

Game Plan for a Warmer World: Assessing the Climate Change
Readiness of National-Level Canadian Sport Organizations

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Climate change is increasingly affecting sports, with warming temperatures and extreme weather events disrupting training and competition schedules, heightening health risks for athletes, coaches, and spectators (e.g., heat-related illnesses), as well as damaging sports infrastructure (e.g., flooded fields). At the same time, many sports and sports tourism are carbon intensive, prompting growing commitments to reduce emissions in line with the Paris Agreement. This study applies a structured content analysis, guided by an adapted climate policy integration (CPI) framework, to assess the climate change readiness of national-level Canadian sport organizations (n=86), including Sport Canada, Multisport Service Organizations (MSOs), and National Sport Organizations (NSOs). The integration of climate or environmental considerations into sport governance is critical for supporting the sector's transition to low-carbon and climate-resilient operations. However, an analysis of official documents and websites found that the climate responses of national-level Canadian sport organizations are fragmented and insufficient, with 29.1% of organizations referencing climate change or environmental sustainability across any communication platform, 19.8% disclosing mitigation or adaptation initiatives, and only 3.5% showing alignment with international climate policy, such as the UN Sport for Climate Action Framework. It is argued that sport organizations must embed climate objectives into strategic planning, strengthen alignment with national climate policy, and build capacity for implementation. This transition should be supported by federal leadership, access to guidance and sector-specific resources, as well as international climate frameworks and best practices in sport sustainability.

Keywords: Sport organizations; Climate change; Sustainability; Adaptation; Climate risk

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Dedication

This thesis is dedicated to my mamma, who taught me to reach for the stars.

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Chapter 1

Introduction

1.1 Research Context

Climate change is a present reality that touches every part of the planet, reshaping lives, ecosystems, and economies. There is overwhelming scientific consensus that climate change is unequivocal and primarily driven by human-induced greenhouse gas (GHG) emissions, which are increasing global temperatures, intensifying the frequency and severity of extreme weather events (e.g., floods, storms, droughts, heatwaves) and causing physical changes in landscapes (e.g., sea-level rise, loss of glacier mass) (Intergovernmental Panel on Climate Change [IPCC], 2021). United under the Paris Agreement, 195 countries have pledged to limit long-term global warming to below 2°C above pre-industrial (1850-1900) levels, with the more ambitious target of 1.5°C to prevent the worst effects of climate change (United Nations Framework Convention on Climate Change [UNFCCC], 2015). In 2024, the global mean surface temperature reached 1.55°C (± 0.13) above pre-industrial levels (1850-1900), marking the first calendar year to exceed the 1.5°C threshold set out in the Paris Agreement (World Meteorological Organization [WMO], 2025). The record warm 2024 was accompanied by record-high carbon dioxide (CO₂) emissions of 37.4 billion tonnes, a 0.8% increase from 2023 (Global Carbon Budget, 2024). While short-term climate variability may temporarily surpass the 1.5°C threshold, the World Meteorological Organization (WMO) (2024) emphasizes that this does not signify a failure to meet the goals of the Paris Agreement.

Nevertheless, the latest United Nations Environment Programme (UNEP) (2024) Emissions Gap Report revealed that current mitigation efforts remain insufficient, with

temperatures projected to rise by up to 3.1°C by the end of the century as countries fall short of emission reduction benchmarks. To align with the 1.5°C target, global emissions must be cut by 42% by 2030 and 57% by 2035, relative to 2019 levels (UNEP, 2024). Meeting the scale of this decarbonization challenge requires rapid action across all areas of society to achieve emission reduction targets and transition to net-zero by 2050. Although 145 countries have pledged to reach net-zero emissions, collectively covering nearly 90% of global emissions, many of these commitments lack robust near-term policies and implementation strategies (Climate Action Tracker, 2023).

As climate change accelerates and its impacts unfold across natural and human systems, the global sports sector is under mounting pressure to adapt and reduce its own emissions (Goldblatt, 2020). The relationship between sport and climate change has become more evident and urgent, with growing media coverage drawing attention to the physical risks for athletes and disruptions to events (e.g., cancellations) (Mehra et al., 2025; Orr et al., 2022a) as well as highlighting the carbon intensity of some sports, particularly those with significant travel demands (e.g., Formula 1) (Wilby et al., 2023). For example, at the 2020 Tokyo Olympics, record heat and humidity led to 78 cases of exertional heat illness, resulting in medical interventions and athlete withdrawals (Soligard et al., 2023). In the United Kingdom, the Football Association reports over 120,000 soccer matches cancelled annually due to flooded fields (British Association for Sustainable Sport [BASIS], 2023). Meanwhile, slow-onset impacts such as declining snow reliability are also taking a toll; in the 2023/24 season alone, the International Ski and Snowboard Federation (FIS) cancelled 26 World Cup races due to poor conditions (WMO, 2024). In turn, climate change is imposing a fundamental shift in the traditional business models and operations of sport organizations to not only adapt to the direct

impacts of new climate realities, but to also align with evolving national policy landscapes to reduce GHG emissions (Orr & Inoue, 2019).

The sports sector contributes to global emissions through multiple channels, including athlete and spectator travel, facility operations, and equipment production (Wilby et al., 2023). Estimates from the Rapid Transition Alliance suggest that the global sport sector produces approximately 300-350 million tCO₂e, although this is likely an underestimation as emissions are often hidden within broader sectors (e.g., tourism) (Goldblatt, 2020). Sport's carbon footprint may be comparable to that of a medium-sized country (Goldblatt, 2020), ranking 18th globally and roughly equal to the United Kingdom, according to 2023 levels (World Population Review, 2025). In response, the United Nations (UN) launched the *Sports for Climate Action Framework* in 2018 (UNFCCC, 2020). Co-developed with the International Olympic Committee (IOC), the UN framework seeks to reduce emissions while leveraging sports' global reach to inspire climate action among participants and spectators (UNFCCC, 2020). Nearly 300 sport organizations from different levels have joined, committing to halve emissions by 2030 and reach net-zero by 2040 (i.e., targets that are more ambitious than the Paris Agreement) (UNFCCC, 2021). Yet, despite the growing awareness, evidence indicates that the majority of sport organizations remain ill-prepared to adapt to climate risks and reduce emissions (Goldblatt, 2020; Hugaerts et al., 2023; McCullough et al., 2020c; Orr & Inoue, 2019; Wall-Tweedie & Nguyen, 2018; Werner, 2024; Wilby et al., 2023). The number of signatories to the UN Framework represents less than 0.1% of the global sport system, with many organizations still in the early stages of understanding their responsibility to address climate change (Goldblatt, 2023; Global Sustainable Sport, 2023).

1.2 Problem Statement

Sport plays an important role in Canadian culture and society, contributing to social and community development, health and wellbeing, education, and economic growth (Sport Information Resource Centre, 2002). Participation in sport is associated with improved mental health, self-esteem, and emotional regulation (Eime et al., 2013), and plays a key role in fostering social inclusion, especially among marginalized groups (Lange et al., 2024). It has also been linked to positive youth development outcomes, including greater school engagement, reduced risk-taking behaviours, and stronger peer relationships, particularly when participation occurs in supportive and inclusive environments (Holt et al., 2017). These benefits are especially significant given that, according to a recent survey by the Canadian Fitness and Lifestyle Research Institute (2024), 68% of children and youth (ages 5-17) participate in some form of sport across Canada. The widespread participation underscores the significance of the sport, physical activity, and recreation sector, which is estimated to contribute approximately \$37.2 billion annually to Canada's GDP, generating direct and indirect benefits (e.g., increased visitor spending, job creation, infrastructure development) (Canadian Fitness and Lifestyle Research Institute & Canadian Parks and Recreation Association, 2023). However, the economic benefits of the sector are likely far greater, with exact estimations difficult to quantify due to its expansive and diverse subsectors, including outdoor recreation (e.g., skiing, golf, kayaking) (valued at \$101.6 billion) (Protect Our Winters Canada, 2024), and sport tourism (valued at \$7.4 billion) (Sport Tourism Canada, 2021) (see section 2.10).

Over the past decade, Canada has experienced a more than twofold increase in annual weather alerts, including extreme heat events, heavy rainfall, severe storms, and hazardous levels of air pollution (Environment and Climate Change Canada [ECCC], 2023). Climate projections

indicate that extreme weather events will intensify in frequency and severity if emissions continue unabated (IPCC, 2023). ParticipACTION's (2024) Report Card on Physical Activity raises concerns about how rising temperatures and extreme weather are compromising safe access to sport in Canada, particularly for young children, who are more vulnerable to climate-related hazards like extreme heat due to their limited ability to regulate body temperature. Specifically, extreme weather conditions are contributing to more days when outdoor play is unsafe, school recesses are moved indoors, and sports are canceled (ParticipACTION, 2024). The report further underscores that climate change is becoming a barrier to physical activity and calls for greater attention from policymakers, public health officials, and sport organizations. In light of these challenges, the Canadian sport sector must take responsibility for addressing climate risks by implementing adaptive measures to protect participants while also ensuring their actions do not contribute to future climate change (i.e., reducing climate altering emissions).

Many sports rely on natural resources (e.g., water, temperature, snow, ice) and favorable weather conditions—all of which are increasingly affected by climate change, especially as Canada warms at twice the global average (ECCC, 2023). Changing climate conditions threaten the integrity of playing conditions, infrastructure, and event scheduling, with far-reaching implications for both the sector and society (Orr et al., 2022a). Recent media coverage highlights the prevalence of disruptions owing to climate-related challenges, such as the 2024 cancellations of the Women's Alpine Skiing World Cup at Mont-Tremblant (Alpine Canada, 2024) and the Plaster Rock World Pond Hockey Championship, attributed to unseasonably warm weather (Rudderham, 2024). Similarly, other events have faced comparable outcomes, such as the 2023 Penticton Triathlon, which was canceled due to wildfires (Triathlon BC, 2023), and the 2022 Manitoba Marathon, where extreme heat forced a mid-race cancellation (Keele, 2022). Each

climate-related disruption brings financial (e.g., lost ticket sales, reduced sports tourism revenue) (Dingle et al., 2023; Scott & Steiger, 2024), social (e.g., reduced community engagement, barriers to participation) (BASIS, 2023; ParticiP ACTION, 2024), and legal risks (e.g., liability for failure to ensure safety standards, breach of contracts) (Environmental Defenders Office [EDO], 2024). While sport organizations cannot directly control climate change, they can (and must) build adaptive capacity through targeted efforts such as risk management (e.g., identifying climate vulnerabilities and developing contingency plans) in order to safeguard athlete wellbeing and protect financial sustainability (Orr & Inoue, 2019).

Despite increasing awareness and media attention on climate change impacts in sport, there is still limited research on how sport organizations are responding to these risks (Mallen et al., 2025; Orr & Inoue, 2019). A unified approach among organizations and stakeholders is lacking, with studies on the adverse effects of climate change and subsequent response strategies remaining fragmented across disciplines (Orr et al., 2022a), including health and medicine (e.g., Mason et al., 2024), environmental sciences (e.g., Gollagher & Fastenrath, 2023), tourism (e.g., Scott & Steiger, 2024), and sports management (e.g., McCullough et al., 2020a). Existing research has predominantly concentrated on winter sports (e.g., skiing; Steiger et al., 2019) and professional and mega-event contexts (e.g., Soccer World Cup; Mullan et al., 2025), while smaller regional and local sports have received little attention (Cury et al., 2023a; Hugaerts et al., 2023; Werner, 2024). The Canadian context remains underexplored, with notable exceptions in golf (Scott & Jones, 2006, 2007; Scott et al., 2018), ski tourism (Knowles et al., 2024b; Ruddy et al., 2017; Scott et al., 2019b), and community infrastructure (Dingle & Mallen, 2021; Mallen & Chard, 2012). No research has examined the climate capacity of Canadian sport organizations, particularly their efforts to (1) adapt to physical climate impacts and (2) mitigate emissions. Yet,

sport organizations actively seek to improve their climate response, as evidenced by partnerships between the Canada Games and Racing to Zero, an Olympian-led organization specializing in carbon footprint assessments (Canada Games, 2024). Existing gaps highlight the need to examine how Canadian sport is responding to the issue of climate change.

1.3 Research Objectives

The presented thesis aims to assess the climate change readiness of national-level Canadian sport organizations, including Sport Canada, Multisport Service Organizations (MSOs), and National Sport Organizations (NSOs), are adapting to climate risks and integrating emission reduction strategies. A content analysis of public documents (e.g., annual reports, strategic plans, sustainability reports) and website content was conducted to do so. To achieve this goal, the research was guided by five key objectives:

1. Assess how national-level Canadian sport organizations incorporate climate change or environmental concerns into their strategic planning and public communications, using a climate policy integration framework.
2. Identify the initiatives (adaptation vs mitigation) undertaken by national-level Canadian sport organizations in response to climate change.
3. Evaluate how national-level Canadian sport organizations' climate responses align with national climate strategies (e.g., emission reduction targets) and international frameworks (e.g., UN Sport for Climate Action Framework).
4. Compare the climate responses of national-level Canadian sport organizations with those of international counterparts to highlight similarities, differences, and best practices.
5. Develop practical recommendations to strengthen the collective climate response of national-level Canadian sport organizations, grounded in the sport policy context.

As the first study to examine the climate change readiness of Canadian sport organizations at any level, this research establishes a foundation for future studies in the subject area and informs the development of strategies to enhance adaptive capacity and leadership to support a sustainable, low-carbon sport sector.

1.4 Structure of Thesis

This thesis has been organized into six chapters: Introduction; Literature Review; Methods; Results; Discussion; and Conclusion. Chapter 1 provides an overview of the research study, outlining its purpose and objectives. Chapter 2 reviews relevant literature, including topics on climate change, impacts on sport, adaptation measures, and emissions mitigation. Chapter 3 details the methods employed in this research. Chapter 4 presents the findings derived from the content analysis. Chapter 5 examines how the findings align with the research objectives, exploring their implications for Canadian sport organizations while comparing strategies, and outcomes with global leaders. Finally, Chapter 6 concludes by reflecting on the intersection of climate change and sport and presenting avenues for future research.

Chapter 2

Literature Review

This chapter reviews the existing literature on the relationship between sport and climate change, focusing on the impacts, vulnerabilities, and response strategies visible across the sector. Sport is defined in this research according to Guttmann's (2004) interpretation, which includes three elements: (1) competition, (2) physical activity, and (3) rule-governed structures. Within this definition, the scope is limited to organized sport, including teams, leagues, governing bodies, events, venues, athletes, and travel associated with sport participation and operations. The broader sport industry includes public and private actors producing, organizing, promoting, or facilitating sport-related activities and experiences (Best & Howard, 2023). This distinction is important, as organized sport operates within a structured institutional context that differs from recreational physical activity (Bernard et al., 2021) and tourism (Steiger et al., 2019), both have received greater attention in climate adaptation research. The chapter begins by situating sport as a socially and economically significant sector with global influence. It then turns to the climate-related risks facing sport, including health, infrastructure, financial, legal, and reputational challenges, before outlining the current state of organizational responses and identifying key gaps in climate readiness, particularly at the national level. Finally, the chapter situates the present research within this broader context by examining the significance of the Canadian sport sector, alongside the sport governance structures and national conditions that shape climate action efforts in Canada.

2.1 The Sports Sector

Sport is a cornerstone of human culture and society, engaging millions of people worldwide and providing benefits that extend beyond physical activity, including promoting mental wellbeing, social inclusion, and community identity (Lee et al., 2013). The UN recognizes sport as a catalyst for sustainable development and social change, playing a role in advancing conversations on racial justice, gender equality, and environmental sustainability (UN, 2018). The global sports market, defined in terms of direct revenue streams from spectator and participant sports, is valued at approximately USD\$508 billion (CAD\$723 billion), and projected to reach USD\$635 billion (CAD \$904 billion) by 2029 (The Business Research Company, 2025). However, estimates of the total economic value vary due to differences in analytical scope and the classification of sector components. For instance, the Best-Howard Model estimates the industry's full economic value at USD\$2.65 trillion (CAD\$3.81 trillion), based on a bottom-up approach that compiles revenue data from three areas: fan engagement (e.g., events, media, entertainment), sports products (e.g., sportswear, equipment, wellness), and sports participation (e.g., sports recreation, outdoor recreation, fitness) (Best & Howard, 2023). This broader valuation positions sport as the ninth largest global industry (Best & Howard, 2023), with strong growth expected over the next decade, as attributed to several factors, including the expanding role of technological innovation (e.g., artificial intelligence to personalize the fan experience) and emerging markets (e.g., the rise in popularity and investment in women's sports) (Giorgio et al., 2025b; The Business Research Company, 2025).

Sport has an unparalleled global reach, as evidenced by record broadcast ratings (e.g., the 2022 Fédération Internationale de Football Association [FIFA] World Cup final was the most-watched ever, drawing over 1.5 billion viewers; FIFA 2024) and massive in-person attendance

(e.g., 22.5 million fans attended National Basketball Association [NBA] games during the 2023-24 regular season; NBA, 2024). Building on this momentum, established leagues are expanding into new markets and boosting revenue through expanded media rights and international exposure (Giorgio et al., 2025b). For example, the National Football League (NFL) plans to increase its number of international games (e.g., games scheduled in London, Munich, and São Paulo during the 2024-25 season) and introduce additional host countries (e.g., opening offices in Brazil and adding to offices in Canada, Mexico, London, Germany, Australia and China) (Casey, 2024). Similarly, FIFA has expanded the Men's World Cup from 32 to 48 teams (Keh, 2017) with considerations for a similar expansion in future editions of the Women's World Cup (Sheldon & Linehan, 2024).

Alongside global market expansion, women's sport has also experienced significant growth, marked by an increase in visibility (e.g., the 2023 FIFA Women's World Cup drew a record 2 billion viewers; FIFA, 2023), participation (e.g., the Paris 2024 was the first Olympic and Paralympic Games to achieve full gender parity; IOC, 2024b), and commercial viability (e.g., global revenues in women's elite sports projected to reach USD\$2.35 billion [CAD\$3.17 billion] in 2025; Haskel et al., 2025). Professional women's leagues, including the Women's National Basketball Association (WNBA), the National Women's Soccer League (NWSL), and the Professional Women's Hockey League (PWHL), have expanded their operations by adding new franchises and are expected to continue this trajectory in the coming years (Giorgio et al., 2025b). For example, the WNBA plans to introduce three new teams by 2026 (i.e., Golden State, Toronto, and Portland), with a target of 16 franchises by 2028 (Pickman & Vorkunov, 2025), while the PWHL is set to grow from six to eight teams for the 2025-26 season (Donkin, 2025). More and more, women in sport are gaining access to career-building opportunities and the

social recognition they deserve (UN Women, 2024). However, despite notable progress, women remain underrepresented in leadership roles, holding 26.9% of executive positions in international federations and leading 24 of 206 National Olympic Committees (Sport Integrity Global Alliance, 2023). There is still work to be done to reach true equality in sport.

Moreover, mega-events (e.g., Olympic and Paralympic Games) reflect sport's true global reach and influence. The 2024 Olympics in Paris serves as a compelling example of this scale and impact, drawing approximately 5 billion viewers (equivalent to 84% of the potential global audience) (IOC, 2024a), and selling 9.5 million tickets (IOC, 2024c). An independent study revealed that the Paris Games were estimated to generate between €6.7 billion and €11.1 billion (CAD\$9.95 billion to CAD\$16.53 billion) in net economic benefits for the city and surrounding regions, stemming from tourism (30%), construction (28%), and the organization of the Games (42%) (Centre de Droit et d'Economie du Sport, 2024). In parallel, the Paris Games aimed to reduce the environmental impact of sport through a range of sustainability initiatives, including low-carbon construction (with 95% existing or temporary venues), plant-based meal options, and the widespread use of electric vehicles and public transportation for athletes and spectators (IOC, 2024c). Collectively, these efforts successfully reduced the carbon footprint of the Paris Games by 54.6% compared to the average emissions of the 2012 London and 2016 Rio Games (3.5 million tCO_{2e}) (IOC, 2023), resulting in a total carbon footprint of 1.59 million tCO_{2e} (IOC, 2024c). This represents a visible transition toward greater sustainability in major sporting events and reflects a broader movement within the sector to integrate environmental responsibility and climate action into management and planning practices (Goldblatt, 2020). Yet, the carbon footprint of sport remains immense (e.g., energy use, waste generation, frequent travel, tourism),

and in many cases, largely overlooked, especially when considering the cumulative impact of sporting events and participation worldwide (Goldblatt, 2020; Wilby et al., 2023).

2.2 Climate Change

The UN Intergovernmental Panel on Climate Change (IPCC) defines climate change as “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/ or the variability of its properties and that persists for an extended period, typically decades or longer” (IPCC, 2018, p. 544). While natural factors (e.g., volcanic activity, variations in solar radiation) have historically contributed to some amount of climate change, the scientific consensus is clear and unequivocal: the primary driver of recent climate change is the excessive emission of GHGs resulting from human activities (e.g., fossil fuel combustion, industrial processes) (IPCC, 2023). Atmospheric CO₂ concentrations, the largest contributor to GHG emissions, have reached their highest level (422.5 parts per million in 2024) (Global Carbon Budget, 2024) in at least 2 million years, driving large-scale shifts in the global climate system (e.g., rising temperatures, intensification of extreme weather) alongside environmental changes (e.g., sea-level rise, melting glaciers) (IPCC, 2023).

2.2.1 Observed Climate Trends and Future Projections

Global surface temperatures have risen at an unprecedented rate since the pre-industrial era (1850–1900), with 2024 marking the warmest year on record at 1.55°C (±0.13°C) above pre-industrial levels (WMO, 2025). This warming trend is part of a broader pattern of intensifying climate change, as the past decade (2015–2024) stands out as the warmest in recorded history (WMO, 2025). The latest IPCC Sixth Assessment Report (2023) synthesizes mounting evidence of widespread climate disruption, including record ice sheet and glacier loss, rising sea-levels,

and an increase in the frequency and intensity of extreme weather events, including heatwaves, heavy rainfall, and periods of drought. These climatic shifts are exacerbating systemic risks to food and water security, public health, and infrastructure, while also driving ecosystem degradation across terrestrial, freshwater, and marine environments (IPCC, 2023).

Observed and projected climate change impacts are not uniformly distributed. Impact severity is shaped by regional vulnerabilities, socio-economic disparities, and adaptive capacities, which disproportionately affect low-income and marginalized communities, small island nations, and regions heavily reliant on climate-dependent sectors (e.g., agriculture, forestry, tourism) (Birkmann et al., 2022). In Canada, temperatures are rising at twice the global average, and up to three times higher in northern regions, resulting in visible changes to ice and snow conditions, which carry significant economic (e.g., reduced reliability of snow impacting winter and skiing tourism), social (e.g., reduced access to winter roads for remote communities), and cultural consequences (e.g., disruption of traditional practices tied to snow and ice) (Derksen et al., 2019).

Future climate change is unavoidable as the global climate system continues to respond to record emissions. Projections indicate that without greater action, the world is on track for a temperature rise of 3.1°C by the end of the current century, surpassing the Paris Agreement's threshold of limiting global warming to well below 2°C, with a preferred target of 1.5°C (UNEP, 2024). Warming at this scale would bring about catastrophic impacts for natural ecosystems (e.g., biodiversity loss, habitat destruction, oceanic changes) and human societies (e.g., health risks, economic challenges, forced migration), some of which are irreversible (IPCC, 2018). To avoid the worst impacts of climate change and align with the critical 1.5°C target, global emissions must be cut by 42% by 2030 and 57% by 2035, relative to 2019 levels (UNEP, 2024).

Achieving large-scale emission reduction requires a rapid transition away from fossil fuels as our primary energy source while simultaneously accelerating the widespread adoption of renewable energy (e.g., solar and wind) coupled with energy efficiency measures (e.g., retrofitting buildings) (IPCC, 2023). As climate realities shift, the need for adaptation is driving changes in policy agendas, national strategies, and industry practices, prompting early resilience efforts, though much greater ambition and coordination are still needed to manage risks effectively and affordably, presently and in the future (IPCC, 2022).

2.3 The Impacts of a Changing Climate on Sport

Several contributions have emphasized the bidirectional relationship between sport and climate, as sport both experiences the impacts of climate change as a sector dependent on specific weather patterns and seasonal conditions and adds to global emissions through energy-intensive operations, events and tourism (McCullough et al., 2020a; Orr et al., 2022a; Wilby et al., 2023). This dynamic is central to *sport ecology*, an emerging subdiscipline within sport management that looks at the intersection of sport and the natural environment (McCullough et al., 2020a), with recent focus on the impacts of climate change (e.g., Orr et al., 2022a) and the subsequent response of athletes (e.g., Knowles et al., 2024a; Orr, 2025), facilities (e.g., Dingle & Stewart, 2018), organizations (e.g., Orr & Inoue, 2019), and fans (e.g., Orr & Schneider, 2018). To date, more research has investigated the impacts of sport on the environment (e.g., carbon footprint), while comparatively less attention has been given to how environmental change affects sport itself (Knowles et al., 2024a; Mallen et al., 2025; Orr & Inoue, 2019; Orr et al., 2022a).

On one hand, the sport sector (like many others) has underestimated its impact on the environment, overconsuming land and natural resources through the production and consumption

of sport (McCullough et al., 2020a). Several aspects of sport are notably carbon-intensive, with emissions arising from athlete and spectator travel, facility operations, equipment production, and merchandising—contributing to an estimated 300-350 million tCO_{2e} each year (Goldblatt, 2020). The majority of these emissions are indirect, tied to travel and supply chains (Wilby et al., 2023). For example, the 2018 FIFA Men’s World Cup in Russia produced an estimated 2.16 million tCO_{2e}, with travel alone accounting for 74% of total emissions (FIFA, 2016). In response to growing recognition of the environmental implications of sport, a steadily expanding body of research has investigated its impact, ranging from individual participation (e.g., athlete carbon footprints; Chard & Mallen, 2012; Dolf & Teehan, 2015; Wicker, 2019) and spectator behaviour (e.g., mass travel; Locke, 2019; Triantafyllidis et al., 2018; Triantafyllidis & Davakos, 2019) to mitigation efforts (e.g., sustainable stadium design; Kellison & Hong, 2015; Kellison & Orr, 2020; Mallen et al., 2010) (see McCullough et al., 2020a for a review). Importantly, several studies suggest that sport organizations can implement sustainability initiatives not only to mitigate their environmental impact but also protect (and potentially benefit) their financial bottom line (Mallen et al., 2010; Orr & Inoue, 2019; Trendafilova et al., 2013).

On the other hand, sports (particularly outdoor sports) are inherently dependent on stable environmental and climatic conditions, positioning the sector as especially vulnerable to climate change and increasingly contingent on adaptive strategies (Orr & Inoue, 2019). Snow-based sports, such as skiing and snowboarding, for instance, require consistent snowfall to ensure safe and viable operations; declining snowpack and rising temperatures have already curtailed ski seasons across various regional markets (Knowles et al., 2024b; Ruddy et al., 2015). Endurance sports, such as cycling and long-distance running are likewise exposed, as they rely on moderate and predictable temperatures to safeguard athlete health and performance; the increasing

frequency of extreme heat has led to event cancellations, medical incidents and renewed calls for revised scheduling and enhanced safety protocols (Nowak et al., 2022). Each of these climate-related disruptions carries cascading consequences for sport organizations (McCullough et al., 2020b), including reduced revenue (Kay & Vamplew, 2006), infrastructure damage or destruction (Kellison & Orr, 2021), logistical and reputational strain of postponed or cancelled events (Fairley et al., 2015), and a potential decline in public interest and grassroots participation (Dawson et al., 2013). However, research on the (potential and actual) impacts of climate change on sport as well as adaptation strategies remains scarce (Dingle & Stewart, 2018; Mallen et al., 2025; Orr, 2020; Orr & Inoue, 2019; Schneider & Mücke, 2024). This gap leaves sport organizations navigating climate challenges without a clear roadmap for effective response (Orr & Inoue, 2019).

Despite newer contributions, the intersection of sport and climate change continues to represent an emerging area of research, with limited scholarly attention until the past decade (Orr et al., 2022a). Orr et al. (2022a) found that most studies have been published following the IPCC's Fifth Assessment Report (in 2014), with a marked increase in recent years aligned with the influence of the Paris Agreement (in 2015) and the launch of the UN's Sport for Climate Action Framework (in 2018). However, much of the existing research on sport and climate remains fragmented across diverse disciplines, including health and medicine (e.g., Mason et al., 2024), environmental sciences (e.g., Gollagher & Fastenrath, 2023), tourism studies (e.g., Scott & Steiger, 2024), event planning (e.g., Mair, 2024), sociology (e.g., McMillian, 2024), and sport management (e.g., McCullough et al., 2020a). This siloed approach has created an incomplete understanding of cascading climate change impacts (e.g., competition canceled due to a heatwave → revenue loss → increased turf irrigation costs from higher evaporation; Mallen et

al., 2025) and, in turn, how organizations can respond to enhance their adaptive capacity (defined as a system's ability to adjust to changing conditions and reduce exposure to climate-related risks) (IPCC, 2018; Orr & Inoue, 2019).

Orr and colleagues (2022a) conducted a scoping review on the impacts of climate change on organized sport (defined by the researchers as competitions and the organizations that host them), marking the first, and to date, only, effort to map the state of research, contrasting with narrower reviews (e.g., Schneider & Mücke, 2024 on sport and health-related climate risks). Their review identified five key themes in the literature: (1) heat impacts on athlete and spectator health; (2) heat impacts on athletic performance; (3) adaptive measures taken in sport; (4) the suitability of different cities for hosting sporting events, and (5) benchmarking and parameters for safe playing conditions (Orr et al., 2022a). The majority of studies on changing climate conditions have focused on heat (e.g., Sambrook et al., 2023), and warmer winters and associated snow shortages (e.g., Scott et al., 2015, 2019), alongside notable exceptions such as the Olympic and Paralympic Games (e.g., Summer; Gerrett et al., 2019; and Winter; Scott et al., 2015; Steiger & Scott, 2024), golf (e.g., Scott et al., 2018), and ski tourism contexts (e.g., Ruttly et al., 2015). It follows, that a comprehensive overview of climate-related impacts on sport is warranted.

2.4 Athlete Health and Performance

Several studies link the effects of climate change to increased health and performance risks for athletes (Knowles et al., 2024a; Nowak et al., 2022), game officials (Archsmith et al., 2018), and spectators (Mason et al., 2024). In a recent survey by World Athletics, 75% of the 373 elite athlete respondents indicated that climate change directly affects their health and performance, an increase from 66% in 2022 (World Athletics, 2023). This upward trend highlights the need to address challenges that athletes may face from extreme weather events and

shifting seasonal patterns (Bernard et al., 2021). While research has primarily focused on the effects of extreme heat (Dee et al., 2022; Grunstein et al., 2021; Mason et al., 2024; Sambrook et al., 2023), broader health risks linked to climate change remain relatively underexplored (Bernard et al., 2021; Schneider & Mücke, 2024). Schneider and Mücke (2024) provide a review of climate-related health risks, setting apart direct effects (e.g., extreme heat causing heat illnesses; increased ultraviolet [UV] radiation leading to skin and eye diseases; and extreme weather events such as lightning strikes, storms, landslides, avalanches, and flooding), from indirect effects (e.g., heightened air pollution contributing to respiratory issues; increased exposure to allergens; and the spread of bacteria and viruses leading to diseases such as Lyme disease). A range of adaptation and prevention measures have been identified across the literature to reduce health-related climate risks (see Section 2.9). Failure to implement such measures may result in legal challenges, as sport organizations owe a duty of care to athletes and sport stakeholders (EDO, 2024).

2.4.1 Extreme Heat and Heat-Related Illnesses

Widespread observed and projected increases in the intensity and frequency of hot extremes have led to growing concerns about the rising risk of exertional heat illnesses (EHIs) among athletes (Dee et al., 2022; Gamage et al., 2020b; Nowak et al., 2022; Sambrook et al., 2023; Schneider et al., 2024b). Exposure to extreme heat and/or humidity can negatively impact the body's ability to regulate its core temperature, particularly during exercise when it generates additional internal heat (Howe & Boden, 2007). This dual challenge of external environmental stress and internal heat production can overwhelm thermoregulatory mechanisms, increasing the risk of EHIs, which range from mild symptoms (e.g., dehydration, muscle cramps) to more severe conditions (e.g., heat exhaustion, heat stroke) (Howe & Boden, 2007). Exertional heat

stroke, the most severe manifestation of EHI, is listed as the third most prevalent cause of death in athletes during physical activity (Bouchama et al., 2022), which disproportionately (and increasingly) impacts youth sports (i.e., claimed the lives of 67 high school athletes in the U.S. between 1981 and 2022) (Stearns et al., 2024). However, EHIs are entirely preventable and linked to well-understood, manageable risk factors including environmental conditions (e.g., high temperature, humidity, direct sun exposure as assessed using the Wet Bulb Globe Temperature [WBGT] index); exercise intensity and duration; clothing and protective equipment; hydration status; physical fitness; acclimatization; and preexisting medical conditions (Armstrong et al., 2007; Casa et al., 2015). Microclimates within sport settings, such as elevated surface temperatures on artificial turf or heat buildup in enclosed stadiums, can exceed ambient conditions reported, posing additional risks to athletes (Fantozzi & Lamberti, 2019; Singh et al., 2024). Therefore, while outdoor athletes face heightened exposure, those training indoors can also develop EHIs, especially if facilities lack sufficient cooling and air flow (Schneider & Mücke, 2024).

Many sports seasons and major international events (e.g., FIFA World Cup, Summer Olympics) traditionally coincide with the hottest months of the year, creating intense heat stress conditions that may compromise athlete safety and performance (Orr et al., 2022a). High-profile incidents have brought these concerns to the forefront, including the 2018 U.S. Open, where five players withdrew during matches due to heat stress (Jurejko, 2018) and later at the 2019 World Athletics Championships in Doha, where 28 of 68 competitors in the women's marathon were unable to finish amid oppressive heat conditions (Ingle, 2019). The effects of heat exposure have been widely studied across a wide range of sports (e.g., football – Grundstein et al., 2018; running – DeMartini et al., 2014; soccer – Nybo et al., 2021; tennis – Smith et al., 2018) as well

as major competitions (e.g., 2020 Tokyo Olympics – Gerrett et al., 2019; 2022 Qatar FIFA World Cup – Sofotasiou et al., 2015; 2024 Paris Olympics – Bandiera et al., 2024). Looking ahead, the 2026 FIFA World Cup, set to take place across the US, Mexico, and Canada, has already come under scrutiny over anticipated heat risks, as a recent study found that 14 of the 16 host cities are projected to exceed WBGTs of 28°C (Mullan et al., 2025). In response, researchers have recommended rescheduling matches in high-risk areas to cooler times of day, consistent with guidelines from governing bodies such as Football Australia, which advise delaying or postponing play when WBGTs exceed 28°C (Mullan et al., 2025). As warming intensifies, sport organizations must take preventative action to protect athletes from rising heat risks by developing heat policies, which currently remain largely unstandardized and inconsistent (Gamage et al., 2022a).

2.4.2 Air Pollution and Respiratory Health

Air pollution is an indirect risk of climate change that adds to direct threats by deteriorating air quality in sport settings and affecting respiratory health and athletic performance (Schneider & Mücke, 2024). Air pollution, composed of fine particulate matter (PM_{2.5}), nitrogen dioxide (NO₂), carbon monoxide (CO), ozone (O₃), and other harmful pollutants, can impair lung function, aggravate asthma, and increase the risk of several respiratory illnesses (Kurt et al., 2016). Climate change and air pollution are closely linked, as GHG emissions and air pollutants are co-emitted from processes including manufacturing, chemical plants, and fossil fuel extraction (Orru et al., 2017). In addition, climate change-driven factors, such as rising temperatures and dry conditions, create an environment conducive to more frequent and severe wildfires, which release pollutants that can travel long distances through smoke (also leading to the cancellation of sporting events due to hazardous air quality; Fitzpatrick, 2023) (Orru et al.,

2017). Long-term exposure is tied to more severe health conditions, including chronic obstructive pulmonary disease (COPD), and cardiovascular disease (Qin et al., 2019). Whereas exposure to air pollution is a point of concern for public health, athletes are especially vulnerable due to their increased breathing rate and depth during exercise, as well as greater reliance on mouth breathing, which bypasses the nasal filtration system (Qin et al., 2019; Reche et al., 2020).

The effects of air pollution are especially relevant for athletes during high-stakes events, with exposure to poor air quality has been shown to diminish physical and cognitive performance (Archsmith et al., 2018). Lichter et al. (2017) analyzed the performance of professional soccer players, demonstrating that elevated levels of particulate matter (PM10) correlated with a measurable decline in productivity, as indicated by a reduction in the total number of passes per match. Similarly, Heintz et al. (2023) found that higher air pollution levels were linked to increased errors in MLB teams and reduced performance in NFL quarterbacks, while Cusick et al. (2023) reported that even moderate pollution slowed race times among collegiate track and field athletes. Research further suggests that adverse effects of air pollution extend beyond athletes to game officials; Archsmith et al. (2018) revealed that a 1 parts per million (ppm) increase in CO over three hours led to an 11.5% increase in umpire errors. The problem remains that many major sporting events take place in urban centres that expose athletes to high pollution levels, as seen in the 2019 World Relays study, where stadium air quality mirrored city pollution (Reche et al., 2020). In response, the sports community has begun to recognize the importance of monitoring air quality, especially during wildfire events, and adopt practical strategies to minimize exposure (and associated effects), as evidenced in consensus statements by the Canadian Academy of Sport and Exercise Medicine and the Canadian Society for Exercise Physiology (Hung et al., 2023) and Australian Institute of Sport (Mooney et al., 2023).

2.4.3 Weather- and Surface-Related Injuries

While health risks associated with atmospheric climate impacts (e.g., rising temperatures) have received attention, those related to extreme weather events remain overlooked in both the literature and practice, with limited empirical research, position statements, consensus frameworks, and actionable guidelines to inform stakeholders (Schneider et al., 2024a). Schneider et al. (2024b) conducted a Delphi study with medical experts and representatives of German sports associations, who indicated that extreme weather may increase the risk of accidents and injuries in sport. Risks mentioned include immediate dangers from sudden events such as torrential rain and storms (which can lead to lightning strikes and fallen tree branches; Schneider & Mücke, 2024), as well as sport-specific risks like avalanches, mudslides, and falling rocks in mountain sports, and rapid changes in water levels and currents in water sports (Schneider et al., 2024b). These concerns are echoed by winter sport athletes, 95% of whom believe climate change is already or will negatively impact their sport, citing increased injuries from harder, icier, and more inconsistent surfaces due to warming and snow variability (Knowles et al., 2024a). Athletes also reported more frequent competitions in unsafe conditions (such as extreme cold, high wind, rain, and fog), while expressing concern that adaptation measures such as artificial snowmaking may further elevate injury risks by altering snow texture and density (Knowles et al., 2024a). Poor snow coverage (less than 10 cm) and wet conditions have been linked to higher crash and injury rates (Fu et al., 2020).

In addition, outdoor surfaces are vulnerable to climate extremes, as temperature and precipitation fluctuations affect the hardness and stability of playing surfaces (e.g., droughts contribute to the compaction of turf sports fields), which may increase the risk of injuries (e.g., stress fractures, joint damage) (Stiles et al., 2009). This phenomenon is well-documented and has

been observed by facility managers (Dingle & Mallen, 2021), as moisture loss increases soil density, reduces impact absorption, and results in harder, less resilient playing surfaces (Straw et al., 2020). In line with this, research also indicates that synthetic turf, often used as an adaptation measure, can exacerbate heat risks by reaching high surface temperatures and increasing injury potential (Singh et al., 2024). Other health risks identified, but not explored in detail, include increased exposure to UV radiation (e.g., greater risk of skin cancer, sunburn, eye damage) and a heightened risk of infections (e.g., the spread of vector-, water-, or food-borne illnesses such as Lyme disease or gastrointestinal infections) (Schneider et al., 2024b). Research findings spotlight a gap in sport-specific climate resilience planning, emphasizing the need for comprehensive risk assessments and targeted guidelines that address both atmospheric and extreme weather-related health risks across diverse sport settings (Schneider et al., 2024a).

2.5 Infrastructure Vulnerability

Several studies have associated climate change to risks for sports infrastructure (Dingle et al., 2023; Dingle & Mallen, 2021; Dingle & Stewart, 2018). Hazards to infrastructure can be classified as either sudden- (e.g., flooding of Chichibunomiya Rugby Stadium during the 2019 Rugby World Cup due to Typhoon Hagibis; World Rugby, 2019) or gradual-onset (e.g., compaction of Australian football fields during the 1996-2010 Millennium Drought; Dingle & Mallen, 2021). The UN Sports for Climate Action Framework strategy document identifies the following challenges for infrastructure: damage to playing surfaces due to extreme temperatures, drought, flooding, and/or pest species extending their natural range; damage to buildings due to violent storms; coastal erosion and sea-level rise directly affecting sport infrastructure in seaside areas; warmer winters and lack of natural snow threatening ski resorts at lower altitudes; and climate adaptation measures as a requirement in the design of new or refurbished sport

infrastructure (UNFCCC, 2020). Taken together, these examples illustrate the multifaceted vulnerability of sports infrastructure, which translate into significant costs for sport organizations, including repair expenses (Dingle & Mallen, 2021), investment in adaptation (and retrofit) strategies (Kellison & Orr, 2020) and revenue losses from disrupted events (Dingle & Mallen, 2021). Nevertheless, sport- and facility-specific responses are evident, reflected in rising climate adaptation expenditures, including investments by ski resorts (Steiger et al., 2019), stadium design (Kellison & Orr, 2020), and community fields (Dingle & Mallen, 2021).

2.5.1 Strain on Fields and Facilities

Weather and climate extreme events have increased in frequency and intensity (IPCC, 2023), contributing to greater wear and tear on infrastructure (Goldblatt, 2023), and subsequent disruptions to sports calendars (e.g., an estimated 120,000 soccer matches are cancelled annually in the UK due to waterlogged pitches; BASIS, 2023). Research across diverse regions and sports (e.g., golf, soccer) highlights the vulnerability of grass turf fields to atmospheric extremes (e.g., Australia – Dingle & Mallen, 2021; Canada – Scott et al., 2018; England – Kay & Vamplew, 2006; Germany – Werner, 2024). Dingle and Mallen (2021) examined the impacts of climate change on community sports fields in Australia and Canada, identifying increased schedule disruptions due to extreme weather; soil hardening from heat and drought; field inundation and turf decay from heavy rainfall; and rising demand and costs for irrigation due to insufficient rainfall. Comparable concerns were reflected in a survey by the R&A (collective of golf courses), which found that 90% of UK golf course professionals are worried about long-term flooding from intense rain events, with 55% already facing disruptions and 29% acknowledging their facilities are unprepared (BASIS, 2023). The literature demonstrates a growing awareness of the climate impacts on field infrastructure, alongside evidence of general adaptation strategies

such as switching to more climate-resilient grass varieties and implementing improved water management practices (Dingle & Mallen, 2021).

Moreover, infrastructural vulnerabilities linked to geographic exposure have emerged as another area of climate risk, particularly for sports facilities in low-lying and coastal regions (Climate Council, 2021). Goldblatt (2020) used Climate Central flood maps to assess future risks to soccer fields, projecting that by 2050, 23 of England's 92 league teams (many in low-lying, coastal, or riverside areas) could face partial or total annual flooding, demonstrating the need for proactive flood protection measures (e.g., flood barriers, elevated playing surfaces). Similarly, a Climate X (2024) report projects USD\$11 billion (CAD\$14.85 billion) in total losses across 30 NFL stadiums by 2050 under a high-emissions scenario (RCP 8.5) due to flooding, wildfire, and drought, with stadiums in low-elevation southern regions at greatest risk (e.g., Caesars Superdome in New Orleans and EverBank Stadium in Jacksonville). Kellison and Orr (2020) argue that climate vulnerability can serve as a strategic opportunity for sport organizations to invest in early stadium replacement, prioritizing sustainable and climate-resilient design, particularly given the energy-intensive nature of many facilities. However, the ability to implement such transformative measures is unevenly distributed. Professional venues are often better equipped to manage these threats due to greater financial and institutional capacity, whereas grassroots facilities remain highly vulnerable, lacking the resources necessary to adapt to escalating climate impacts (BASIS, 2023).

2.5.2 Declining Snow Cover and Winter Sports

Warming winters are increasingly destabilizing winter sports by shortening seasons and undermining the reliability of traditional snow-dependent regions (Scott et al., 2021). Several studies have explored how projected climate change will continue to affect ski seasons and resort

operations across various regions, irrespective of greater artificial snowmaking requirements (e.g., North America – Knowles et al., 2024b; Scott et al., 2019b, 2021; Asia – Fang et al., 2021; Europe – Rice et al., 2021; Steiger & Scott, 2020; Scott et al., 2019a). For example, resorts in central Canada (Ontario and Quebec) could lose up to 22% of their season by mid-century, weakening regional competitiveness as fewer can maintain the crucial 100-day season (Scott et al., 2019b). Meanwhile, although more resilient, ski markets in Western Canada (Alberta and British Columbia) will face increasing snowmaking demands, particularly in lower-elevation and coastal areas (Knowles et al., 2024b). In the same way, other winter activities, including Nordic skiing (Falk & Hagsten, 2017; Orr, 2020), pond hockey (Fairley et al., 2015), and sliding sports (e.g., bobsleigh, skeleton, luge) (Werner, 2024) are also vulnerable. McLeman et al. (2023) projects that under current emissions pathways, January temperatures will be too mild to build outdoor rinks across much of eastern North America by the 2050s, expanding to the western U.S. and Canada's Prairie provinces by the 2080s under high-emission scenarios (RCP8.5), thereby reducing access to affordable, community recreation opportunities. For example, in Ottawa, the Rideau Canal Skateway (once the world's largest naturally frozen skating rink) has experienced repeated closures due to insufficient ice formation, highlighting the threat to accessible winter sport experiences (Ables, 2023).

Changing climate conditions are taking away the ability of winter sports to take place under natural conditions, forcing event organizers to rely on adaptations, such as moving events indoors where possible (e.g., hockey, speedskating) and increasing the use of artificial surfaces (e.g., ice, snow) to ensure safe and fair competition (Rutty et al. 2015). Recent Olympic and Paralympic Winter Games have become increasingly reliant on artificial snow, with coverage reaching approximately 85% in Sochi 2014, 90% in PyeongChang 2018, and 100% in Beijing

2022; however, its effectiveness is limited under excessively warm ground and air temperatures (Orr, 2024). The longstanding practice of snowmaking has met criticism over its sustainability as a climate adaptation, both in mega-events and the broader ski industry, particularly due to its high energy consumption, extensive water use, and carbon emissions (Moser & Baulcomb, 2020). While concerns are pronounced in water-scarce regions, such as those emphasized during the Beijing Olympic Games (e.g., De Guzman, 2022), recent studies indicate that the energy and water footprint of snowmaking is very location specific (Knowles et al., 2024c; Scott et al., 2024). Despite advancements in snowmaking technology and efficiency, the high financial and resource demands of artificial snow production continue to put pressure on organizers (Falk & Hagsten, 2017; Steiger & Scott, 2024).

As climate trends reduce the number of reliable winter venues, uncertainty grows over the future viability of host locations for major events, including the Olympic and Paralympic Winter Games, where each event (e.g., freestyle ski and snowboard, ski jumping, alpine ski events) requires minimum snow requirements (Orr et al., 2022c). Steiger and Scott (2024) assessed 93 potential host locations for the Olympic and Paralympic Winter Games, finding that under a mid-range emissions scenario (RCP4.5, SSP2-45), 52 locations remain viable for the Olympic Winter Games in the 2050s and 46 in the 2080s, while the Paralympic Winter Games, scheduled later in the season, faces greater risk, with only 22 reliable locations by the 2050s and 16 by the 2080s. Future events will therefore be limited to more northern and higher-altitude regions, where even then, snowmaking will likely be essential to ensure sufficient coverage and uphold competition standards (Steiger & Scott, 2024). Hosting viable snow events may require smaller, more remote venues, in turn creating logistical challenges for organizations (e.g., limited infrastructure, fewer tourist amenities, reduced accessibility) (Orr et al., 2022c). As climate

change further restricts access to reliable winter conditions, the increasing cost and resource intensity of snow-dependent sports risk exacerbating their exclusivity, limiting opportunities for young athletes to develop and compete at elite level (Protect Our Winters Europe, 2022).

2.6 Rising Costs and Operational Challenges

Climate change may place considerable financial strain on sport organizations, as frequent disruptions and rising operating costs reshape budgets and long-term planning (EDO, 2024; Orr & Inoue, 2019; Werner, 2024). Several studies across different sports have linked climate extremes (i.e., high/low temperatures, rainfall) to increasing maintenance demands, especially in water-intensive facility management (e.g., community fields – Dingle & Mallen, 2021; golf courses – Scott et al., 2018; ski resorts – Knowles et al., 2024c; stadiums – Dingle & Stewart, 2018; Dingle et al., 2023). Dingle et al. (2023) examined the impact of climate change on water resources at major Australia sports stadiums, identifying six challenges: (a) reduced rainfall; (b) increased evaporation from playing surfaces; (c) regulatory restrictions on water use; (d) rising water costs; (e) capital expenditures for water management infrastructure; and (f) public scrutiny over high water consumption. To address increasing water demands, stadiums may implement water management strategies (e.g., water harvesting, storage, recycling) and/or transition to drought-resistant grass varieties (Dingle & Mallen, 2021; Dingle et al., 2023; Scott et al., 2018), while others are opting for artificial turf for its climate resilience and lower maintenance (notwithstanding concerns about heat retention and increased rate of foot and ankle injuries) (Gould et al., 2022; Singh et al., 2024). However, supplementary water resources are required in some cases to comply with higher standards for insurance, as it helps to prevent field compaction and reduces associated injury risk (Dingle & Mallen, 2021).

In addition to maintenance demands (which predominate in current studies on operational challenges to climate variability), sports tied to seasonal conditions are exposed to increasing (and compounding) financial pressures from climate change. Organizations risk lost ticket revenue (e.g., fewer skier visits due to poor snow conditions; Scott & Steiger, 2024), large scale damages (e.g., stadium destruction from extreme weather events; Climate X, 2024), contractual penalties (e.g., breaches of sponsorship, vendor, or broadcasting agreements due to event cancellations; EDO, 2024), rising insurance premiums (e.g., higher costs for coverage due to frequent event disruptions; Werner, 2024), and expensive climate adaptations (e.g., reinforced drainage systems; Dingle & Mallen, 2021; cooling infrastructure; Gamage et al., 2020a; artificial snowmaking; Scott et al., 2022). For example, a study by Scott and Steiger (2024) found that declining skier visits and rising snowmaking costs have resulted in an average annual loss of USD\$252 million (CAD\$343 million) for the U.S. ski industry. Nevertheless, research on the financial impact of climate change remains limited (with the exception of Scott & Steiger, 2024), within individual sports and across different sports and competition levels, as most studies focus on isolated cases (e.g., projected financial losses for NFL stadiums; Climate X, 2024), rather than providing a comprehensive assessment of cumulative, long-term financial losses (McCullough et al., 2020b).

2.7 Legal Liability and Reputational Harm

Failure to adequately respond to the aforementioned climate impacts may expose sport organizations to legal liability, as affected parties could seek compensation (for injuries, property damage, or financial losses) (EDO, 2024). A recent report by the sports climate advocacy group FrontRunners, in partnership with the Environmental Defenders Office (EDO) (2024), outlines

the legal implications of climate risk for sports governance in Australia, identifying the following areas of potential liability:

- (1) Player safety negligence (e.g., breach of duty of care due to heat-related illnesses and injuries from unsafe playing surfaces, such as hardened fields from drought or extreme heat;
- (2) Spectator safety negligence (e.g., breach of duty of care by venue operators who fail to protect spectators from foreseeable risks, such heat stroke during summer events);
- (3) Vicarious liability (e.g., liability arising from referees or other employees failing to enforce rules properly, leading to player injuries);
- (4) Contractual obligations (e.g., legal disputes arising from match suspensions or cancellations due to extreme weather events, involving broadcasters, stadiums, equipment providers, and other contracted businesses responsible for delivering goods or services for sporting events);
- (5) Directors' duties (e.g., breach of director duties by failing to consider climate change as part of risk management and strategic planning).

At the time of the report's publication, only 6% of the 123 Australian (national and state) sport organizations had issued guidance or publications on their website on climate change or sustainability, highlighting the lack of precedent to address emerging climate risks and their associated liability concerns (EDO, 2024). This trend is mirrored in other national sports landscapes, as research on German sport organizations indicates that they are not yet adequately prepared to adapt to climate risks, particularly smaller organizations with limited resources and finances, which exposes them to legal liability (Werner, 2024).

To protect a sport organization from emerging liabilities, several measures can be implemented, including obtaining tailored insurance coverage (e.g., public liability, event cancellation, indemnity, weather index) to mitigate financial risks and cover potential losses (Levine & Miller, 2022; Werner, 2024). However, select sources have raised concerns of climate risks driving up insurance premiums (or loss of cover), which raises questions regarding affordability and financial sustainability (Climate Council, 2021; EDO, 2024; Werner, 2024). Equally important is the establishment of clear policies (e.g., heat warning systems), contingency plans, and well-defined contracts (with media, sponsors and other relevant stakeholders) that guide communication and decision-making in the face of disruptions from extreme weather (Murfree & Moorman, 2021). Research has noted the lack of consistent materials and guidelines, creating gaps in organizational preparedness (Gamage et al., 2020a; Grundstein et al., 2021; Levine & Miller, 2022; Murfree & Moorman, 2021; Orr, 2023). For example, Murfree and Moorman (2021) analyzed Division I college football contracts regarding the legal implications of game cancellations due to hurricanes, revealing inconsistencies in how force majeure clauses (contract provisions excusing obligations due to unforeseen events) define extreme weather, with many lacking specific provisions, creating ambiguity in assigning responsibilities and liabilities when games are disrupted. Similarly, Gamage et al. (2020a) conducted a qualitative document and content analysis of heat illness policies and guidelines published by sport organizations in Australia, finding considerable variation in content and quality, with most documents requiring updates to align with emerging evidence and international best practices.

Inadequate climate (in)action can result in legal battles and lawsuits, as seen in several recent cases where entities have been held liable in failing to protect athletes against harm. In 2020, 20-year-old Grant Bruce died of heatstroke after a wrestling team training session at the

University of the Cumberlands (Kentucky), prompting a USD\$14.1 million (CAD\$20.3 million) settlement (Vinall, 2024), while that same year, 15-year-old Cristian Navarro also suffered fatal heat stroke during a California high school football practice in 39°C heat, where coaches failed to provide adequate hydration breaks, resulting in a USD\$9 million (CAD\$12.8 million) settlement against the school district (Adamson Ahdoot, 2022). Similar cases have occurred globally, including the 2017 death of London endurance cyclist Barry Covington, 36, who suffered fatal heat stroke during the 93-mile L'Union Cycliste Internationale (UCI) Gran Fondo Amateur World Championships in the south of France (Vinall, 2024). His family reached a six-figure settlement with the event's insurers, alleging that the UCI, the sport's governing body, failed to protect competitors from heat-related risks (Vinall, 2024). Moreover, these cases may prompt policy reforms and stronger safeguards, as seen after Jordan McNair's heatstroke death during a University of Maryland football workout, which led to new regulations requiring cooling stations, extended breaks, increased medical staff, and enhanced training protocols (Almasy, 2018). His family further pushed for systemic change through the 2023 Jordan McNair Student Athlete Heat Fatality Prevention Act, which, if passed by Congress, would mandate emergency heat-illness action plans and equipment in higher education institutions (Brown, 2023).

If sport organizations fail to address and manage the impacts of climate change, they risk reputational damage, which may, in turn, undermine their financial position and performance as an organization (EDO, 2024). In a comparable manner, growing scrutiny of sponsorships tied to high-carbon industries further exacerbate reputational risks (Tricarico & Simms, 2021). Companies have long leveraged sports sponsorships to reach new audiences to increase demands for products and services as well as strengthen their public image, a strategy reflected in a

YouGov (2022) study, which found that 45% of Australian fans view sponsorship as a means for companies to maintain social relevance. Moreover, a report by the Rapid Transition Alliance and Badvertising identified 258 sponsorship deals across 13 sports, highlighting the widespread presence of high-carbon industries (e.g., fossil fuel companies, airlines, car manufacturers) (Tricarico & Simms, 2021). High-profile cases, such as FIFA's recent deal with Saudi oil giant Aramco (Carosella, 2024) and British Cycling's partnership with Shell (Ingle, 2022), run counter to the sustainability commitments made by these organizations, and more broadly, fuels public accusations of greenwashing (Traberg et al., 2025). Amid media scrutiny and advocacy efforts (e.g., an open letter from 100 female soccer players urging FIFA to drop the Aramco sponsorship; Gornall, 2024), research on the long-term impact of high-carbon sponsorships remains limited, leaving gaps in understanding their effects on fan engagement and organizational sustainability.

2.8 The Climate Capacity of Sport Organizations

While the impacts of climate change vary by sport, location, and level of play, all organizations (particularly in their duty to athlete safety) must assess their specific vulnerabilities and implement strategic responses to strengthen adaptive capacity in an increasingly complex and evolving risk landscape (Orr, 2023). This process is captured in the Climate Vulnerability of Sport Organizations (CVSO) framework developed by Orr and Inoue (2019), which applies well-established concepts from climate vulnerability literature (i.e., exposure, sensitivity, and adaptive capacity) to the sport context. The framework introduces two key constructs: *Climate Impacts on Organizations* (CIO), which captures the likelihood and severity of climate-related risks based on an organization's exposure and sensitivity, and *Organizational Climate Capacity* (OCC), which reflects the organization's ability to adapt with minimal disruption or cost. More

specifically, the framework emphasizes the dynamic interaction between CIO and OCC, rather than viewing them in isolation. For example, a soccer organization based in Miami may face high exposure to extreme heat (CIO), but in response has implemented adaptation measures, such as shaded spectator areas, adjusted match schedules, and athlete cooling protocols to reduce risk (OCC). Management awareness and decision-making are central to organizational climate change readiness, as sport managers directly influence both an organizations vulnerability to climate risks and its ability to respond effectively (Orr, 2024).

2.9 The Response of Sport to Climate Change

The 1994 Winter Olympics in Lillehammer was the first to formally consider the environmental impact of hosting the Games, introducing energy-efficient facility design, waste management systems, and public engagement campaigns—setting the precedent for sustainability at future sporting events (IOC, 2020). Since then, awareness of sustainability in the broader sports sector has grown, accompanied by the emergence of membership organizations to promote environmentally responsible practices (e.g., Green Sports Alliance). Although sport’s collective contribution to global emissions is relatively small, the significant and escalating impacts of climate change on sport organizations have prompted a range of climate actions across the sector, including the integration of green technologies into infrastructure (e.g., Climate Pledge Arena’s carbon-neutral design), the development of global frameworks to guide climate strategy (e.g., UN Sport for Climate Action Framework), national strategies that align sports policy with emission reduction goals (e.g., Sport England’s *New Move* strategy), and the innovation of alternative, lower-impact sports (e.g., Formula E) (Orr et al., 2022a). As a result, climate change has become an increasingly prominent focus within sport management, as

organizations and managers seek to adapt to evolving conditions and implement strategies to mitigate future emissions (McCullough, 2023).

Responses to climate change can be understood in two ways: first, as adaptation measures taken to accommodate new conditions and manage risks (e.g., heat policies) and second as mitigation efforts aimed at reducing carbon emissions (e.g., retrofitting facilities) (McCullough, 2023). Existing research suggests that sport managers remain uncertain and inadequately prepared to address climate change concerns (Casper et al., 2012; Kellison et al., 2015; Werner, 2024), particularly in the area of adaptation (Mallen et al., 2025). Werner (2024) found that even though awareness of climate impacts is evident among German sport managers and event planners, adaptation remains a secondary concern as most available guidelines target elite and professional level sports, leaving community sports with limited practical guidance. Insights into adaptation largely originate outside sport management literature, with notable contributions from disciplines such as health sciences and medicine. For example, Schneider et al. (2024a) offer a prevention-based model against climate-related health risks in outdoor sports based on results of an expert Delphi study (see Table 2.1). However, the direct application of this model remains underexplored. Building on this, there is an absence of sport-specific adaptation measures that account for the unique physical, environmental, and organizational demands of different sporting contexts (Schneider et al., 2024a). Without tailored guidance, sport organizations, particularly at the community and amateur levels, are left without the tools necessary to proactively manage climate risks and protect athlete wellbeing (Giorgio et al., 2025a; Werner, 2024).

Table 2.1. Prevention measures for climate-related health risks in outdoor sports.

Main category	Examples of prevention measure
Technical and structural measures	<ul style="list-style-type: none"> ● Shaded areas (e.g., trees, awnings) ● Cooling areas (e.g., cold water immersion tubs) ● Adapt construction of facilities (e.g., air-conditioning)

Organizational measures	<ul style="list-style-type: none"> ● Delay, reschedule or cancel competition and training <ul style="list-style-type: none"> ○ E.g., when heat thresholds are exceeded, air quality is poor, UV index is extreme, storms or lightning are forecasted ● Modify competition rules (e.g., shorter playing times, additional breaks, more frequent substitutions) ● Monitor environmental factors <ul style="list-style-type: none"> ○ E.g., ambient temperature, UV exposure levels, air quality
Personalized measures	<ul style="list-style-type: none"> ● Provide water and electrolyte drinks ● Protective sportswear (e.g., UV protection) ● Medical care during competition and training
Education	<ul style="list-style-type: none"> ● Provide education to stakeholders, such as athletes, coaching staff, and game officials <ul style="list-style-type: none"> ○ E.g., make them aware of the signs and symptoms of heat-related illnesses
Action plans and warning concepts	<ul style="list-style-type: none"> ● Set up weather policies that include the definition of indicators, thresholds (align with national standards), measures, and responsibilities <ul style="list-style-type: none"> ○ E.g., response plan when heat thresholds are exceeded (e.g., extra hydration breaks) ● Set up emergency action plan for when athletes begin to show signs or symptoms of heat-related illnesses
Cooperation and coordination	<ul style="list-style-type: none"> ● Coordinate national support for sport organizations to ensure they are aware and equipped to respond to climate risks
Evaluation	<ul style="list-style-type: none"> ● Undertake risk management to review current training conditions, trainer qualifications and health hazards ● Review current prevention measures and action plans, and adapt accordingly to respond to climate risk

Source: Adapted from Schneider et al. (2024a)

At the same time, there is mounting pressure for sport organizations to address sustainability in event planning and operations, including regulatory measures (e.g., national carbon pricing and emission reduction targets) (Scott & Gössling, 2021) and stakeholder expectations (e.g., a collective letter from professional skiers urging the International Ski Federation to commit to net-zero emissions by 2035; POW Europe, 2022). The sport sector

contributes to climate change, and more broadly environmental degradation, relying on carbon-intensive activities that generate direct and indirect emissions (Wilby et al., 2023). In response, sport organizations can use governance and policy mechanisms to formalize their sustainability commitments, for example, by adopting emission reduction targets and embedding them into organizational strategy to drive reductions across areas such as travel, energy, water use, waste management, and procurement (Powell & Bernard, 2022). Mitigation efforts have been documented across professional and mega-events (e.g., Goldblatt, 2020), collegiate sports (e.g., Dolf & Teehan, 2015), and smaller-scale events (e.g., McCullough et al., 2023), encompassing responsible procurement guidelines, facility retrofits, low-carbon transportation options, putting an end to sponsorships with high-carbon industries (e.g., fossil fuels), and fan education and awareness campaigns to promote pro-environmental behaviours (Wilby et al., 2023). While some teams and leagues have initiated efforts to transition to net-zero (evidenced by signatories of the UN Sport for Climate Action Framework), the adoption of sustainable practices have been slow (Cury et al., 2022a), with contributing factors such as insufficient staff, limited funding, and lack of knowledge (Dingle & Stewart, 2018; Martínez-Martínez et al., 2019; Trendafilova et al., 2014).

2.9.1 International Governance

Recognizing the impacts of climate change on sport, the sector has begun to acknowledge its responsibility to act, with global institutions such as the UNFCCC and the IOC setting the tone through the UN Sports for Climate Action Framework (UNFCCC, 2020). Nearly 300 sport organizations, from global leagues to individual teams and events across professional, collegiate, and amateur levels (e.g., FIFA, Formula 1, World Athletics, Sport England, New York Mets), have joined, committing to emission targets that exceed the Paris Agreement (i.e., halving

emissions by 2030 and reach net-zero by 2040) as well as annual public reporting (from 2021 onwards) to maintain signatory status (UNFCCC, 2020; 2021). Signatory organizations commit to five principles:

- (1) Systematic efforts to promote environmental responsibility: integrate climate considerations into core strategy across all operations and activities, including events, procurement, infrastructure and communications.
- (2) Reduce climate impact: measure, manage, and reduce emissions associated with their organization and events to achieve specific climate goals of halving emissions by 2030 and aiming to achieve net-zero by 2040.
- (3) Education for climate action: foster knowledge exchange to highlight best practices, bridge gaps, and strengthen climate action across the sports sector.
- (4) Sustainable consumption: promote sustainable procurement and transport to reduce emissions and drive demand for low-carbon options among providers and stakeholders.
- (5) Advocate through communication: use communication channels, athlete voices, and event platforms to raise climate awareness and mobilize action across sports communities.

The UN' framework plays an important role in guiding the sports sector toward a low-carbon economy while educating stakeholders, in line with research that shows sport is a uniquely effective platform for promoting pro-environmental behaviors (Casper et al., 2020). However, physical climate risks and adaptation measures remain largely absent from the five principles, leaving a critical gap in addressing the direct and increasing threats to sport and those who participate in it.

Among other international governance efforts, national sport governing bodies have begun to integrate climate considerations into their strategic planning. World Rugby, the global governing body for rugby, is a notable example, having developed a comprehensive environmental sustainability plan focused on reducing emissions (excluding offsets), advancing sustainable event practices, and educating stakeholders across all levels of the sport (World Rugby, 2024). Specifically, the organization stands out for explicitly acknowledging climate risks, including commercial impacts and threats to athlete health, and for identifying the rugby nations most vulnerable to climate impacts (e.g., increased number of hot days), accompanied by tailored recommendations for adaptation and resilience (World Rugby, 2024). More broadly, membership organizations such as the Green Sports Alliance (founded in the U.S. in 2010 and now operating globally) have emerged to support professional sports teams, venues, and collegiate athletic departments in enhancing strategic planning through the offering of advisory services and community resources (e.g., webinars, guidelines, case studies). Several actors, including membership organizations (e.g., Sports Environment Alliance), research collectives (e.g., Sport Ecology Group), and athlete advocacy groups (e.g., Protect Our Winters) work in parallel with general environmental certification systems (e.g., Leadership in Energy and Environmental Design [LEED] standard for facilities, ISO 20121 for event management) to drive the sports community toward more sustainable and resilient practices.

2.9.2 Professional Teams and Leagues

Professional sport organizations, typically equipped with substantial financial, human, and technological resources, are increasingly subject to external pressures (e.g., consumer demand, changing societal norms) to engage in environmentally focused management practices (Trendafilova et al., 2013). Several studies have investigated the types of sustainability initiatives

professional teams and leagues undertake as well as how they communicate their efforts to the public (McCullough et al., 2020c; Trendafilova et al., 2013; Wall-Tweedie, & Nguyen, 2018). For example, McCullough et al. (2020c) analyzed the websites of 147 North American professional sport organizations and their venues to assess the transparency of their environmental communications. Researchers found that only one team (i.e., Cleveland Indians) published a standalone sustainability report, while 42 had highlighted environmental initiatives through dedicated webpages, most of which focused on fan engagement rather than detailed reporting or performance metrics (McCullough et al., 2020c). Similarly, Wall-Tweedie and Nguyen (2018) assessed the environmental sustainability practices of 114 professional sport teams in the Asia-Pacific region and found significantly lower levels of adoption and communication compared to North America, with 17 teams disclosing at least one initiative. As such, the adoption and consistency of environmental practices among professional sport vary across regions and organizations.

Professional sport organizations (like many others) demonstrate varying levels of commitment to environmental sustainability, ranging from low to high. Sport management scholars distinguish low engagement efforts as affordable, highly visible actions (e.g., recycling, energy or water reduction, waste management) that are often reactive or implemented in isolation, whereas high engagement initiatives are more strategic, embedded in long-term planning, and aligned with broader sustainability goals (Casper et al., 2012; Hugaerts et al., 2023; McCullough et al., 2016). A leading example of high engagement is the Forest Green Rovers, an English soccer team whose climate-focused model includes a stadium powered by 100% renewable energy, bamboo and recycled plastic jerseys, vegan-only menu, and environmentally aligned sponsors (see Table 2.2) (Papp-Váry & Farkas, 2022). Despite examples

of leadership, many professional sport organizations have yet to publicly communicate their climate or environmental strategies, relying on organizational memberships (e.g., Green Sports Alliance) or framework signatories (e.g., UN Sport for Climate Action Framework) to signal sustainability performance (McCullough, 2023; McCullough et al., 2020c).

Table 2.2. Sustainability initiatives implemented by the Forest Green Rovers.

Category	Sustainability initiatives
Energy efficiency and infrastructure	<ul style="list-style-type: none"> • Stadium powered entirely by renewable energy sources • Installation of solar panels • Organic turf in the stadium
Transportation	<ul style="list-style-type: none"> • On-site electric vehicle charging stations • Team exclusively uses electric vehicles to travel • Promotion of cycling, car-sharing, and public transport for fans attending home and away games
Procurement and waste management	<ul style="list-style-type: none"> • Elimination of single-use plastics • Team jerseys are made from bamboo waste and recycled plastic • Serving exclusively vegan food to players, staff members and spectators
Engagement and communications	<ul style="list-style-type: none"> • Promotion of environmentally conscious behavior among supporters by implementing educational programs tailored for local communities and educational institutions • Collaboration with sustainable sponsors and partners, including Ecotricity, Bolt, Oatly, Quorn, and many more

Source: Adapted from Papp-Vary and Farkas (2022)

2.9.3 National Sport Organizations

While research on sport and sustainability has grown in recent years, much of it remains focused on heavily commercialized professional sport contexts (Cury et al., 2023a), leaving a gap in understanding how amateur sport organizations, particularly NSOs (also referred to as

national governing bodies or sports federations), engage with environmental considerations (Cury et al., 2023a). NSOs often operate within inherently complex systems, coordinating diverse stakeholders, including athletes, coaches, board members, and government actors, across multiple levels of the sport, from grassroots to elite competition (Parent et al., 2018). Sport systems can look different across national contexts (Cury et al., 2023a), specifically in places like Australia, Brazil and Canada, NSOs are heavily reliant on government funding or membership-based fundraising (e.g., participation fees) and are influenced by national sport policy (Mezzadri et al., 2014; Parent et al., 2018; Shilbury et al., 2017). The organizational complexity of NSOs, combined with commonly cited pressures of limited financial and human resources (Parent et al., 2018), can constrain their capacity to prioritize or implement climate mitigation or adaptation initiatives (Orr & Inoue, 2019). Hugaerts et al. (2023) examined the environmental initiatives of 141 Belgian sport federations and found low overall commitment, with only 37 federations having publicly communicated initiatives, most of which were limited to low engagement efforts (e.g., stakeholder outreach). Similarly, Cury et al. (2023b) assessed 46 Australian Olympic sport organizations and found that 32 lacked any formal guidelines, policies, or sustainability plans, pointing to a broader lack of measurable goals and alignment with international frameworks. The findings of these studies highlight just how much stronger governance and national support are still needed to pursue coordinated climate response.

NSOs are also being called upon to implement systemic changes that better manage climate risks to protect stakeholders, especially athletes (EDO, 2024). In Australia, legal scrutiny of sport organizations is intensifying, with warnings that litigation over heat-related athlete injuries is becoming increasingly likely as climate change impacts escalate (EDO, 2024). Media coverage has amplified these national concerns, shaping public discourse and raising

expectations for institutional accountability for climate response (Vinall, 2024). However, although research shows that environmental response among NSOs is limited (Cury et al., 2023b; Hugaerts et al., 2023), the specific ways in which NSOs are addressing (or failing to address) climate change and related risks have largely been overlooked in academic studies. Nonetheless, pioneering initiatives are beginning to shift the landscape, Sport England, a public body under the Department for Culture, Media, and Sport, has emerged as a leader through its *Every Move* sustainability strategy, pledging £45 million (CAD 76.5 million) to support membership organizations reduce their environmental impact and adapt to effects of climate change. Yet, with Sport England as the only NSO listed as a signatory of the UN Sport for Climate Action Framework, it is clear that sector-wide commitment to national climate leadership among NSOs remain in the early stages (Cury et al., 2023b).

2.10 Study Context: The Canadian Sport Sector

Against this backdrop, this study seeks to assess the climate change readiness of Canadian sport organizations at the national level, a topic that has received no direct scholarly attention to date. Sport is an integral part of Canadian society, with over 250,000 sporting events held annually, ranging from grassroots to elite and professional competitions (Canadian Centre for Ethics in Sport, 2022). Sport tourism is the fastest-growing segment of Canada's tourism industry, drawing in significant numbers of visitors and investments that positively impact local and regional economies (Lethbridge Sport Council, 2024; Sport Information Resource Centre, 2022; Sport Tourism Canada, 2019). For example, in 2019, sports tourism generated CAD\$7.4 billion in total spending (e.g., accommodations, food and beverage, transportation) and attracted 15.9 million visitors, including 14.4 million domestic and 1.4 million international travelers (Sport Tourism Canada, 2019). This marked a significant increase from 2018 when total

spending reached \$6.8 billion (Sport Tourism Canada, 2018). In addition to immediate economic gains, the impact of sporting events extends long-term, as demonstrated by the 1988 Winter Olympics in Calgary, which helped in the development of new infrastructure and sports facilities that still serve the community today (i.e., Olympic Park and Olympic Oval) (Tourism Calgary, 2024). Similarly, the 2015 Pan American Games in Toronto resulted in a \$70 million legacy fund to maintain the facilities built for the event (i.e., Toronto Pan Am Sports Centre, the Milton Velodrome, and York University Athletics Stadium), supporting continued community access and athlete development (Office of the Auditor General of Ontario, 2016).

2.10.1 Sport Governance in Canada

Sport in Canada is underpinned by a complex governance system involving diverse governmental, non-governmental, and private sector stakeholders, including Sport Canada, MSOs, NSOs, Provincial/Territorial Sport Organizations (P/TSOs), and community sport clubs, though the latter two are beyond the scope of this study (see Table 2.3). Sport Canada, a branch of the Department of Canadian Heritage, is overseen by the Minister of Sport and Physical Activity and serves as the central authority responsible for sport policy, funding, and program delivery in Canada (Library of Parliament, 2020). Specifically, Sport Canada is the largest investor in the country's amateur sport system, articulating its core principles and objectives through the Canadian Sport Policy (2002, 2012), which all sport organizations must adopt as a condition to receive federal funding (Library of Parliament, 2020). While governance span all geographic levels, national-level organizations, including Sport Canada, MSOs, and NSOs, are particularly well-positioned to mobilize sector-wide responses to critical issues (e.g., climate change), owing to their resource capacity, policy influence, and coordination mandates. In

contrast, P/TSOs and community sport clubs may serve as vital implementation partners, however these actors tend to operate with more limited capacity (Doherty & Cuskelly, 2019).

Table 2.3. The roles and responsibilities of actors in the Canadian sport system.

Organization	Description	Example
Sport Canada	Sport Canada provides leadership (e.g., policies and programs) and funding to national organizations that make up the Canadian sport system	N/A
Multisport Service Organizations (MSOs)	MSOs support the national sport community by coordinating key services such as coach education, post-secondary sport development, Indigenous sport initiatives, gender equity in sport, dispute resolution, major event management, and participation promotion	E.g., Canada Games Council, Canadian Olympic Committee, USports
National Sport Organizations (NSOs)	NSOs govern their respective sports, overseeing high-performance programs, national teams, competition sanctioning, sport development, coach and official training, and bids for international events	E.g., Alpine Canada, Hockey Canada, Canada Soccer

Climate change is increasingly threatening safe and equitable access to sport in Canada. ParticipACTION’s (2024) Report Card on Physical Activity explicitly identifies it as a growing threat, particularly for children, who are more vulnerable to hazards such as extreme heat due to their limited ability to regulate body temperature. This concern is especially pressing given that 68% of children and youth (ages 5-17) participate in some form of sport, according to a recent survey by the Canadian Fitness and Lifestyle Research Institute (2024). In this context, national-level sport organizations warrant closer attention in their response to climate change, not only because they set the direction for sport policy and funding, but also because their inaction can undermine the sector’s ability to protect stakeholders and mitigate climate risks. With their central role and broad influence, these organizations are well-resourced and positioned to lead coordinated action through the integration of climate considerations into strategic planning and

supporting provincial, territorial, and community sport in adapting and reducing emissions (Hugaerts et al., 2023). This raises a key question: How prepared are Canada's national-level sport organizations to respond to climate change through their planning and strategic efforts?

2.11 Summary of Literature

Climate change presents a significant threat to the future of sport, as new climate realities increasingly determine where, when, and how it can be played. While awareness of these challenges is rising among sport organizations and stakeholders, responses across the sector remain uneven and limited in scope. The available literature underscores the multifaceted impacts of climate change on the sports sector, highlighting risks to athlete health and performance (e.g., heat-related illnesses, respiratory diseases, accidents and injuries from extreme weather), as well as the increasing vulnerability of sport infrastructure (e.g., turf degradation, damaged facilities, declining snowpack at ski resorts). Moreover, secondary impacts include broader operational (e.g., rising maintenance demands, higher insurance premiums, water resource challenges), legal (e.g., liability for player or spectator harm, breaches of sponsorship and broadcasting contracts, directors' duties), and reputational challenges (e.g., criticism over high-carbon sponsorships, public backlash following athlete injuries, scrutiny over inadequate climate action) facing sport organizations. A number of emerging strategies have been proposed to strengthen organizational climate capacity and guide adaptation at international, national, and professional levels. However, despite some progress, a clear gap remains between the scale of the threat and the sector's collective response, underscoring the urgent need for coordinated climate action across all levels of sport governance.

Chapter 3

Methods

This chapter outlines the methodological approach used to assess the climate change readiness of national-level Canadian sport organizations, including Sport Canada, MSOs, and NSOs, are adapting to changing conditions and mitigating operational emissions. Data was collected from publicly available sources, including organizational documents (i.e., strategic plans, annual reports and sustainability reports) and website content, following a systematic review process. All relevant data was compiled and analyzed using content analysis, in line with sport and sustainability research (Cury et al., 2023b; Hugaerts et al., 2023; McCullough et al., 2020c; Wall-Tweedie & Nguyen, 2018) as well as insights from organizational reports (EDO, 2024; Goldblatt, 2020). Finally, the chapter addresses method limitations related to transparency, reporting variability, and the reliance on publicly available information.

3.1 Study Sample

The study sample comprises national-level sport organizations, including Sport Canada, NSOs, and MSOs (roles and responsibilities previously detailed in Table 2.3). These organizations were selected because they occupy key leadership positions within Canada's sport system, influencing the strategic direction of sport through policy development and funding allocation. Sampling began with a comprehensive list of government recognized organizations and their official websites, sourced directly from the Government of Canada's sport directories which include (1) the National Sport Organizations Directory and (2) the Multisport Service Organizations Directory (see Appendix A). Organizations with inaccessible or defunct websites were excluded from the final sample (i.e., the Bowling Federation of Canada).

3.2 Data Sources

Data collection relied on publicly available organizational documents and website content, including the most recent available strategic plans, annual reports (2023-24 reporting year), and sustainability (or environmental) reports (see Table 3.1). These documents were selected because they represent formal mechanisms through which organization articulate their goals, report achievements, and communicate commitments, including those related to environmental sustainability (Junior et al., 2014; McCullough et al., 2020c). While document titles and formats varied across organizations, efforts were made to identify functionally equivalent materials, even when alternative naming conventions were used (e.g., "annual report" may also be called "progress report," "impact report," or "year in review"). This approach ensured consistency in data collection by prioritizing the communicative intent and content of documents, rather than relying solely on standard labels. Management literature further highlights the role of websites to support organizational transparency and accountability, especially through the publications of strategic documents such as policies, plans, and performance reports (Allen & Craig, 2016; Junior et al., 2014), serving as a platform for sports organisations to communicate with external stakeholders, conveying information about their social and sustainability initiatives (McCullough et al., 2020c). It is important to note that national organizations may not report on the sustainability activities of individual events, teams, or affiliated entities; therefore, external information published on other websites was not included in this analysis (e.g., sustainability initiatives of 2023 Canada Games).

Table 3.1. Types of organizational documents and their function.

Document types	Description
Strategic plan	A document outlining an organization’s goals and the actions required to achieve them, serving as a roadmap for decision-making and resource allocation.
Annual report	A document summarizing an organization's activities, financial performance, and achievements over the past year, typically including key metrics (e.g., revenue, investments, partnerships, carbon footprint).
Sustainability report	A document outlining an organization’s environmental, social, and governance practices and performance, detailing efforts to reduce environmental impact, promote social responsibility, and maintain ethical governance.

3.3 Data Collection Procedure

A structured document and webpage search was conducted for each organization, following a similar process to Cury et al. (2023b) and McCullough et al. (2020c) (see Figure 1). The search employed the keywords *climate change* and *environmental sustainability* (along with variations such as *climate*, *environment*, and *sustainability*), and content was deemed relevant and collected when these terms were applied in relation to the natural environment (i.e., environmental impact, emissions, extreme weather conditions, air quality or similar climate-related factors). Specifically, the search involved navigating site menus, subpages, and document repositories to locate documents, including strategic plans, annual reports, and sustainability reports, as well as general website content (e.g., homepage messaging, news updates, community pages, program descriptions, dedicated sustainability webpage). For the purpose of this study, the terms *climate change* and *environmental sustainability* were treated as functionally interchangeable to avoid excluding relevant materials, with the latter interpreted specifically in terms of environmental impact, rather than broader organizational sustainability contexts. If relevant content was identified, it was retrieved for subsequent analysis. Where no references

were immediately visible, internal website search functions were used to query keywords. If no search bar was available and no content was located through the review, the organization was recorded as having no publicly available climate- or sustainability-related information. All materials were confined to official organizational communications; information sourced from third-party platforms or event-specific websites was excluded.

All identified documents and webpages were systematically organized, with extracted content associated with their respective organizations. This study produced a structured dataset of organizational profiles coded according to the presence or absence of climate response, forming the foundation for the content analysis.

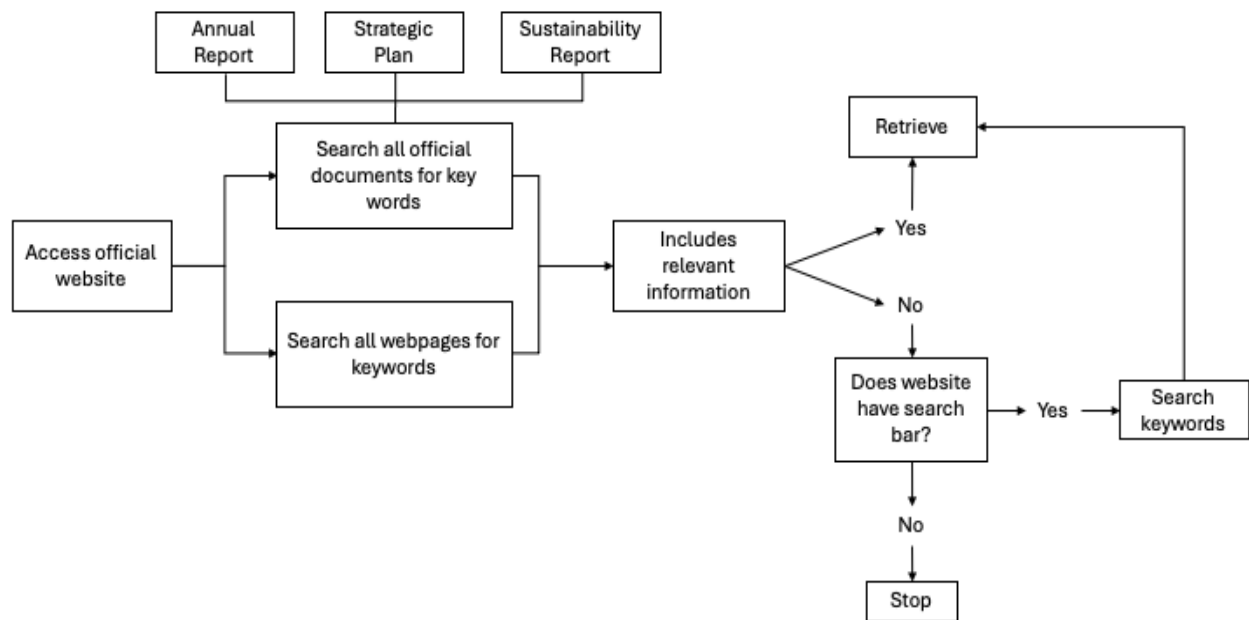


Figure 1. Data collection procedure (*Source:* adapted from Cury et al., 2023b).

3.4 Data Analysis

Content analysis was used to assess the climate change readiness of each sport organization, an approach consistent with previous studies on sport and sustainability (e.g., Cury

et al., 2023b; Hugaerts et al., 2023; McCullough et al., 2020c). As defined by Krippendorff (2004), content analysis enables researchers to draw valid and replicable insights from texts by interpreting their meaning within a specific context. In this study, content analysis allowed for a systematic examination of organizational documents and communications to gauge how climate change concerns (e.g., mitigation, adaptation, risk management) are being addressed. To guide the analysis, a climate policy integration framework developed by Becken et al. (2020) was applied. Becken et al. (2020) originally developed their framework to assess the integration of climate change in tourism policy documents, evaluating integration across four parameters (i.e., coverage, scope, materiality, alignment). Specifically, *coverage*, refers to the frequency and depth of climate change references within organizational documents. *Scope*, considers the climate change focus of the policy framework, strategy or plan (i.e., mitigation, adaptation, or both). *Materiality*, assesses the extent to which climate-related content is embedded in concrete objectives, actions, or measurable outcomes. *Alignment*, evaluates references to and consistency with broader environmental frameworks, policies, or strategic agendas.

Moreover, Becken et al.'s (2020) framework is grounded in the concept of Climate Policy Integration (CPI), which refers to the coordination of multiple policy objectives, governance structures, and planning processes to address both climate mitigation and adaptation (Di Gregorio et al., 2017). CPI evolved from the broader idea of Environmental Policy Integration (EPI) that first emerged to prioritize the environment in policymaking (Jordan & Lenschow, 2010). EPI has been applied in various public and private contexts, including sport; for example, Cury et al. (2023b) used an EPI-based framework to analyse the responses of Australian Olympic sport organisations to environmental sustainability. As such, given the increasing risks that climate change presents for sport (e.g., pressures to mitigate emissions,

facility disruptions, athlete safety concerns, event cancellations) there is a clear need for sport organizations to incorporate climate into strategic planning and core operations. In the absence of a standardized tool for assessing climate change readiness, Becken et al.'s (2020) framework provides a structured and adaptable approach.

Becken et al.'s (2020) framework was selected for this study based on several considerations: (1) its alignment with the overarching objective of advancing understanding of organizational responses to climate change; (2) the parallels between the tourism and sport industries, both of which are service-oriented, environmentally dependent, and vulnerable to climate-related disruptions; and (3) its prior application in the sport context (e.g., Cury et al., 2023b). For this study, Becken et al.'s (2020) framework was adapted and operationalized, using three of the four original parameters (coverage, scope, and alignment) and excluding materiality due to the lack of publicly available strategic objectives, actions, and measurable indicators in organizational documents and website content (see Table 3.2). The adapted evaluation criteria were defined as follows: (1) *coverage*, refers to the frequency of references to climate change or environmental sustainability across communication platforms (e.g., strategic plans, annual reports, sustainability reports, webpages). (2) *Scope*, captures the thematic focus of these references; when actionable initiatives (e.g., policies) were identified, they were classified as either low (e.g., isolated, low-cost actions such as recycling or energy reduction) or high engagement (e.g., strategic, long-term initiatives aligned with broader sustainability goals) (Casper et al., 2012; Hugaerts et al., 2023; McCullough et al., 2016). (3) *Alignment*, evaluates whether organizations referenced broader policies, strategies, or frameworks relevant to climate change or environmental sustainability at the national (i.e., Canadian) and/or international level (e.g., Paris Agreement, UN Sport for Climate Action Framework). To add, this study also

incorporated sector-specific best practices (related to climate change considerations and risk management), including the identification of high-carbon sponsorship. High-carbon sponsors are defined as companies operating in the extractive, aviation, and automotive industries, following classifications outlined by the Rapid Transition Alliance (Tricarico & Simms, 2021).

Results are organized according to (1) each communication platform and (2) the overall performance of each organization. This dual approach allows for a nuanced understanding of where and how climate change is being integrated into each organization’s operations and communications, as well as an overall comparison of their climate change readiness.

Table 3.2. Adapted CPI in sport parameters and evaluation criteria.

	Adapted parameters	Evaluation criteria
Coverage	Frequency of references to climate change or environmental sustainability across communication platforms	<i>Absent</i> : no references <i>Minimal</i> : one platform <i>Moderate</i> : two platforms <i>Solid</i> : three or more platforms
Scope	The focus of references to climate change or environmental sustainability in communication platforms	<i>Absent</i> : no references <i>Unclear</i> : climate change or environmental sustainability identified but vague claims <i>Climate mitigation</i> : information, initiatives, goals and/or policies to minimise impact on the environment <i>Climate adaptation</i> : information, initiatives, goals and/or policies to minimise the effects of climate change and help manage risks <i>Both</i> : included environmental sustainability and climate change efforts
Alignment	Reference to other policies, frameworks and strategies relevant to climate change or environmental sustainability	<i>Absent</i> : no references <i>National</i> : references to national climate policies, strategies, or frameworks

Global: references to international framework or agreements (e.g., Paris Agreement, UN Sustainable Development Goals, UN Sport for Climate Action Framework)

3.5 Limitations to the Data

While this study approach provides a structured means to assess climate change readiness, several methodological limitations must be acknowledged. First, the analysis relies on self-reported information, limited to what organizations choose to disclose through their official communication platforms. As such, internal actions not publicly communicated are not captured. This reliance on publicly available data is a common limitation in content analysis, as the absence of evidence in the public domain does not necessarily indicate an absence of action (McCullough et al., 2020c). Second, there is considerable variability in how and where organizations report climate-related information. Environmental topics may appear in different types of documents or sections, and terminology often varies. Some organizations may embed climate issues within broader sustainability or strategic plans, while others might reference them only in news updates. Even standard documents such as annual reports were inconsistently labeled (e.g., "progress reports," "impact reports," "year in review"), though all such variations were included in the analysis if they served a similar function. To mitigate these challenges, multiple keyword searches were conducted across all available documents and webpages to maximize the likelihood of capturing relevant content. Finally, the study represents a snapshot in time based on the most recent documents and website content available during the data collection period. As policies and communications evolve, it is possible that new climate-related initiatives or updates released after the analysis are not reflected in the findings. Despite these limitations, the methodology offers a replicable approach for assessing the visible climate preparedness of

Canada's national-level sport organizations. While findings must be interpreted cautiously, recognizing that they reflect publicly disclosed actions, they provide valuable insights into how the sport sector is responding to the growing challenges of climate change.

Chapter 4

Results

This chapter presents the results of a content analysis evaluating the climate change readiness of national-level sport organizations in Canada. The analysis first assesses coverage, then the scope of climate-related content, distinguishing between vague references, mitigation-oriented actions aimed at reducing environmental impacts, and adaptation efforts designed to manage climate risks. Finally, the analysis examines alignment with external climate policies, strategies, or frameworks, identifying the extent to which organizations reference national or global climate strategies, highlighting emerging themes related to global sport and climate frameworks, as well as links to high-carbon sponsorships.

4.1 Overview of Canadian Sport Organizations

The initial list of 87 organizations identified for this analysis (Sport Canada, 23 MSOs, and 63 NSOs) was reduced to 86 because the Bowling Federation of Canada, the national governing body overlooking the sport of bowling (5 and 10 pins), did not have an operational website on which to conduct the content analysis. In turn, the final study sample consisted of Sport Canada, 23 MSOs, and 62 NSOs (see Appendix B).

4.2 Coverage

Content analysis first examined *coverage*, defined as the frequency of references to climate change or environmental sustainability across communication platforms (i.e., organizational documents and website content), categorized as absent (no references), minimal (one platform), moderate (two platforms), or solid (three or more platforms) (see Table 3.1). The analysis revealed that climate change, and environmental sustainability more broadly, receives

little coverage across national-level Canadian sport organizations' official reports (i.e., strategic plan, annual report and sustainability report) and website content (i.e., dedicated webpage and general website content). Of the 86 organizations reviewed, climate change or environmental sustainability is mentioned in 11 (12.8%) strategic plans and four (4.7%) annual reports, with no existing sustainability reports (i.e., 0%) (see Figure 2). These are not mutually exclusive, as all four organizations that reference climate change or environmental sustainability in their annual reports also include references in their strategic plans (i.e., Canada Games Council, Canadian Olympic Committee, Golf Canada, and Sail Canada) (see Appendix C, Table C1). In terms of webpage content, only five (5.8%) organizations maintained a dedicated webpage on climate change or environmental sustainability (i.e., Canada Games Council, Canadian Olympic Committee, Sport Information Resource Centre, Golf Canada, and Sail Canada), while 23 (26.7%) organizations made at least one reference to these topics elsewhere on their website (e.g., press release, weather policy) (see Appendix C, Table C1). Overlap remains limited, as only nine organizations reference climate change or environmental sustainability in both their formal documents (strategic plans or annual reports) and website content, including the Canada Games Council, Canadian Centre for Ethics in Sport, Canadian Olympic Committee, Bowls Canada Boulingrin, Curling Canada, Golf Canada, Nordic Canada, Rowing Canada, and Sail Canada.

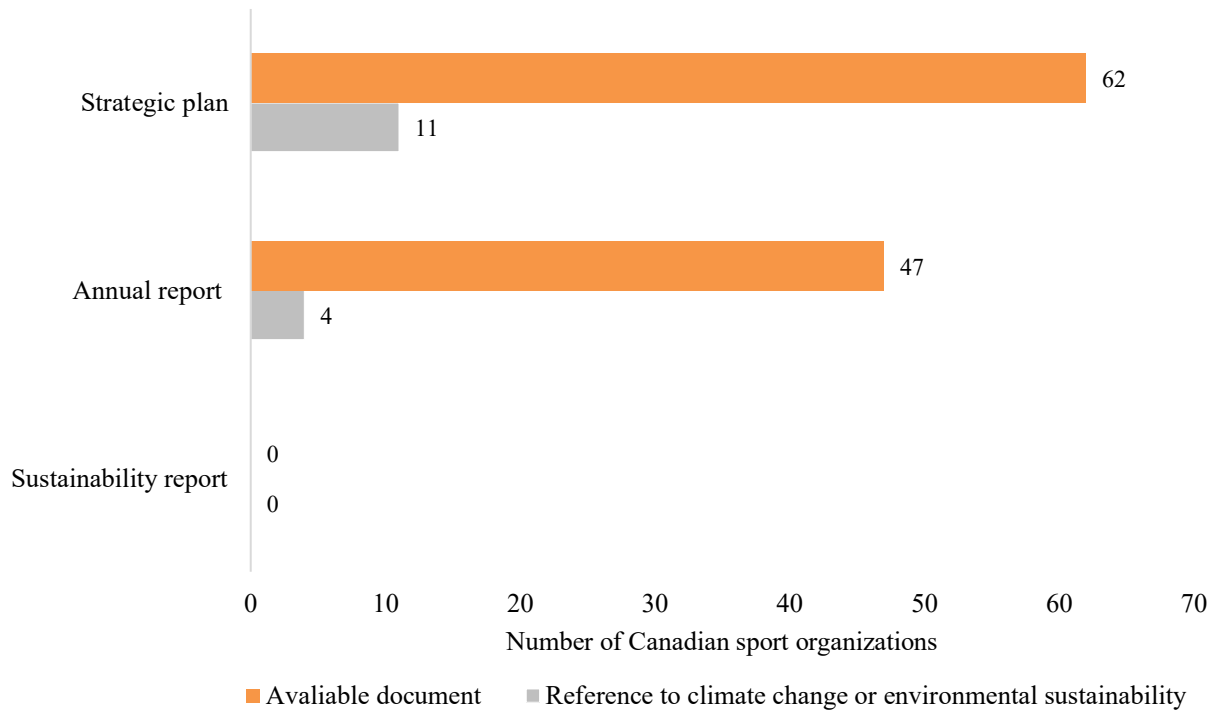


Figure 2. The comparison between document availability and references to climate change or environmental sustainability among national-level Canadian sport organizations.

In total, 25 (29.1%) organizations made reference to climate change or environmental sustainability across any communication platform. Among these, coverage was most often minimal, with references limited to a single communication platform, such as a brief mention in a strategic plan or a one-off reference on a webpage, rather than integrated across multiple platforms. In total, 15 organizations (17.4%) demonstrated minimal coverage, 6 (7%) had moderate coverage, and only 4 (4.7%) organizations, including the Canadian Olympic Committee, the Canada Games Council, Golf Canada and Sail Canada, achieved solid coverage (see Figure 3). Moreover, the Canadian Collegiate Athletic Association, the Canadian Paralympic Committee, and Nordiq Canada, for example, included such references in their strategic plans but did not reinforce these commitments in annual reports, webpages, or other communication platforms. This finding suggests that while these issues are acknowledged in

principle, they lack consistent reinforcement across organizational messaging, highlighting the fragmented nature of current climate-related coverage. The vast majority of organizations (i.e., 61 or 70.9%), including Sport Canada, had absent coverage, with no reference to climate change or environmental sustainability on any communication platform (see Figure 3).

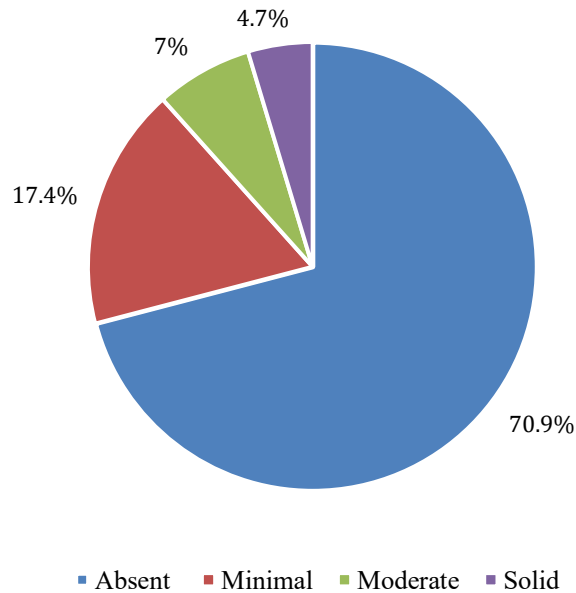


Figure 3. The coverage of climate change or environmental sustainability references across communication platforms of national-level Canadian sport organizations.

4.3 Scope

Next, *scope* was assessed, defined as the focus of references to climate change or environmental sustainability, categorized as absent (no references), unclear (vague claims), climate mitigation (reduce environmental impact), climate adaptation (manage climate risks), or both (see Table 3.1). To add, when actionable initiatives (e.g., policies) were identified, their level of engagement was also evaluated as either low (i.e., affordable, highly visible) or high engagement (i.e., strategic, embedded in long-term planning, and aligned with broader sustainability goals) (Casper et al., 2012; Hugaerts et al., 2023; McCullough et al., 2016).

4.3.1 Strategic Plan

Given the central role of strategic plans in articulating long-term organizational goals and priorities, references to climate change or environmental sustainability within these documents were examined separately. The focus of these references varied. Four organizations (4.7%) (i.e., Canadian Olympic Committee, Canada Games Council, Bowls Canada Boulingrin, and Sail Canada) embedded climate change or environmental sustainability (or related terms) as a core value or guiding principle, while one organization (i.e., Nordiq Canada) identified it as a long-term goal (i.e., 2026 targets include integrating environmental impact into their decision-making process). Six (7%) organizations referenced climate change or environmental sustainability within broader Environmental, Social, and Governance (ESG) standards (i.e., Canadian Centre for Ethics in Sport, Canadian Collegiate Athletic Association, Curling Canada, Golf Canada, and Rowing Canada) or UN Sustainable Development Goals (SDGs) frameworks (i.e., Canadian Paralympic Committee). Importantly, none of the references within the strategic plans included detailed actions or implementation measures, though Curling Canada and Bowls Canada Boulingrin expressed future intentions to develop a formal sustainability strategy. In a similar manner, the Canada Games Council outlined key success measures (e.g., emissions, waste, energy efficiency, and water/air quality), however lacked concrete actionable initiatives to support this. Moreover, two (2.3%) organizations (i.e., Canadian Olympic Committee and Bowls Canada Boulingrin) explicitly acknowledged the impacts of climate change on sport, with Bowls Canada Boulingrin citing shortened seasons, more frequent extreme heat, and deteriorating green conditions as risks.

4.3.2 Annual Report and Webpages

References to climate change or environmental sustainability were also examined across annual reports and webpages, which serve as key communication platforms for reporting ongoing climate- or environmental-related initiatives. In total, 17 (19.8%) of organizations publicly disclosed identifiable climate or sustainability initiatives (see Appendix C, Table C1; Table C2; Table C3). Table 4.1 presents a summary of these initiatives, organized by inductive categories and classified according to their level of engagement (i.e., low or high): (1) extreme weather, (2) education and awareness, (3) energy and climate, (4) waste management, (5) water conservation, (6) transportation, and (7) biodiversity. Moreover, only two organizations (2.3%) had established emission reduction targets (i.e., halving emissions by 2030 and aiming to achieve net-zero by 2040), both of which are signatories to the UN Sport for Climate Action Framework (i.e., Canada Games Council, Canadian Olympic Committee) (see Section 4.4). No organization was found to have a robust environmental sustainability or climate strategy, as defined by Powell and Bernard (2022) as a framework that explicitly outlines sustainability commitments, presents a clear implementation plan, and details mechanisms for monitoring and reporting progress (see Appendix C, Table C2).

Table 4.1. Profile of initiatives reported by national-level Canadian sport organizations.

Category	Description	No. of organizations*	Engagement
Extreme weather (adaptation)	Includes formal policies to prepare for and respond to weather disruptions, including policies or protocols for heat, air quality, storms, and other extreme weather events that may impact athlete safety, event scheduling, or facility operations.	10	Low

Education and awareness (mitigation)	Includes activities to create awareness and educate athletes, staff and stakeholders on sustainability and climate action.	6	Low
Energy and climate (mitigation)	Includes emission reduction and energy efficiency measures, using carbon assessments, or supporting net-zero commitments.	3	High
Waste management (mitigation)	Includes actions to reduce, reuse, or recycle materials, and divert waste from landfills.	1	Low
Water conservation (adaptation)	Includes actions that reduce water use or reuse wastewater.	1	High
Transportation (mitigation)	Includes efforts to cut transport emissions and promote sustainable transportation options.	1	High
Biodiversity (adaptation)	Includes actions to protect wildlife habitats, manage land use, or support natural regeneration.	1	High

*National-level Canadian sport organizations found to have actionable climate or sustainability initiatives include the Canada Games Council, Canadian Olympic Committee, Sport Information Resource Centre, Archery Canada, Athletics Canada, Baseball Canada, Bowls Canada Boulingrin, Canoe Kayak Canada, Equestrian Canada, Golf Canada, Nordiq Canada, Rowing Canada Aviron, Sail Canada, Softball Canada, Speed Skating Canada, Tennis Canada, and Volleyball Canada.

As shown in Table 4.1, 10 organizations (11.6%) referenced initiatives related to extreme weather, most commonly in the form of extreme weather policies (i.e., guidelines or protocols outlining responses to adverse or hazardous weather conditions). Of these, eight organizations (9.3%) have extreme heat policies, which rely on temperature-based thresholds to trigger response protocols. However, the extreme heat policies identified lack standardization, with considerable variation among organizations in the metrics used to measure and quantify heat risk (see Table 4.2). For example, 6 (7%) organizations refer to the humidity index (also known as the humidex), which reflects how the combined effects of air temperature and humidity are perceived (Government of Canada, 2024a). In rare cases, 2 (2.3%) organizations refer to the

more sophisticated WBGT index, which accounts for several environmental factors, including air temperature, humidity, wind speed, and solar radiation, to assess heat risk exposure (Government of Canada, 2024b). Response protocols also vary widely: some organizations outline detailed, tiered measures based on temperature ranges (e.g., Athletics Canada, Equestrian Canada), while others adopt a single threshold or general recommendation to suspend activity (e.g., Tennis Canada, Canoe Kayak Canada).

Table 4.2. National-level Canadian sport organizations with an extreme heat protocol.

Sport organization	Trigger threshold	Metric used*	Response protocol
Archery Canada	31°C - 39.9°C	Humidity index	<ul style="list-style-type: none"> Participants are advised to take extra precautions by staying hydrated and taking breaks in shaded areas whenever possible.
Athletics Canada	27°C - 32°C 32°C - 41°C	Humidity index	<ul style="list-style-type: none"> Schedule mandatory rest and water breaks every 25 minutes. Ensure cold water is accessible to all participants and provide shaded areas throughout the facility. Consider availability of cold water (2–4°C) immersion tubs at the facility. Schedule longer endurance events either in the early morning or late evening. New or unconditioned athletes should refrain from practicing or competing. Well-conditioned athletes should take more frequent rest and hydration breaks, scheduled every 20 minutes. Ensure cold water is accessible to all participants and provide shaded areas throughout the facility.

	> 41°C		<ul style="list-style-type: none"> • Consider availability of cold water (2–4°C) immersion tubs at the facility. • Officials should have access to shaded areas and work shorter officiating shifts. • Adjust the competition schedule and timetable according to the time of day and event length (e.g., longer endurance events should be rescheduled to the early morning or late evening). • All training and competition should be postponed.
Baseball Canada	> 35°C	Humidity index	<ul style="list-style-type: none"> • Inquire with participants to ensure pre-event hydration, medication use, and susceptibility to heat injury (including prior occurrences). • Unlimited substitution is recommended during games. • Implement frequent fluid breaks for all participants.
Bowls Canada Boulingrin	35°C - 38°C	Humidity index	<ul style="list-style-type: none"> • Play/competition should be interrupted at 20-minute intervals (at the completion of the end in play) for a 5-minute break, during which drinks should be made available. • Any time limit imposed on the interrupted game will be waived.
	> 38°C		<ul style="list-style-type: none"> • Play/competition will be suspended. • The Head Event Umpire, on behalf of the Controlling Body, will determine whether to discontinue play. Consideration should be given to all relevant factors, including the age and health of players and officials, the level of humidity, and the

amount of shade or shelter available at the venue.

Canoe Kayak Canada	> 30.1 °C	WBGT index	<ul style="list-style-type: none"> • Trigger an immediate pause of competition or training until the temperature drops to at least 28°C. • Coaches overseeing training must monitor the temperature and ensure individuals return to shore if the specified thresholds are reached.
Equestrian Canada	28°C - 30°C	WBGT index	<ul style="list-style-type: none"> • Regularly check stabling/holding areas to ensure adequate resources like water, shade, and fans. • Shorten distances and reduce the intensity of activities. • Increase oversight by stewards and veterinarians in all areas.
	30°C - 33 °C		<ul style="list-style-type: none"> • Additional precautions to limit overheating of equines will be necessary. • Competitions or high exertion phases must be held during cooler parts of the day, between 7:00-11:00 a.m. and/or after 4:00 p.m.
	> 33°C		<ul style="list-style-type: none"> • Seek further veterinary consultation and advice before proceeding with event.
Tennis Canada	> 40.1°C	Humidity index	<ul style="list-style-type: none"> • Recommended that play/competition be suspended.
Volleyball Canada	> 40°C	Humidity index	<ul style="list-style-type: none"> • Competitors will be permitted to drink water while walking between side switches to stay hydrated without delaying the matches.

-
- Allow one extra timeout per set per team.
 - If a team plays back-to-back matches, add 5 minutes of extra time between those matches.
-

*Refers to the heat stress indices used to guide extreme heat protocols (e.g., humidity index, WBGT).

Similarly, five (5.8%) organizations have air quality guidelines, which outline measures to reduce health risks during periods of elevated air pollution (see Table 4.3). All of these organizations used the Air Quality Health Index (AQHI), a tool developed by the Government of Canada (2015) to communicate the health impacts of air pollution and support informed decision-making. The AQHI is reported on a scale from 1 to 10+, with corresponding health risk categories and messages, including tailored guidance for at risk populations (e.g., children, elderly, individuals with preexisting heart or breathing conditions):

- Low (AQHI 1-3): ideal air quality for outdoor activities.
- Moderate (AQHI 4-6): at-risk individuals should consider reducing or rescheduling strenuous outdoor activities if they have symptoms. General public can continue normal activities unless symptoms such as coughing or throat irritation occur.
- High (AQHI 7-10): at-risk individuals (including children and older adults) should reduce or reschedule strenuous outdoor activities. General public should also consider limiting strenuous activities if symptoms appear.
- Very high (AQHI above 10): at-risk individuals should avoid all strenuous outdoor activity. General public should reduce or reschedule strenuous activities, especially if symptoms occur.

While all five organizations relied on the same index, there was notable variation in how they applied it. For example, some adopted a general approach by postponing activities at AQHI 7 or higher (e.g., Canoe Kayak Canada), while others outlined detailed step-by-step protocols based on specific thresholds (e.g., Volleyball Canada, Bowls Canada Boulingrin).

Table 4.3. National-level Canadian sport organizations with air quality guidelines.

Sport organization	Air quality guideline
Athletics Canada	AQHI 7-8: <ul style="list-style-type: none"> • Issue warnings to competitors with respiratory issues (e.g., asthma) • Consider shortening event durations or canceling junior events AQHI 9-10: <ul style="list-style-type: none"> • Shorten event durations • Evaluate event cancellation or postponement, including junior events AQHI above 10: <ul style="list-style-type: none"> • Cancel all events and outdoor training sessions
Bowls Canada Boulingrin	AQHI 4-6: <ul style="list-style-type: none"> • If a participant experiences symptoms, play may stop for 20 minutes • After 10 minutes, the participant will be assessed • If able to continue, play will resume after 20 minutes • If unable to continue, a substitute will be recruited, and play will resume after 20 minutes • If no substitute is available, the break may be extended to 20 minutes; if the participant is still unable to continue, the game will be forfeited AQHI 7 or higher: <ul style="list-style-type: none"> • All play will be suspended for at least one hour • Players should rest and seek shelter indoors with better air quality • The Head Event Umpire will decide if/when to resume play, considering the participants' age, health, venue proximity to air quality stations, and the forecast
Canoe Kayak Canada	AQHI 7-10: <ul style="list-style-type: none"> • Activities should be postponed
Equestrian Canada	AQHI 4-6: <ul style="list-style-type: none"> • Competitors with high-risk equines should monitor closely and retire if respiratory distress symptoms occur • High-risk equines include older and younger equines and those with pre-existing respiratory conditions AQHI 7-10: <ul style="list-style-type: none"> • Reduce exertional effort or reschedule strenuous activities when the AQHI is lower

	AQHI above 10:
	<ul style="list-style-type: none"> • Consider canceling all strenuous activities

Volleyball Canada	AQHI 4-6:
	<ul style="list-style-type: none"> • The Tournament Committee may allow players to drink water while walking between side switches, grant one extra timeout per set per team, add 5 minutes between back-to-back matches, and have teams self-officiate with spectator assistance for scorekeeping
	AQHI 7 or higher:
	<ul style="list-style-type: none"> • Tournament will be canceled or delayed until the air quality index is lowered

Education and awareness initiatives followed as the most frequently reported category, identified by six (7%) organizations (see Table 4.1). For example, the Canada Games Council hosts the annual Green Sports Day Summit to raise awareness on climate action in sport. The Canadian Olympic Committee engages national team athletes and students (grades K–8) through targeted educational sessions on sport and sustainability. Nordiq Canada and Sail Canada, in collaboration with their international federations, distribute educational materials and provide specialized training on sustainability and the impacts of climate change. Speed Skating Canada partnered with carbon capture provider Svante to launch a digital marketing campaign highlighting the effects of climate change on the sport. Lastly, the Sport Information Resource Centre publishes training guidelines to help sport organizations address climate-related health risks, such as exertional heat illness and the shrinking winter sport season.

Additional initiatives were identified, often concentrated among the same organizations (see Table 4.1). For example, the Canada Games Council, in partnership with Racing to Zero, undertook efforts to calculate its greenhouse gas (GHG) emissions for the 2023–24 fiscal year and committed to reducing emissions by 50% by 2030 and achieving net-zero emissions by 2040 through the UN Sports for Climate Action Framework. The Canadian Olympic Committee made a similar commitment to reduce emissions by 50% by 2030 and reach net-zero by 2040 under the

same international framework. Golf Canada reported the most comprehensive set of initiatives spanning multiple sustainability areas. To reduce emissions, Golf Canada implemented optimized practices across its operations and events, including powering merchandise, hospitality, and media tents with battery systems and transitioning to electric golf carts. In the area of waste management, the organization introduced water refill stations and recyclable takeaway containers to reduce single-use plastics and divert waste from landfills. Water conservation efforts were also reported, with refillable water stations promoted at events to limit bottled water use. For transportation, Golf Canada prioritized the use of electric golf carts at major events and encouraged low-emission spectator travel through transit shuttles and on-site bike valet services. Additionally, the organization advanced biodiversity initiatives by collaborating with golf courses to increase naturalized areas, protect wildlife habitats, and promote ecosystem health across course properties.

4.3.3 Organizational Performance

As shown in Figure 4, among the organizations that referenced climate change or environmental sustainability, eight (9.3%) provided references that were unclear, while only a small number focused specifically on either mitigation (5 organizations, 5.8%) or adaptation (10 organizations, 11.6%). Only two organizations (2.3%) addressed both, including the Canada Games Council (e.g., sustainability targets encompassing energy and climate, circularity and waste, and natural regeneration) and Golf Canada (e.g., initiatives spanning electric cart use, biodiversity protection, and low-emission event transportation options) (see Appendix C, Table C1). Although such examples of leadership remain rare within the Canadian sport community, they demonstrate that organizations of varying capacities can meaningfully engage with their membership to develop targeted climate response and serve as models for better practice across

the sector. Overall, these findings suggest that while a small number of sport organizations are beginning to acknowledge climate change or environmental sustainability, most still lack a coherent or integrated strategy for addressing them.

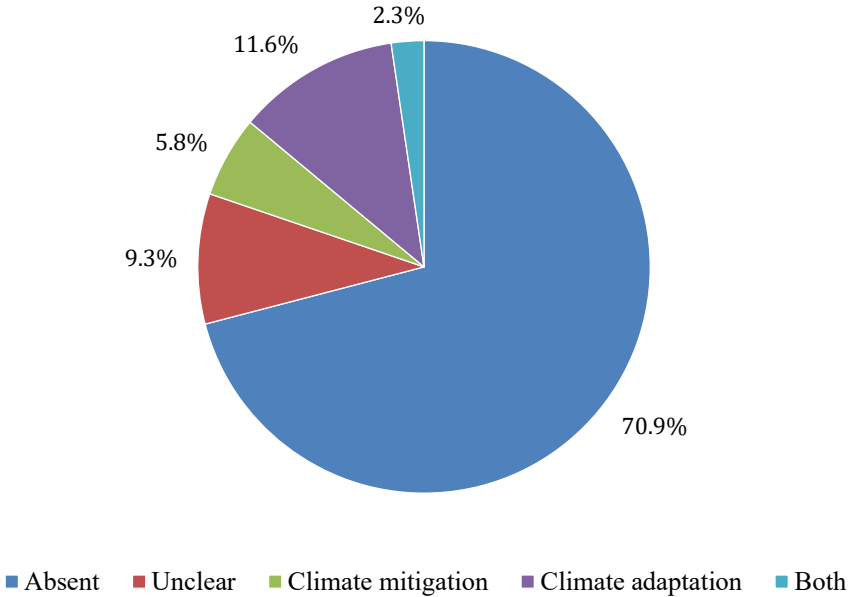


Figure 4. The scope of references to climate change or environmental sustainability across communication platforms of national-level Canadian sport organizations.

4.4 Alignment

Finally, content analysis assessed *alignment*, defined as references to other policies, frameworks, or strategies relevant to climate change or environmental sustainability. No organization (i.e., 0%) demonstrated any alignment with national climate policy, with no link to Canadian climate strategies (e.g., reduce emissions by 40-45% by 2030 and achieve net-zero by 2050). Only three organizations (3.5%) demonstrated alignment with global climate policy, either by referencing the UN SDGs, as seen in the Canadian Paralympic Committee’s 2023–2033 Strategic Plan, which highlights SDGs 12 (ensure sustainable consumption) and 13 (climate action), or by formally joining the UN Sports for Climate Action Framework, as in the case of

the Canadian Olympic Committee and Canada Games Council. Signatory organizations to the UN Framework are expected to adhere to specific principles and targets, including setting emission reduction targets (i.e., halving emissions by 2030 and reach net-zero by 2040) and engaging in annual public reporting (from 2021 onwards) to maintain signatory status. Table 4.4 outlines how each organization aligns with the UN’s framework’s principles and reveals that while these organizations are far more advanced in their climate change response, neither organization has met the public reporting requirement nor appears on track to meet the interim 2030 emission reduction target.

Table 4.4. Alignment of Canadian Signatories to the UN Sport for Climate Action Framework.

Framework principles	Canadian signatories	
	Canada Games Council	Canadian Olympic Committee
Principle 1: Systematic efforts to promote environmental responsibility	<ul style="list-style-type: none"> ● Sustainability is one of the organization’s core guiding principles, integrating environmental impact considerations into both planning and operations. ● Launched sustainability and impact framework in 2023, which aims to address three key areas: (1) energy and climate; (2) circularity and waste; and (3) natural regeneration. 	<ul style="list-style-type: none"> ● The planet is identified as a key area from impact within the vision plan for strategy and operations.
Principle 2: Reduce overall climate impact, with signatories requested to commit to achieving specific climate goals of halving emissions by 2030 and aiming to achieve net-zero by 2040	<ul style="list-style-type: none"> ● Calculate baseline metrics to establish a foundation for setting GHG emission reduction targets for future Games. ● Partnership with Racing to Zero, an 	<ul style="list-style-type: none"> ● Committed to the UN Race to Zero Framework in 2022, which includes commitments to reduce the organization’s GHG emissions by 50% by 2030 and achieve net-zero emissions by 2040.

<p>Principle 3: Educate for climate action</p>	<p>Olympian-led organization specializing in carbon footprint assessment, to analyze the GHG emissions for the 2023-24 fiscal year and find areas for reduction (no report published to share performance)</p> <ul style="list-style-type: none"> ● Implement energy-efficiency practices and innovative technologies in future Games. ● No public sustainability performance report. ● Host annual Green Sports Day virtual summit to raise awareness and inspire action across Canadian sports and sustainability sectors. 	<ul style="list-style-type: none"> ● Measures and reports to the UN its annual carbon footprint as well as progress made with emissions reductions. ● Recognized for their sustainability efforts receiving the IOC Carbon Action Awards in both 2020 and 2021 for their steps in reducing GHG emissions. ● Greenest building design awards, including LEED Platinum and BOMA Best Platinum for their Toronto office. ● No public sustainability performance report. ● Partnered with Head to Head to develop a bilingual educational resource titled “Sport and Sustainability – Team Canada”. ● Launched the Greenest Olympic Games resource in 2019 for students and teachers across the country.
<p>Principle 4: Sustainable consumption</p>	<ul style="list-style-type: none"> ● None 	<ul style="list-style-type: none"> ● None
<p>Principle 5: Advocate through communication</p>	<ul style="list-style-type: none"> ● Co-Chair of the Canadian Alliance on Sport for Climate Action. 	<ul style="list-style-type: none"> ● Member of the Canadian Alliance on Sports for Climate Action. ● Network of Team Canada athletes directly involved in climate action projects. ● Participated in various climate action summits including the Sport Positive Summit.

4.5 International Best Practices: High-Carbon Sponsorship

To expand the analysis, the content analysis also considered sector-specific climate best practices and risk management, including the role of high-carbon sponsorship. High-carbon sponsors were defined as companies from the extractive (e.g., oil, gas, mining), aviation, and automotive industries, following the classification by the Rapid Transition Alliance (Tricarico & Simms, 2021). As shown in Table 4.5, 15 (17.4%) organizations reported sponsorships ties with these industries. In some cases, these partnerships appear to conflict with the public sustainability commitments of the organizations. For example, the Canadian Olympic Committee and the Canadian Paralympic Committee have acknowledged climate change and expressed support for environmental sustainability. The Canadian Olympic Committee has also set formal emission reduction targets. Despite these efforts, both continue to maintain sponsorships ties with companies from carbon-intensive industries, including Petro-Canada (gas), Teck Resources (mining), Air Canada (aviation), and Toyota (automotive). However, not all partnerships reflect clear contradictions. Table 4.6 provides a sector-by-sector breakdown of high-carbon sponsors, highlighting differences in climate ambition and helping to contextualize their influence within the sport sector. Some sponsors, such as Teck Resources (net-zero by 2050; 40% cut in shipping emissions by 2030) and Air Canada (net-zero by 2050; 20–30% operational reductions by 2030), have outlined ambitions toward decarbonization. Among car manufacturers, Audi and Toyota have also outlined staged reductions in vehicle emissions. These efforts suggest that some sponsorships may reflect evolving business models and an increasing alignment with climate goals, rather than straightforward inconsistency.

Table 4.5. High-carbon sponsors of national-level Canadian sport organization.

Sport organization	High-carbon sponsors		
	Extractive company*	Airline	Car manufacturer
Multisport Service Organizations (MSOs)			
Coaching Association of Canada	Petro-Canada	-	-
Canadian Collegiate Athletic Association	-	WestJet	-
Canadian Olympic Committees	Petro-Canada; Teck Resources	Air Canada	Toyota
Canadian Paralympic Committees	Petro-Canada; Teck Resources	Air Canada	Toyota
National Sport Organizations (NSOs)			
Canada Snowboard	-	-	Toyota
Canada Soccer	Teck Resources	-	Toyota
Canadian Fencing Federation	Spartan Delta Corp	-	-
Golf Canada	-	-	Audi
Hockey Canada	Esso	-	-
Squash Canada	Hemisphere Energy; Birchcliff Energy; Tourmaline Oil	AirSprint	-
Triathlon Canada	-	-	Subaru
Wheelchair Basketball Canada	-	-	Toyota

*Extractive companies included in this analysis operate in industries such as oil, gas, and mining.

Table 4.6. Sector ranking of high-carbon sponsors identified among national-level Canadian sport organizations

High-carbon company	Global ranking	Emissions target	No. of appearances*
Extractive company			
Petro-Canada	N/A	No such commitments	3
Teck Resources	N/A	Net-zero by 2050; 33% reduction in carbon intensity by 2030; net-zero Scope 2 by	3

		2025; 40% cut in shipping emissions by 2030	
Spartan Delta Corp	N/A	No such commitments	1
Esso (owned by Exxon Mobil Corporation)	N/A	No such commitments	1
Hemisphere Energy	N/A	No such commitments	1
Birchcliff Energy	N/A	No such commitments	1
Tourmaline Oil	N/A	Reduce Scope 1 emission intensity by 25% from 2018 levels by 2027	1
Airline**			
Air Canada	D	Net-zero by 2050; 2030 target to cut flight emissions by 20% and ground operations by 30% (vs. 2019)	2
WestJet	D	No long-term target; 11% emissions intensity reduction achieved in 2023 vs. 2019	1
AirSprint	N/A	Offset 100% of emissions from all flights starting in 2025	1
Car manufacturer***			
Toyota	D	Reduce emissions from new vehicles by 33.3% by 2030 and over 50% by 2035 (vs. 2019)	5
Audi (owned by Volkswagen group)	C -	Targeting net carbon neutrality across the value chain by 2050	1
Subaru	N/A	Reduce Scope 1 and 2 emissions by 2035; carbon neutrality target by 2050	1

*Number of times each company was identified as a sponsor across national-level Canadian sport organizations

**Airline rankings are based on the *Atmosfair Airline Index* (2024), which evaluates global carriers on carbon efficiency and climate performance, including fleet technology, operations, and use of sustainable aviation fuel.

***Automaker rankings are drawn from the *InfluenceMap* (2022) report, the Automotive Sector and Climate Change, which assesses manufacturers on their climate commitments, policy engagement, and alignment with the goals of the Paris Agreement.

4.6 Summary of Results

Overall, the content analysis reveals a largely absent climate or environmental policy integration across Canada's national-level sport organizations, based on their organizational documents and web content. Only 29.1% of organizations made reference to climate change or environmental sustainability across any communication platform. Specifically, 12.8% of organizations integrated references in their strategic plans and 5.8% maintained a dedicated webpage on these topics. Moreover, 19.8% disclosed any actionable climate or sustainability initiative, and among those that did, 11.6% initiatives focused on adaptation, such as the development of extreme heat (9.3%) and air quality policies (5.8%). Far fewer efforts addressed mitigation, with only 5.8% reporting actions aimed at reducing environmental impact, such as emission reduction, energy use, waste reduction or transportation. Just two organizations, Golf Canada and the Canada Games Council, implemented both mitigation and adaptation initiatives. Collectively, findings suggest that high engagement initiatives, which are often those requiring greater financial investment and long-term planning, remain relatively uncommon across the Canadian Sports system.

Alignment with national and global policies, strategies, or frameworks is similarly absent, with only two organizations (i.e., the Canadian Olympic Committee and Canada Games Council) having joined as signatories to the UN Sport for Climate Action Framework. However, neither organization has fulfilled the UN's framework reporting requirements, nor have they demonstrated clear progress toward interim goals, such as halving emissions by 2030. Moreover, sponsorship ties with high-carbon industries, reported by 17.4% of organizations, may (in some cases) undermine the credibility of public climate commitments. Taken together, these findings point to an inadequate state of climate readiness. Few organizations have taken visible or

coordinated steps to address the escalating climate risks, including Sport Canada. As a result, many appear underprepared to manage climate-related hazards (e.g., extreme heat, poor air quality), raising concerns about athlete and participant safety, as well as potential legal and reputational consequences for failing to address foreseeable risks.

Chapter 5

Discussion

The presented research set out to assess the climate change readiness of national-level sport organizations in Canada. The results indicate an inadequate state of readiness, reflected in the largely absent climate or environmental policy integration across organizational documents and web content (*coverage*), response initiatives (*scope*) and alignment with global sport and climate frameworks (i.e., UN Sport for Climate Action Framework) (*alignment*). Perhaps most telling, however, is the absence of clearly articulated federal leadership in this area. Sport Canada, the national authority responsible for sport development, has not yet issued public guidance to support organizations in adapting to nor mitigating against climate change, nor is there any evidence that climate concerns have been incorporated into national sport policy or long-term planning frameworks. The leadership gap is notable given that climate change was identified as a federal priority throughout the decade-long Trudeau government (2015-2025). During this time, several ministers with the responsibility for the sport portfolio, including Carla Qualtrough (2015-2017), Kent Hehr (2017-2018), Kirsty Duncan (2018-2019), Steven Guilbeault (2021), Pascale St-Onge (2021-2023), Carla Qualtrough again (2023-2024), and Terry Duguid (2024-present), were directed, through their mandate letters, to "work with the sports sector to find solutions to reduce its environmental footprint as well as better involve our athletes in the conversation on the fight against climate change" (Government of Canada, 2023). To date, this mandate has not been accompanied by clear action, which may come in the form of policy mandates, funding criteria, or reporting mechanisms. Without national coordination, P/TSOs and municipalities lack consistent guidance and resources, contributing to fragmented climate

response. While the newly elected Carney government may still act, the current inaction marks a missed opportunity to equip the sport sector to address challenges of climate change.

In the absence of coordinated leadership and accountability mechanisms, climate change considerations remain peripheral and unevenly addressed by national-level Canadian sport organizations, leaving the sector and its stakeholders (e.g., coaches, athletes, sport managers) ill-prepared to navigate escalating climate risks. Research in climate governance and adaptation planning underscores that strong institutional leadership (supported by dedicated resources and funding) is critical to mainstream climate considerations and build systemic resilience across sector, including sport (Ford & King, 2015; Giorgio et al., 2025a). However, the lack of national policy direction, benchmarks, or guidance has led to inconsistent approaches to climate change readiness in the context of sport. For example, among the few organizations that publicly reported having an extreme heat policy, there was considerable variation in both quality and implementation; while some outlined clear, tiered response protocols with defined trigger thresholds (e.g., Athletics Canada), others offered only vague guidance (e.g., Tennis Canada). There remains no consensus on safety thresholds, with organizations applying different metrics and standards for safe participation. Moreover, current extreme weather policies, particularly those focused on heat, often fail to align with the latest scientific understanding of human physiology and athletic performance under heat stress (Gamage et al., 2020a; Grundstein et al., 2021; Racinais et al., 2023). Further adding to these challenges, existing heat management guidelines are predominantly designed to serve elite and professional sports that benefit from substantial financial resources, while amateur sports (where most participation occurs) remain largely unsupported (Sambrook et al., 2023; Werner, 2024).

While it is important to recognize that the lack of public reporting does not necessarily imply the absence of internal action, transparency remains a critical indicator of an organization's commitment and accountability on environmental issues (McCullough et al., 2020c). In this case, the absence of a strong narrative, including specific data (e.g., measurable climate goals), and visible, concrete action (e.g., public reporting on emissions) suggests that climate change has not yet been elevated to a material concern within the Canadian sport sector. These findings are not surprising; limited environmental responses reflect trends identified in previous research on national organizations elsewhere, including studies from Australia (Cury et al., 2023b) and Belgium (Hugaerts et al., 2023). More broadly, similar patterns have also been observed across other organizational settings, including professional sports leagues in North America (McCullough et al., 2020c) and the Asia-Pacific region (Wall-Tweedie & Nguyen, 2018). Taken together, these studies that spread across several continents suggest that while some leaders and pioneering organizations have emerged, the global sport sector has been slow to respond to climate change relative to other areas (e.g., water management and forestry; Mallen & Dingle 2021).

5.1 International Comparison: How Does Canada Compare?

Canada's approach to addressing climate change in sport remains in its early stages relative to the progress of international counterparts. Sport England perhaps serves as the gold standard in climate strategy, having developed an integrated and enforceable approach to meet the goals set out in the UN Sport for Climate Action Framework, including to halve emissions by 2030 and achieve net-zero by 2040. Rather than relying on voluntary participation from network organizations, Sport England has made continued funding contingent on the development and implementation of robust sustainability action plans, requiring all 130 system partners, including

national governing bodies, to meet this condition by March 2027 (Sport England, 2024). To support this transition, Sport England has invested in a range of capacity-building initiatives, for example, appointing a full-time Environmental Sustainability Strategic Lead, providing practical guidance and training resources (e.g., step-by-step instructions for developing sustainability policies and action plans), and funding retrofits to existing facilities (e.g., £60 million [CAD\$110.5 million] allocated for capital improvements to enhance the energy efficiency of public swimming pool infrastructure) (Sport England, 2024). Sport England’s model is distinctive not only in its scope (encompassing climate mitigation and adaptation) and enforceability, but also in its direct response to one of the sport sector’s most persistent challenges—the lack of internal knowledge and expertise needed to translate climate commitments into meaningful, measurable action (Cury et al., 2023a). In contrast, the fragmented and largely voluntary efforts observed across national-level Canadian sport suggest that, in the absence of top-down recognition of climate change as a material risk (through clear policies, funding conditions, or reporting frameworks) many organizations continue to view climate considerations as an elective concern and action agenda.

Another exemplar organization is the German Olympic Sports Confederation (DOSB), which is the non-governmental entity overseeing German sports. The DOSB has initiated various projects to meet the UN Sustainable Development Goals (e.g., gender equality, anti-racism, climate), including the development of an online portal for sustainable sporting events (DOSB, 2024). More specifically, the portal is a product of a collaboration between the German Olympic Sports Confederation, the German Sport University Cologne, and the Institute for Applied Ecology (Oeko-Institut), bringing together expertise in sport governance, environmental science, and applied sustainability to support the integration of sustainability principles into event

planning and evaluation (DOSB, 2024). Structured around strategic transformation areas, such as climate, nature, people/society, resources and economy, the portal offers defined targets, indicators, and implementation guidance to help organizations maximize the social benefits of sport and reduce their environmental impact. The *Climate Transformation Area* directly aligns with the climate goals of the German Government (i.e., a 65% reduction in emissions by 2030 and climate neutrality by 2045), promoting emission reductions through targeted strategies in energy, transport, venue operations, and catering (DOSB, 2024). While adoption remains at the discretion of individual organizations (i.e., voluntary), the development of the portal sets an important precedent for operationalizing climate goals within sport, especially for smaller or less experienced organizations that may lack the expertise or resources to do so on their own.

In France, the Ministry of Sports (Ministère des Sports), the governmental body responsible for national sport policy, has also demonstrated strides towards responsible sport, notably through its longstanding partnership with the World Wildlife Fund (WWF). For example, in 2017, the Ministry of Sports and WWF launched *the Charter of 15 Environmentally Responsible Commitments*, a voluntary framework signed by 51 sport entities (e.g., French Skiing Federation, AccorHotels Arena) to promote sustainable practices across various domains such as mobility, energy efficiency, and biodiversity conservation, aiming to foster a culture of responsibility within the sports community. However, it is unclear to what extent these commitments have been implemented or monitored across signatory organizations. More recently, the Ministry of Sports and WWF collaborated on a study outlining the climate change impacts on sport and partnered with the 2024 Paris Olympic and Paralympic Games and the French National Olympic and Sports Committee (CNOSF) to launch the *Climate Coach for Events* (Paris 2024, 2023). This is a free tool designed to help organizations assess and reduce the carbon footprint of sporting events

through tailored recommendations across ten key areas: catering, accommodation, travel, infrastructure and energy, sports equipment, logistics, site preparation, promotional items, digital material and waste (Paris 2024, 2023).

Overall, Europe's leadership in advancing climate policy, as exemplified by the European Green Deal and the legally binding European Climate Law, which commits countries to reduce emissions by 55% by 2030 and achieve net-zero by 2050 (European Parliament, 2024), could explain why pioneering sustainable sport initiatives, such as those led by the DOSB and CNOSF, have emerged in the region. The aforementioned examples have also demonstrated deliberate alignment between sport governance and national climate objectives (e.g., emission reduction target), supported by sport policy, funding frameworks, special resources, and strategic alignment with broader decarbonization plans. In contrast, while Canada has made comparable national climate commitments (i.e., reduce emissions by 40-45% by 2030 and achieve net-zero by 2050, National Adaptation Strategy), these policies have yet to be translated into expectations, mandates, or structural supports for the sport sector. As such, national case studies coming out of Europe demonstrate that while greater ambition within the sport sector is both possible and necessary, pathways to progress vary, offering highly valuable insights for countries seeking to advance climate action in sport.

5.2 Why Does Canada Fall Behind?

Canada's inadequate response to climate change within its sport sector may be the result of a combination of structural and systemic factors. There is little to no reliable, sector-specific data on the carbon footprint of Canadian amateur sport, nor are there standardized systems in place to measure, monitor, or report the environmental of sport. In the absence of environmental data, stakeholders cannot accurately assess the sector's contribution to climate change, prioritize areas

for intervention, nor inform mitigation strategies (Dolf & Teehan, 2015; McCullough et al., 2020b). One viable avenue for addressing this gap is the adoption of environmental impact indicators, such as those proposed by the Organisation for Economic Co-operation and Development (OECD) (2023), which can support data collection, guide performance monitoring (e.g., total carbon footprint, % of waste diverted from landfill, % of value of contracts awarded in compliance with sustainability standards), and help build the evidence base and business case for climate action within the sport sector. Compounding data challenges is a general lack of communication regarding the availability of resources (where they exist) on behalf of Sport Canada or other government agencies (e.g., Department of Canadian Heritage) which is critical to support network organizations in integrating climate considerations, and more broadly, environmental sustainability, into their core activities (e.g., daily operations, facility management, event delivery) (Cury et al., 2024). Moreover, although examples of climate action exist within the Canadian sport sector, at the national level (e.g., the Canada Games Council, Golf Canada), efforts remain isolated, with no clear measures in place to facilitate knowledge sharing or build sector-wide capacity to promote collective action. Federal leadership plays an important role providing structured support mechanisms (e.g., financial pathways, policy direction, knowledge resources, capacity building) that network organizations often lack, but in its absence, leadership can emerge from alternative sources, including subnational governments (e.g., provincial or territorial departments or programs) and nonprofits (e.g., Protect Our Winters) (Cury et al., 2024). Nonetheless, leadership at any level remains a key driver of environmental change implementation, as network organizations may struggle to effectively engage with climate action without coordinated guidance and access to sector-specific resources (Giorgio et al., 2025a).

The Canadian sport system also operates within a crowded and increasingly complex policy environment, where limited financial resources (Pingue, 2024), competing demands (Spencer, 2025), and ongoing crises, such as the mishandling of sexual assault allegations by Hockey Canada (McLeod, 2022), have pushed climate action down the agenda. It follows, then, that organizations, particularly at the national level, are under considerable pressure, having assumed additional responsibilities without corresponding increases in funding (The Sport Matters Group, 2019) or updates to policy (the current Canadian Sport Policy has remained unchanged since 2012 and its scheduled 2023 renewal is now overdue). More specifically, Canada's NSOs have not received an increase in government funding since 2005, according to recent reports (CBC, 2025) and often forced to seek alternative funding from the private sector (Morrison, 2024). In this context, sponsorships from high-carbon industries present an attractive, and sometimes necessary, source of financial support. Canada's sport system, in its current state, lacks adequate capacity (Doherty & Cuskelly, 2019; Misener & Doherty, 2009), that is, the ability to respond to the impacts of climate change and, more broadly, to contribute meaningfully to mitigation efforts and leverage its platform to advocate for broader societal action (Orr, 2023). As in many areas of public policy, proactive climate measures in sport appear to receive limited attention unless prompted by an immediate crisis (Pagnotta et al., 2016), for example, in Arkansas, policy change addressing heat safety was enacted only after the death of a high school athlete from exertional heat stroke (Frye, 2011). It is clear that approaches to climate action vary widely, shaped by national policy contexts, system structures, and organizational capacity (Misener & Doherty, 2009), underscoring a critical insight: the sport sector's ability to contribute meaningfully to climate action depends on both organizational ambition and the existence of enabling policy environments that mandate, incentivize, and support sustainable transitions (Cury et al., 2023b).

5.3 A Roadmap for Advancing Climate Change Readiness in Canadian Sport

The Canadian sport system must first build foundational climate capacity before widespread action is possible. Orr (2023) identified several indicators that illustrate how climate capacity manifests within sport organizations, including infrastructural resources (e.g., the use of renewable energy), natural resources (e.g., sustainable water use), planning and development resources (e.g., sustainability reporting systems), human resources (e.g., staff with expertise in addressing climate and environmental issues), financial resources (e.g., dedicated investments in sustainability initiatives), and network and relationship resources (e.g., partnerships with environmentally conscientious organizations). Building capacity across the Canadian sport system will require deliberate investment, strategic leadership, coordination and training (Doherty & Cuskelly, 2019; Misener & Doherty, 2009). These efforts must be multi-scalar, led by national authorities such as Sport Canada, which is well-positioned to assume a central role in advancing sustainability efforts, and supported by P/TSOs and local governments to ensure implementation at the municipal and community levels. It is critical to recognize that Sport Canada's role should not be limited to increasing or administering funding; rather, it must extend to shaping policy frameworks (e.g., integrating climate targets into future funding agreements), setting sector-wide expectations (e.g., encouraging sport organizations to sign onto the UN Sport for Climate Action Framework), facilitating knowledge-sharing initiatives (e.g., offering carbon literacy training for sport managers, creating centralized hubs for sustainability resources, providing risk management support), and ensuring oversight (e.g., appointing a sustainability officer to monitor and guide progress). International models, such as Sport England's *Every Move* (2024) sustainability strategy and action plan, offer valuable examples of how a strong

policy mandate can integrate environmental stewardship across all levels of the sport system, from national policy to grassroots delivery.

In the absence of fully realized implementation pathways and feasibility measures, individual sport organizations can nonetheless take immediate and proactive steps. Key recommendations include:

- **Develop weather policies:** Sport organizations can take steps to strengthen their climate resilience by developing weather policies. Research consistently shows that adaptation is both feasible and effective across all levels of organized sport, particularly for managing the growing risks of extreme heat (Orr et al., 2022a). Establishing heat policies with clearly defined thresholds for safe play and standardized response protocols is a critical adaptation strategy. For example, Athletics Canada has implemented detailed extreme-heat safety guidelines that include defined temperature thresholds, preventative measures (e.g., mandatory hydration breaks), operational adjustments (e.g., rescheduling events to cooler times of the day), and emergency protocols (e.g., availability of cold-water immersion tubs). For further support, sport organizations, particularly NSOs, can draw on guidance from their respective international federations, many of which (e.g., World Rugby) have developed comprehensive and science-based weather safety policies.
- **Forge strategic partnerships:** Sport organizations can amplify their climate impact by leveraging their visibility and networks to form strategic partnerships that advance environmental and organizational goals. Collaborations with environmental nonprofits (e.g., Protect Our Winters Canada, Green Sports Alliance, EcoAthletes), sustainability consultants (e.g., Racing to Zero), national initiatives (e.g., Green Sports Day Canada), and academic institutions (e.g., University of British Columbia Centre for Sport and

Sustainability) enhance credibility, expand reach, and provide access to specialized expertise. For example, the Canada Games Council and Canadian Olympic Committee have partnered with Racing to Zero to measure and reduce GHG emissions, and with researchers from the University of Toronto's Climate Positive Energy initiative to develop innovations targeting Scope 3 emissions reduction. More broadly, beyond formal collaborations, resource- and information-sharing initiatives, offer practical ways to strengthen adaptation efforts and accelerate sector-wide progress. However, the absence of a coordinated national platform in Canada to facilitate such exchanges remains a critical gap, limiting the ability of sport organizations to scale climate solutions.

- Join the UN Sport for Climate Action Framework: Sport organizations should prioritize signing onto the UN Sport for Climate Action Framework as it aligns them with international best practices for climate leadership and establishes a structured approach for setting, planning, and reporting on emissions-reduction targets (e.g., committing to a 50% reduction in emissions by 2030, achieving net-zero by 2040). In addition to operational direction, the framework offers a credible and globally recognized platform that strengthens organizational accountability and signals commitment to stakeholders (e.g., athletes, fans, sponsors). Strengthening participation would enhance Canada's leadership on climate action in sport, building on the example of early signatories such as the Canada Games Council, the Canadian Olympic Committee, Banff Marathon, Run Ottawa, and SailGP Canada.

Building in-house capacity across the sport system, alongside concrete organizational action, represents a critical first step toward strengthening climate readiness in Canadian sport. Without such efforts, continued inaction may intensify existing climate risks, leaving organizations and

stakeholders increasingly exposed to operational disruptions, financial losses, and reputational harm. At the same time, rising climate threats may affect sport participation, particularly at the community level, by making sport less accessible, less reliable, and, in some cases, unsafe (ParticipACTION, 2024). This not only disrupts programming but also jeopardizes the broader social, developmental, and health benefits that sport provides across the country.

Chapter 6

Conclusion

If current GHG emissions continue (an outcome that remains plausible without decisive global action), the sport sector will face escalating climate disruptions that challenge traditional competition schedules, facility design, athlete performance and safety, and event delivery models (Orr, 2024). In this evolving risk landscape, sport organizations must begin to take proactive and systemic action to enhance climate resilience and reduce emissions, while also protecting themselves from legal liability and reputational harm. The presented study assessed the climate change readiness of national-level Canadian sport organizations (i.e., Sport Canada, MSOs and NSOs) through a content analysis of public-facing materials. Guided by five key objectives, the findings reveal a significant gap between the climate risks facing sport and the limited response from national governing bodies. Using a climate policy integration framework, the study found that only 29% of organizations made any reference of climate change or environmental sustainability in their organizational documents and website content (*Objective 1*). Just 19.8% of organizations reported taking any form of climate or sustainability action, and most of these were adaptation-focused (e.g., policies for extreme heat or air quality). Mitigation efforts, particularly those aimed at reducing emissions, were largely absent (*Objective 2*). There was little evidence of alignment with national or global climate policies, with 3.5% of organizations showing any engagement with international frameworks, such as the UN Sport for Climate Action Framework (*Objective 3*). Compared to international counterparts, particularly in Europe, Canadian organizations lag in climate ambition, policy development, and implementation, highlighting opportunities to adopt best practices (e.g., Sport England’s *Every Move* sustainability strategy) (*Objective 4*). Overall, study findings informed a set of practical, context-specific

recommendations to strengthen the sector's climate response including building foundational climate capacity through deliberate investment and the development of targeted resources (e.g., training tools) (*Objective 5*). As Sport Canada rolls out the new Canadian Sport Policy (2023-2033), this research helps build the case for coordinated, sector-wide action on climate change.

It is also necessary to acknowledge the methodological limitations of this study as data collection was limited to publicly available content, which may not reflect internal efforts or emerging practices within sport organizations. That said, any absence of transparent, public reporting on climate action would be revealing on its own, as it suggests that climate change, or more broadly environmental sustainability, has not yet been fully recognized as a core component of organizational accountability within the Canadian sport sector. Moving forward, future research should engage directly with sport stakeholders (e.g., administrators, coaches, athletes) via surveys or interviews to delve deeper into climate change perceptions within organizations, exploring questions, such as: what motivates or hinders climate action and environmental sustainability? What forms of support are needed to close the gap between awareness and implementation of effective climate strategies? Gaining insights into motivations, limitations, and barriers can inform the design of targeted support mechanisms and address identified needs that help organizations meet their responsibilities to athletes, spectators, and the environment. In parallel, research should also assess the actual scope and severity of climate impacts across different levels and types of sport. If certain areas are found to be less affected, this too is important to establish, as it may warrant a more focused or self-interested approach to climate action in those specific contexts. Advancing this research agenda can ultimately help Canadian sport strengthen its climate resilience while sharing valuable lessons and practical strategies with sport systems around the world facing similar climate challenges.

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Appendix A

Official Websites of National-Level Canadian Sport Organizations

Government entity	
Sport organization	Corresponding website
Sport Canada	https://www.canada.ca/en/canadian-heritage/services/role-sport-canada.html

Multisport Service Organizations (MSOs)	
Sport organization	Corresponding website
AthletesCAN	https://athletescan.ca/
Aboriginal Sport Circle	https://www.aboriginalsportcircle.ca/
Canada Games Council	https://www.canadagames.ca/
Canadian Centre for Ethics in Sports	https://cces.ca/
Canadian Collegiate Athletic Association	https://www.ccaa.ca/splash/index
Canadian Deaf Sports Association	https://assc-cdsa.com/en/
Canadian Olympic Committee	https://olympic.ca/
Canadian Paralympic Committee	https://paralympic.ca/
Canadian Tire Jumpstart Charities	https://jumpstart.canadiantire.ca/
Canadian Women and Sport	https://womenandsport.ca/
Coaching Association of Canada	https://coach.ca/
Commonwealth Games Canada	https://commonwealthsport.ca/
Go Le Grand Défi inc.	https://www.legdpl.com/en
KidSport Canada	https://kidsportcanada.ca/
Motivate Canada	https://motivatecanada.ca/
Own the Podium	https://www.ownthepodium.org/en-CA/

ParticipACTION	https://www.participaction.com/
Physical and Health Education Canada	https://phecanada.ca/
Special Olympics Canada	https://www.specialolympics.ca/
Sport Dispute Resolution Centre of Canada	https://www.crdsc-sdrcc.ca/eng/home
Sport for Life Society	https://sportforlife.ca/
Sport Information Resource Centre	https://sirc.ca/
U SPORTS	https://usports.ca/en

National Sport Organizations (NSOs)		
Sport	Sport organization	Corresponding website
Alpine Skiing	Alpine Canada	http://www.alpinecanada.org/
Archery	Archery Canada	https://archerycanada.ca/
Athletics	Athletics Canada	http://athletics.ca/
Badminton	Badminton Canada	http://www.badminton.ca/
Baseball	Baseball Canada	https://www.baseball.ca/
Basketball	Canada Basketball	http://www.basketball.ca/en
Biathlon	Biathlon Canada	http://biathloncanada.ca/
Bobsleigh and skeleton	Bobsleigh Canada Skeleton	http://www.bobsleighcanadaskeleton.ca/
Boccia	Boccia Canada	http://bocciacanada.ca/en/
Boxing	Boxing Canada	http://boxingcanada.org/
Bowling - 5 and 10 pin	Bowling Federation of Canada	https://www.canadabowls.ca/
Broomball	Broomball Canada	http://www.broomball.ca/wp/
Canoe and kayak	Canoe Kayak Canada	http://canoekayak.ca/
Climbing	Climbing Canada	https://www.climbingcanada.ca/
Cricket	Cricket Canada	https://cricketcanada.org/

Cross country skiing	Nordiq Canada	https://nordiqcanada.ca/
Curling	Curling Canada	https://www.curling.ca/
Cycling	Cycling Canada	http://www.cyclingcanada.ca/
Dancesport	Canada DanceSport	https://www.dancesport.ca/
Diving	Diving Canada	https://diving.ca/
Equestrian	Equestrian Canada	https://www.equestrian.ca/
Fencing	Canadian Fencing Federation	http://fencing.ca/
Field hockey	Field Hockey Canada	http://www.fieldhockey.ca/en/home
Figure skating	Skate Canada	https://skatecanada.ca/
Football	Football Canada	http://footballcanada.com/
Freestyle skiing	Freestyle Canada	http://www.freestylecanada.ski/en/
Goalball	Canadian Blind Sports Association	https://canadianblindsports.ca/
Golf	Golf Canada	http://www.golfcanada.ca/
Gymnastics	Gymnastics Canada	http://www.gymcan.org/
Ice hockey	Hockey Canada	https://www.hockeycanada.ca/en-ca/home
Judo	Judo Canada	http://www.judocanada.org/?lang=en
Karate	Karate Canada	https://karatecanada.org/
Lacrosse	Lacrosse Canada	https://www.lacrosse.ca/
Lawn bowls	Bowls Canada Boulingrin	https://bowlscanada.com/en/
Luge	Luge Canada	http://www.luge.ca/en/
Pentathlon	Pentathlon Canada	https://www.pentathloncanada.ca/
Racquetball	Racquetball Canada	https://racquetballcanada.ca/
Ringette	Ringette Canada	http://www.ringette.ca/
Rowing	Rowing Canada Aviron	http://rowingcanada.org/
Rugby	Rugby Canada	https://rugby.ca/en
Sailing	Sail Canada	http://www.sailing.ca/

Shooting	Shooting Federation of Canada	http://sfc-ftc.ca/
Skateboard	Canada Skateboard	https://www.canadaskateboard.ca/
Ski jumping	Ski Jump Canada	https://skijumpingcanada.com/
Snowboard	Canada Snowboard	https://www.canadasnowboard.ca/en/
Soccer	Canada Soccer	http://canadasoccer.com/
Softball	Softball Canada	http://www.softball.ca/
Speed skating	Speed Skating Canada	http://www.speedskating.ca/
Squash	Squash Canada	http://www.squash.ca/en
Surfing	Surf Canada	https://csasurfcanada.org/
Swimming	Swimming Canada	http://www.swimming.ca/en/
Swimming - artistic	Canada Artistic Swimming	https://artisticswimming.ca/
Table tennis	Table Tennis Canada	https://ttcanada.ca/
Taekwondo	Taekwondo Canada	http://taekwondo-canada.com/
Tennis	Tennis Canada	http://www.tenniscanada.com/
Triathlon	Triathlon Canada	http://www.triathloncanada.com/
Volleyball	Volleyball Canada	http://www.volleyball.ca/
Water polo	Water Polo Canada	http://www.waterpolo.ca/Default.aspx
Water ski and wakeboard	Water Ski and Wakeboard Canada	http://wswc.ca/
Weightlifting	Canadian Weightlifting Federation	http://www.halterophiliecanada.ca/?lang=en
Wheelchair basketball	Wheelchair Basketball Canada	http://www.wheelchairbasketball.ca/
Wheelchair rugby	Wheelchair Rugby Canada	https://wheelchairrugby.ca/
Wrestling	Wrestling Canada	https://wrestling.ca/

Source: Government of Canada's sport directories

Appendix B

Study Sample of National-Level Canadian Sport Organizations

Sport organizations

Aboriginal Sport Circle	Golf Canada
Alpine Canada	Gymnastics Canada
Archery Canada	Hockey Canada
Athletics Canada	Judo Canada
AthletesCAN	Karate Canada
Badminton Canada	KidSport Canada
Baseball Canada	Lacrosse Canada
Biathlon Canada	Luge Canada
Bobsleigh Canada Skeleton	Motivate Canada
Boccia Canada	Nordiq Canada
Boxing Canada	Own the Podium
Bowls Canada Boulingrin	ParticipACTION
Broomball Canada	Pentathlon Canada
Canada Artistic Swimming	Physical and Health Education Canada
Canada Basketball	Racquetball Canada
Canada DanceSport	Ringette Canada
Canada Games Council	Rowing Canada Aviron
Canada Skateboard	Rugby Canada
Canada Snowboard	Sail Canada
Canada Soccer	Shooting Federation of Canada
Canadian Blind Sports Association	Skate Canada
Canadian Centre for Ethics in Sports	Ski Jump Canada
Canadian Collegiate Athletic Association	Softball Canada
Canadian Deaf Sports Association	Special Olympics Canada
Canadian Fencing Federation	Speed Skating Canada
Canadian Olympic Committee	Sport Canada
Canadian Paralympic Committee	Sport Dispute Resolution Centre of Canada
Canadian Tire Jumpstart Charities	Sport for Life Society
Canadian Weightlifting Federation	Sport Information Resource Centre
Canadian Women and Sport	Squash Canada
Canoe Kayak Canada	Surf Canada
Climbing Canada	Swimming Canada
Coaching Association of Canada	Table Tennis Canada
Commonwealth Games Canada	Taekwondo Canada
Cricket Canada	Tennis Canada
Curling Canada	Triathlon Canada
Cycling Canada	USPORTS
Diving Canada	Volleyball Canada
Equestrian Canada	Water Polo Canada
Field Hockey Canada	Water Ski and Wakeboard Canada
Football Canada	Wheelchair Basketball Canada
Freestyle Canada	Wheelchair Rugby Canada
Go Le Grand Défi inc.	Wrestling Canada

Appendix C

Results of Content Analysis

- = Not available
- ✓ = Includes reference
- / – = Document not available; no reference found
- ✓ / – = Document available; no reference
- ✓ / ✓ = Document available; includes reference

Table C1. Results of climate change or environmental sustainability coverage in communication platforms of national-level Canadian sport organizations.

Sport organization	Reference to climate change or environmental sustainability					Climate and sustainability initiatives
	Organizational documents			Website Content		
	Strategic plan	Annual report*	Sustainability report	Dedicated webpage	General website**	
Government entity						
Sport Canada	– / –	– / –	–	–	–	–
Total	0	0	0	0	0	0
Multisport Service Organizations (MSOs)						
AthletesCAN	– / –	– / –	–	–	–	–
Aboriginal Sport Circle	– / –	– / –	–	–	–	–

Canada Games Council	✓ / ✓	✓ / ✓	–	✓	✓	<ul style="list-style-type: none"> • Outlines various sustainability targets including energy and climate (e.g., GHG emissions, energy efficiency, air quality), circularity and waste (e.g., plastic reduction, waste reduction, circular economy), and natural regeneration (e.g., climate adaptation, water quality, protected areas). • Hosts annual Green Sports Day Summit in Canada • Co-Chair of the Canadian Alliance on Sport for Climate Action. • Partnership with Race to Zero, an Olympian-led organization focused on carbon footprint assessments. • Signatory of the UN Sport for
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						Climate Action Framework.
Canadian Centre for Ethics in Sports	✓ / ✓	✓ / -	-	-	✓	-
Canadian Collegiate Athletic Association	✓ / ✓	- / -	-	-	-	-
Canadian Deaf Sports Association	✓ / -	✓ / -	-	-	-	-
Canadian Olympic Committee	✓ / ✓	✓ / ✓	-	✓	✓	<ul style="list-style-type: none"> • Member of the Canadian Alliance on Sports for Climate Action • Network of Team Canada athletes directly involved in climate action projects • Commitment to reduce GHG emissions by 50% by 2030 and achieve net-zero emissions by 2040 • Signatory of the UN Sport for Climate Action Framework

Canadian Paralympic Committee	✓ / ✓	✓ / -	-	-	-	-
Canadian Tire Jumpstart Charities	- / -	✓ / -	-	-	-	-
Canadian Women and Sport	✓ / -	✓ / -	-	-	-	-
Coaching Association of Canada	✓ / -	✓ / -	-	-	-	-
Commonwealth Games Canada	✓ / -	✓ / -	-	-	✓	-
Go Le Grand Défi inc.	✓ / -	- / -	-	-	-	-
KidSport Canada	- / -	✓ / -	-	-	-	-
Motivate Canada	- / -	- / -	-	-	-	-
Own the Podium	- / -	- / -	-	-	-	-
ParticipACTION	✓ / -	✓ / -	-	-	✓	-
Physical and Health Education Canada	✓ / -	✓ / -	-	-	-	-
Special Olympics Canada	✓ / -	✓ / -	-	-	-	-

Sport Dispute Resolution Centre of Canada	✓ / -	✓ / -	-	-	-	-
Sport for Life Society	✓ / -	✓ / -	-	-	-	-
Sport Information Resource Centre	- / -	- / -	-	✓	✓	<ul style="list-style-type: none"> • Publish training guidelines to help sport organizations, providing insights on sport safety and addressing impacts such as exertional heat illness and shorter winter sport seasons
U SPORTS	✓ / -	✓ / -	-	-	-	-
Total	5	2	0	3	6	3
National Sport Organizations (NSOs)						
Alpine Canada	✓ / -	✓ / -	-	-	-	-
Archery Canada	✓ / -	✓ / -	-	-	✓	<ul style="list-style-type: none"> • Extreme weather policy
Athletics Canada	✓ / -	✓ / -	-	-	✓	<ul style="list-style-type: none"> • Extreme weather policy

Badminton Canada	- / -	- / -	-	-	-	-
Baseball Canada	✓ / -	- / -	-	-	✓	• Extreme weather policy
Biathlon Canada	- / -	- / -	-	-	-	-
Bobsleigh Canada Skeleton	✓ / -	✓ / -	-	-	-	-
Boccia Canada	✓ / -	✓ / -	-	-	-	-
Bowls Canada Boulingrin	✓ / ✓	✓ / -	-	-	✓	• Extreme weather policy
Boxing Canada	✓ / -	- / -	-	-	-	-
Broomball Canada	- / -	✓ / -	-	-	-	-
Canada Artistic Swimming	✓ / -	✓ / -	-	-	-	-
Canada Basketball	✓ / -	- / -	-	-	-	-
Canada DanceSport	- / -	- / -	-	-	-	-
Canada Skateboard	- / -	- / -	-	-	-	-
Canada Snowboard	✓ / -	✓ / -	-	-	-	-
Canada Soccer	✓ / -	✓ / -	-	-	-	-
Canadian Blind Sports Association	- / -	- / -	-	-	-	-

Canadian Fencing Federation	✓ / -	- / -	-	-	-	-
Canadian Weightlifting Federation	- / -	- / -	-	-	-	-
Canoe Kayak Canada	✓ / -	✓ / -	-	-	✓	• Extreme weather policy
Climbing Canada	✓ / -	✓ / -	-	-	-	-
Cricket Canada	✓ / -	- / -	-	-	-	-
Curling Canada	✓ / ✓	✓ / -	-	-	✓	-
Cycling Canada	✓ / -	✓ / -	-	-	-	-
Diving Canada	- / -	- / -	-	-	-	-
Equestrian Canada	✓ / -	✓ / -	-	-	✓	• Extreme weather policy
Field Hockey Canada	✓ / -	✓ / -	-	-	-	-
Football Canada	✓ / -	- / -	-	-	-	-
Freestyle Canada	✓ / -	- / -	-	-	✓	-
Golf Canada	✓ / ✓	✓ / ✓	-	✓	✓	• Sustainability gameplan based on biodiversity, water management,

energy
efficiency, and
waste

- management,
Previous events,
including the
2024 RBC
Canadian Open
and the CPKC
Women's Open
showcases
sustainability
initiatives
encompassing
transportation,
water and waste
management, and
renewable
energy.
- Integrate
sustainability
initiatives into
daily operations,
including water
bottle refill
stations,
promoting the
switch to electric
golf carts, and
increase the
among of
naturalized area.

Gymnastics Canada	-/-	✓/-	-	-	-	-
Hockey Canada	-/-	✓/-	-	-	-	-
Judo Canada	-/-	-/-	-	-	-	-
Karate Canada	✓/-	-/-	-	-	-	-
Lacrosse Canada	✓/-	-/-	-	-	-	-
Luge Canada	-/-	-/-	-	-	-	-
Nordiq Canada	✓/✓	-/-	-	-	✓	<ul style="list-style-type: none"> • Education initiatives, including promoting free environmental sustainability training courses offered by the International Ski and Snowboard Federation (FIS) to its members as well as special topics seminars on climate change
Pentathlon Canada	✓/-	-/-	-	-	-	-
Racquetball Canada	-/-	✓/-	-	-	-	-
Ringette Canada	✓/-	✓/-	-	-	-	-

Rowing Canada Aviron	✓ / ✓	✓ / –	–	–	✓	• Extreme weather policy
Rugby Canada	✓ / –	✓ / –	–	–	–	–
Sail Canada	✓ / ✓	✓ / ✓	–	✓	✓	• Offer educational resources developed by World Sailing to promote sustainability, including information booklets, activity guides, and trainer manuals, covering topics such as climate change and its impact on waterways and oceans.
Shooting Federation of Canada	– / –	– / –	–	–	–	–
Skate Canada	✓ / –	✓ / –	–	–	–	–
Ski Jump Canada	✓ / –	– / –	–	–	–	–
Softball Canada	✓ / –	– / –	–	–	✓	• Extreme weather policy

Speed Skating Canada	✓ / -	✓ / -	-	-	✓	<ul style="list-style-type: none"> Partnership with carbon capture provider Svante to develop a digital marketing campaign that raises awareness of climate change impacts on the sport.
Squash Canada	✓ / -	✓ / -	-	-	-	-
Surf Canada	✓ / -	- / -	-	-	-	-
Swimming Canada	✓ / -	✓ / -	-	-	✓	-
Table Tennis Canada	- / -	- / -	-	-	-	-
Taekwondo Canada	- / -	- / -	-	-	-	-
Tennis Canada	✓ / -	✓ / -	-	-	✓	<ul style="list-style-type: none"> Extreme weather policy
Triathlon Canada	✓ / -	- / -	-	-	-	-
Volleyball Canada	✓ / -	✓ / -	-	-	✓	<ul style="list-style-type: none"> Extreme weather policy
Water Polo Canada	✓ / -	- / -	-	-	-	-
Water Ski and Wakeboard Canada	✓ / -	- / -	-	-	-	-

Wheelchair Basketball Canada	✓ / –	– / –	–	–	–	–
Wheelchair Rugby Canada	✓ / –	– / –	–	–	–	–
Wrestling Canada	✓ / –	✓ / –	–	–	–	–
Total	6	2	0	2	17	14
Overall total	11 (12.8%)	4 (4.7%)	0 (0%)	5 (5.8%)	23 (26.7%)	17 (19.8%)

*Most recent annual report was reviewed

**Explicit reference to climate change or environmental sustainability at least once in any document/webpage (besides those previously mentioned)

Table C2. Climate and environmental sustainability initiatives disclosed by national-level Canadian sport organizations.

Sport organization	Environmental sustainability or climate strategy*	Signatory of the UN Sport for Climate Action Framework	Emissions reduction target	High-carbon sponsorship
Government entity				
Sport Canada	–	–	–	–
Multisport Service Organizations (MSOs)				
AthletesCAN	–	–	–	–
Aboriginal Sport Circle	–	–	–	–
Canada Games Council	–	Since 2019	Emission reductions of 50% by 2030, and net-zero by 2040	–
Canadian Centre for Ethics in Sports	–	–	–	–
Canadian Collegiate Athletic Association	–	–	–	WestJet
Canadian Deaf Sports Association	–	–	–	–
Canadian Olympic Committee	–	Since 2020	Emission reductions of 50% by 2030, and net-zero by 2040	Petro-Canada, Teck Resources, Air Canada, Toyota
Canadian Paralympic Committee	–	–	–	Petro-Canada, Teck Resources, Air Canada, Toyota

Canadian Tire Jumpstart Charities	–	–	–	Canadian Tire Gas+
Canadian Women and Sport	–	–	–	–
Coaching Association of Canada	–	–	–	Petro-Canada
Commonwealth Games Canada	–	–	–	–
Go Le Grand Défi inc.	–	–	–	–
KidSport Canada	–	–	–	–
Motivate Canada	–	–	–	–
Own the Podium	–	–	–	–
ParticipACTION	–	–	–	–
Physical and Health Education Canada	–	–	–	–
Special Olympics Canada	–	–	–	–
Sport Dispute Resolution Centre of Canada	–	–	–	–
Sport for Life Society	–	–	–	–
Sport Information Resource Centre	–	–	–	–
U SPORTS	–	–	–	–
National Sport Organizations (NSOs)				

Alpine Canada	–	–	–	Teck Resources
Archery Canada	–	–	–	–
Athletics Canada	–	–	–	–
Badminton Canada	–	–	–	–
Baseball Canada	–	–	–	–
Biathlon Canada	–	–	–	–
Bobsleigh Canada Skelton	–	–	–	–
Boccia Canada	–	–	–	–
Bowls Canada Boulingrin	–	–	–	–
Boxing Canada	–	–	–	–
Broomball Canada	–	–	–	–
Canada Artistic Swimming	–	–	–	–
Canada Basketball	–	–	–	Flair Airlines, Toyota
Canada DanceSport	–	–	–	–
Canada Skateboard	–	–	–	–
Canada Snowboard	–	–	–	Toyota
Canada Soccer	–	–	–	Teck Resources, Toyota
Canadian Blind Sports Association	–	–	–	–

Canadian Fencing Federation	–	–	–	Spartan Delta Corp
Canadian Weightlifting Federation	–	–	–	–
Canoe Kayak Canada	–	–	–	–
Climbing Canada	–	–	–	–
Cricket Canada	–	–	–	–
Curling Canada	–	–	–	–
Cycling Canada	–	–	–	–
Diving Canada	–	–	–	–
Equestrian Canada	–	–	–	–
Field Hockey Canada	–	–	–	–
Football Canada	–	–	–	–
Freestyle Canada	–	–	–	–
Golf Canada	–	–	–	Audi
Gymnastics Canada	–	–	–	–
Hockey Canada	–	–	–	Esso
Judo Canada	–	–	–	–
Karate Canada	–	–	–	–
Lacrosse Canada	–	–	–	–

Luge Canada	–	–	–	–
Nordiq Canada	–	–	–	–
Pentathlon Canada	–	–	–	–
Racquetball Canada	–	–	–	–
Ringette Canada	–	–	–	–
Rowing Canada Aviron	–	–	–	–
Rugby Canada	–	–	–	–
Sail Canada	–	–	–	–
Shooting Federation of Canada	–	–	–	–
Skate Canada	–	–	–	–
Ski Jump Canada	–	–	–	–
Softball Canada	–	–	–	–
Speed Skating Canada	–	–	–	–
Squash Canada	–	–	–	Hemisphere Energy, Birchcliff Energy, Tourmaline Oil, AirSprint
Surf Canada	–	–	–	–
Swimming Canada	–	–	–	–
Table Tennis Canada	–	–	–	–

Taekwondo Canada	–	–	–	–
Tennis Canada	–	–	–	–
Triathlon Canada	–	–	–	Subaru
Volleyball Canada	–	–	–	–
Water Polo Canada	–	–	–	–
Water Ski and Wakeboard Canada	–	–	–	–
Wheelchair Basketball Canada	–	–	–	Toyota
Wheelchair Rugby Canada	–	–	–	–
Wrestling Canada	–	–	–	–
Total	0 (0%)	2 (2.3%)	2 (2.3%)	15 (17.4%)

*Only robust environmental sustainability or climate strategies were considered (which explicitly outline the organization's sustainability commitments, present a clear plan for achieving those goals, and describe how environmental impacts and progress will be monitored and reported) (Powell & Bernard, 2022).

Table C3. Weather policies disclosed by national-level Canadian sport organizations.

Sport organization	Weather policy	Heat addressed	Other conditions addressed	Notes
Government entity				
Sport Canada	–	–	–	–
Multisport Service Organizations (MSOs)				
AthletesCAN	–	–	–	–
Aboriginal Sport Circle	–	–	–	–
Canada Games Council	–	–	–	–
Canadian Centre for Ethics in Sports	–	–	–	–
Canadian Collegiate Athletic Association	–	–	–	–
Canadian Deaf Sports Association	–	–	–	–
Canadian Olympic Committee	–	–	–	–
Canadian Paralympic Committee	–	–	–	–
Canadian Tire Jumpstart Charities	–	–	–	–
Canadian Women and Sport	–	–	–	–

Coaching Association of Canada	–	–	–	–
Commonwealth Games Canada	–	–	–	–
Go Le Grand Défi inc.	–	–	–	–
KidSport Canada	–	–	–	–
Motivate Canada	–	–	–	–
Own the Podium	–	–	–	–
ParticipACTION	–	–	–	–
Physical and Health Education Canada	–	–	–	–
Special Olympics Canada	–	–	–	–
Sport Dispute Resolution Centre of Canada	–	–	–	–
Sport for Life Society	–	–	–	–
Sport Information Resource Centre	–	–	–	–
U SPORTS	–	–	–	–
National Sport Organizations (NSOs)				
Alpine Canada	–	–	–	–
Archery Canada	Yes	Yes	Storm conditions (lightning, thunder), wind, rain	Overarching extreme weather policy

Athletics Canada	Yes	Yes	Air quality, storm conditions (thunder, lightning), wind, ice, cold weather	Overarching extreme weather policy
Badminton Canada	–	–	–	–
Baseball Canada	Yes	Yes	Storm conditions (thunder, lightning)	Overarching extreme weather policy
Biathlon Canada	–	–	–	–
Bobsleigh Canada Skelton	–	–	–	–
Boccia Canada	–	–	–	–
Bowls Canada Boulingrin	Yes	Yes	Cold weather, air quality, storm conditions (thunder, lightning)	Championship policies document
Boxing Canada	–	–	–	–
Broomball Canada	–	–	–	–
Canada Artistic Swimming	–	–	–	–
Canada Basketball	–	–	–	–
Canada DanceSport	–	–	–	–
Canada Skateboard	–	–	–	–
Canada Snowboard	–	–	–	–
Canada Soccer	–	–	–	–

Canadian Blind Sports Association	–	–	–	–
Canadian Fencing Federation	–	–	–	–
Canadian Weightlifting Federation	–	–	–	–
Canoe Kayak Canada	Yes	Yes	Storm conditions (lightning, thunder), wind, water conditions, cold weather, air quality, water quality	Code of safety document
Climbing Canada	–	–	–	–
Cricket Canada	–	–	–	–
Curling Canada	–	–	–	–
Cycling Canada	–	–	–	–
Diving Canada	–	–	–	–
Equestrian Canada	Yes	Yes	Cold weather, air quality	Overarching extreme weather policy
Field Hockey Canada	–	–	–	–
Football Canada	–	–	–	–
Freestyle Canada	–	–	–	–
Golf Canada	–	–	–	–
Gymnastics Canada	–	–	–	–

Hockey Canada	–	–	–	–
Judo Canada	–	–	–	–
Karate Canada	–	–	–	–
Lacrosse Canada	–	–	–	–
Luge Canada	–	–	–	–
Nordiq Canada	–	–	–	–
Pentathlon Canada	–	–	–	–
Racquetball Canada	–	–	–	–
Ringette Canada	–	–	–	–
Rowing Canada Aviron	Yes	–	Storm conditions (lightning, thunder, heavy wind)	Overarching extreme weather policy
Rugby Canada	–	–	–	–
Sail Canada	–	–	–	–
Shooting Federation of Canada	–	–	–	–
Skate Canada	–	–	–	–
Ski Jump Canada	–	–	–	–
Softball Canada	Yes	–	Storm conditions (lightning, thunder)	Overarching extreme weather policy
Speed Skating Canada	–	–	–	–

Squash Canada	–	–	–	–
Surf Canada	–	–	–	–
Swimming Canada	–	–	–	–
Table Tennis Canada	–	–	–	–
Taekwondo Canada	–	–	–	–
Tennis Canada	Yes	Yes	Rain, cold weather	Rules of the court document
Triathlon Canada	–	–	–	–
Volleyball Canada	Yes	Yes	Storm conditions (lightning, thunder), air quality	Individual policies
Water Polo Canada	–	–	–	–
Water Ski and Wakeboard Canada	–	–	–	–
Wheelchair Basketball Canada	–	–	–	–
Wheelchair Rugby Canada	–	–	–	–
Wrestling Canada	–	–	–	–
Total	10 (11.6 %)	8 (9.3%)	10 (11.6%)	N/A