of athletes for international competitions, and the massive mobilization of fans that travel globally to attend events. A single Premier League football match can see away fans travel over 10,000 cumulative miles (Erta^o *et al.*, 2019).

Energy-intensive stadiums: Modern stadiums are energy behemoths. The electricity required to power massive floodlights, giant HD screens and temperature control systems for both open-air and domed venues creates a huge demand, often met by fossil fuels. On non-game days, these facilities continue to consume energy for maintenance, heating and cooling, contributing to a steady baseline of emissions (Herold *et al.*, 2024). While some newer venues have incorporated solar panels, many older structures remain reliant on carbon-intensive grid power.

The supply chain and infrastructure: The emissions from building new sporting infrastructure are stag-

gering. The construction of stadiums, parking lots and access roads requires vast amounts of carbon-intensive concrete and steel (Xuan *et al.*, 2025). Furthermore, the lifecycle of sporting well adds a substantial, often overlooked, layer to the industry's carbon footprint. The culture of single-use plastics at concessions stands further compounds the problem, generating both emissions and waste.

An unlevel playing field: How climate change threatens sports

The world of sport is built upon a foundational promise of fairness, a level playing field where competition is determined by skill, strategy and athleticism. Yet, an insidious and powerful opponent is now undermining this very principle, introducing a profound and uncontrollable variable that respects no league boundaries or final whistles: climate change. This global threat is no longer a distant spectre but a present and active disruptor, warping the fields of play, altering the conditions of competition and jeopardizing the very future of countless sports. The playing field is becoming fundamentally unlevel, not through human design, but through environmental degradation. The most immediate impact is felt through the rapidly escalating dangers of extreme heat. Athletes, from weekend marathon runners to elite soccer players, are competing in increasingly perilous conditions. Soaring temperatures elevate risks of heatstroke, dehydration, and catastrophic cardiac events, forcing event cancellations, altering performance outcomes, and placing an unacceptable health burden on competitors (Plakias *et al.*, 2024). The materials of the games themselves are changing; turf fields become blistering hot plates and equipment behaves differently in dense, warm air. Beyond the heat, the weather becomes more volatile and violent. Major matches are delayed or abandoned due to unprecedented rainfall and flooding, while wildfires, fuelled by hotter, drier conditions, blanket regions in toxic smoke, cancelling training and competitions for weeks and damaging respiratory health.

For winter sports, the existential crisis is even more stark. The reliable cold required for skiing, snowboarding and ice hockey is vanishing. Glaciers are retreating, and natural snowfall becomes less predictable, forcing a complete reliance on energy-intensive artificial snow-making, which itself contributes to the problem. The shorter winter seasons and melting ice are shrinking the operational win-

dows for resorts and rinks, threatening local economies and the cultural fabric of communities built around these activities. Rising sea levels and increased coastal erosion pose a direct threat to the infrastructure of waterside stadiums and golf courses, literally washing away the grounds we play on. In short, the relationship between sports and climate change is not a one-way street. The industry is increasingly vulnerable to the very disruptions it helps to cause, creating a vicious cycle that threatens its very existence.

The environmental 'Red Card'

In sports, the "environmental Red Card" uses the metaphor of a red card for a significant foul to represent environmental challenges, such as climate change, as a serious transgression that requires an immediate halt and action from those involved in the sport. This is not a disciplinary tool wielded by a referee for a dangerous tackle, but a powerful symbolic gesture issued by athletes, fans and activists against the games they love. It represents a growing, urgent demand for sports to reform its environmentally damaging practices and live up to its potential as a force for planetary good. It represents a growing, global demand for the world of sports to not just be a spectacle, but to become a leader in the fight against climate change and environmental degradation. The concept is simple yet profound, as its meaning extends far beyond the physical card. It is a metaphor for a wholesale calling-out. Athletes are now showing this proverbial red card by speaking out, using their immense platforms to question the carbon footprint of constant travel, the waste generated by mega-events and the irony of competitions being sponsored by the largest polluters. They are refusing to be silent partners in a system that contradicts the very health their profession embodies.

Furthermore, the environmental hypocrisy of many sporting institutions has become impossible to ignore. The world marvels at the engineering marvel of a Formula 1 car, while ignoring the colossal carbon footprint of its global travel circus. In 2019, Formula One calculated their carbon emissions to be 256,551 tonnes and by 2022, these emissions had reduced to 223,031 tonnes (Gallagher, 2021). Hopefully, now the Formula 1 is reducing the emissions and parading towards net zero. Thus, the environmental red card is more than a protest; it is a demand for a new playbook. It calls for sports governing bodies to implement tangible sustainability mea-

tures: transitioning to renewable energy in stadiums, imposing strict zero-waste policies for events, prioritizing public transport for fans, and choosing sponsors based on ethical and environmental standards, not just the size of their wallets. It demands that the values of fairness, respect, and striving for a better future, values so intrinsic to sport itself, be applied to the planet. Ultimately, the environmental red card signals a critical shift. The world of sports can no longer exist in a bubble, separate from the world's most pressing crisis.

Strategies for a sustainable sports industry

The immense scale and global influence of the sports industry means its environmental footprint is significant, but this also positions it as a powerful agent for change. Confronted by the undeniable realities of climate change, from event cancellations to endangered winter sports, the sector must move beyond symbolic gestures and implement a comprehensive suite of sustainable strategies. This transformation requires a concerted effort from every stakeholder to fundamentally reengineer how sports are organized, operated and consumed, ensuring their longevity on a healthy planet. A primary focus must be on decarbonizing operations, starting with the massive carbon footprint of travel. Leagues must optimize fixtures to minimize air miles, prioritizing regional play where possible and investing in carbon offset programs for essential travel that meets rigorous standards. The infrastructure of sport itself must be revolutionized. Existing and new stadiums should be transformed into models of efficiency, powered by onsite renewable energy sources like solar panels and wind turbines, equipped with water recycling systems and built with sustainable materials. The shift to a circular economy for merchandise is crucial, moving away from fast fashion by producing high-quality, durable apparel from recycled materials and establishing take-back programs for end-of-life recycling.

The net-zero game plan: Sports organizations must move beyond token gestures and commit to science-based, net-zero emissions targets which requires a rigorous accounting of all Scope 1, 2 and 3 emissions (including fan travel). Leagues must mandate comprehensive carbon reporting and invest in high-quality carbon offset projects only for emissions that cannot yet be eliminated.

Decarbonizing travel and logistics: This is the most critical hurdle. Solutions include optimizing sched-

ules to minimize long-distance travel, prioritizing rail over air travel for domestic competitions and investing in sustainable aviation fuel (SAF) for necessary flights. For fans, initiatives like providing subsidized public transport, creating park-and-ride schemes and promoting virtual attendance options can drastically reduce the carbon footprint of a matchday.

Building green venues: Every stadium and arena must become a model of sustainability. This means retrofitting old venues with LED lighting and high-efficiency systems, and designing new ones to the highest environmental standards. Installing on-site renewable energy generation, implementing water recycling systems and enforcing a strict zero-waste policy by eliminating single-use plastics and championing circular economy principles are all essential steps.

Leveraging influence for change: The greatest asset of sports is its platform. Teams and athletes are trusted influencers who can educate billions of fans on climate action. By broadcasting sustainability initiatives, promoting plant-based food options in stadiums and using their media reach to advocate for policy changes, sports can normalize green behaviour and drive change on a scale far beyond its own operational footprint.

Conclusion

The intersection of sports, carbon emissions and climate change represents a critical frontier in the global effort to address environmental degradation. The concept of the environmental red card has emerged as a powerful tool to hold the sports industry accountable. It is evident that sports, despite their cultural and social significance, contribute substantially to carbon emissions and ecological harm. From massive infrastructure projects to energy-intensive events, travel and supply chains, the environmental footprint of sports are undeniable. Yet, the industry's influence also offers a unique platform for driving change, raising awareness and modelling sustainable behaviour. The urgency of climate change demands that all sectors of society, including sports, take meaningful action. The environmental red card is not just a metaphor; it is a call to action for athletes, fans, organizations and policymakers to rethink how sports are organized, consumed and valued. Moreover, sports entities must use their visibility to educate and inspire bil-

lions of people worldwide, leveraging the emotional connection fans have with their teams and heroes to foster a culture of sustainability. However, a shift in mindset is pivotal from viewing environmental responsibility as an optional add-on to making it a core value of sports governance and culture. To conclude, the environmental red card serves as a stark reminder that sports cannot exist in a vacuum. The games are intimately connected to the health of the planet and the time for half-measures and greenwashing is over. The sports industry must face its responsibilities with courage and creativity, transforming itself into a leader in the fight against climate change. By doing so, it can not only reduce its own footprint but also inspire a broader societal transformation toward a more sustainable and net zero future.

Conflict of Interest - None

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