WORLD SNOWBOARD FEDERATION

ZERO EMISSION RIDES OBJECTIVE

REPORT ON THE IMPACT OF SNOWBOARDING ON CLIMATE CHANGE AND ON THE ENVIRONMENT

Deliverable 4

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Abbreviations

Full Phrase	Abbreviation
Carbon Dioxide	CO2
Carbon Dioxide equivalent	CO2e
Greenhouse gas emission	GHG
Gigawatt hours	GWh
kilowatt hours	kWh
Meter above sea level	m.a.s.l.
World Snowboard Federation	WSF

Introduction

Climate change stands as one of the most pressing global crises, reinforced by critical reports from entities like the IPCC and COP28. Records consistently reflect climbing temperatures, with recent years marking the hottest in the history of recorded weather patterns. This escalating trend compels every global community, including sports, to actively engage in combating this accelerating environmental shift.

Winter sports, including snowboarding, have been under considerable scrutiny owing to the visible impacts of climate change, prominently showcased through diminishing snow coverage in the Alps. The contrast of white snow against verdant valleys serves as a visual testament to this issue, often drawing unwarranted negative attention in the public sphere.

As part of the EU co-funded “Erasmus +” program, the World Snowboard Federation (WSF) and its partners have initiated a ground-breaking project - the "ZERO Emission Rides Objective"- aimed at curbing climate change within their community. Collaborating with key partners German Sports University, Protect our Winters (POW), SandSi and the snowboard federations of Hungary, Portugal, Germany, Flanders, the Netherlands, Finland, and Switzerland is to foster a community that generates minimal emissions.

This report serves as the initial step in evaluating the impact of the snowboarding scene on greenhouse gas emissions (GHG) while identifying potential areas for sustainable practices. The approach encompasses a comprehensive analysis across multiple domains to paint a holistic picture of snowboarding's environmental footprint.

Beginning with an overview of the Alpine landscape, the report delves into current climate conditions and future projections, specifically focusing on temperature trends and snow cover. These factors are pivotal in determining the viability of mountain sports, including snowboarding, in the foreseeable future.

Subsequently, the report narrows its focus to scrutinize the influence of mountain sports on GHG emissions, with an emphasis on delineating specific aspects relevant to snowboarding. It investigates various facets within the mountain sports and snowboarding communities, seeking opportunities for emission reductions. Analysing mobility, energy usage, resource management, and production conditions will uncover potential avenues for sustainability measures at an individual, organisational, and community level.

Climate and snow in the European Alps

Europe is by far the world's dominant winter tourism market containing about 50% of the world's total ski resorts and over 80% with more than 1 million skier visits per year (François et al., 2023; Vanant, 2021). For this reason, ski tourism became one of the most important economic drivers of alpine regions development accounting for 6,4% of Austria's gross domestic product (Neger et al. 2021). Since it is reliant on the availability of snow, the winter sport and therefore snowboarding industry is directly and highly affected by the warming climate in Europe and worldwide.

The average temperature in the European alpine region and Europe as a whole has shown a more pronounced increase compared to the global average over the last 150 years. Presently, the temperature has surged by approximately 2°C and is anticipated to elevate by an additional 2°C by the century's conclusion. Hence, even if the global objective of limiting the temperature rise to 2°C is achieved, the temperature, relative to pre-industrial levels, will have escalated by a total of 4°C (Olefs, 2023). This heightened temperature will impact all seasons and will notably exceed the global average in its prominence, particularly in the Alpine region (Fig. 1 a) & b); Becker et al., 2022).

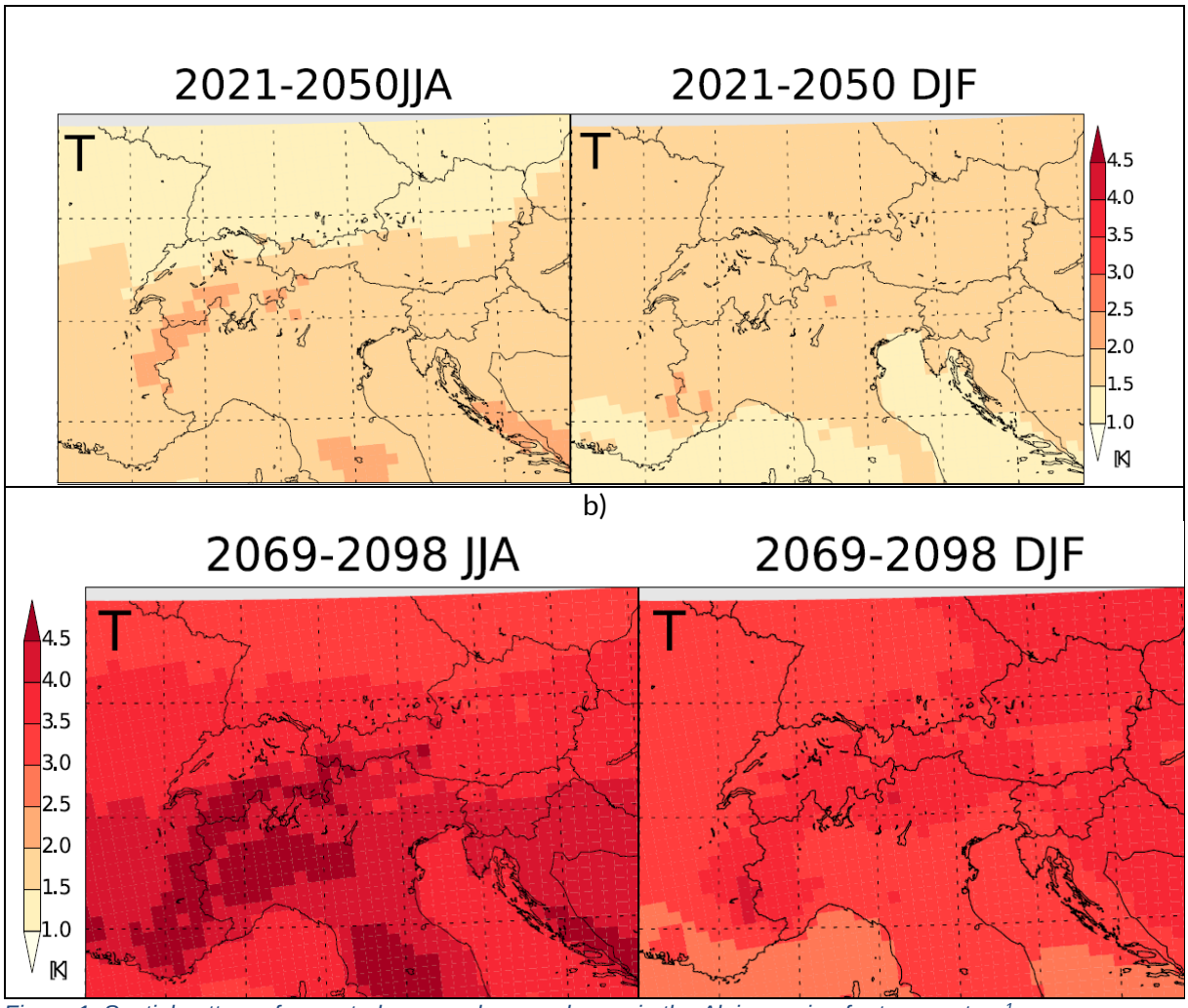

Figure 1: Spatial pattern of expected seasonal mean change in the Alpine region for temperature[1]

As a consequence of this warming trend, the naturally occurring snow cover suitable for winter sports will continue to gradually diminish, especially in the mid-altitude regions of the Alps and mountainous areas (Fig. 2). This reduction will shorten the duration of snow coverage by several weeks in late winter and, to a slightly lesser extent, in early winter (Fig 3; Becker et al., 2022).

[1] Fig. 1: Spatial pattern of expected seasonal mean change in the Alpine region for temperature (T) to the reference period 1961–1990 in summer and winter. a): 2021–2050, b): 2069–2098. Adopted from Gobiet et al., 2014.

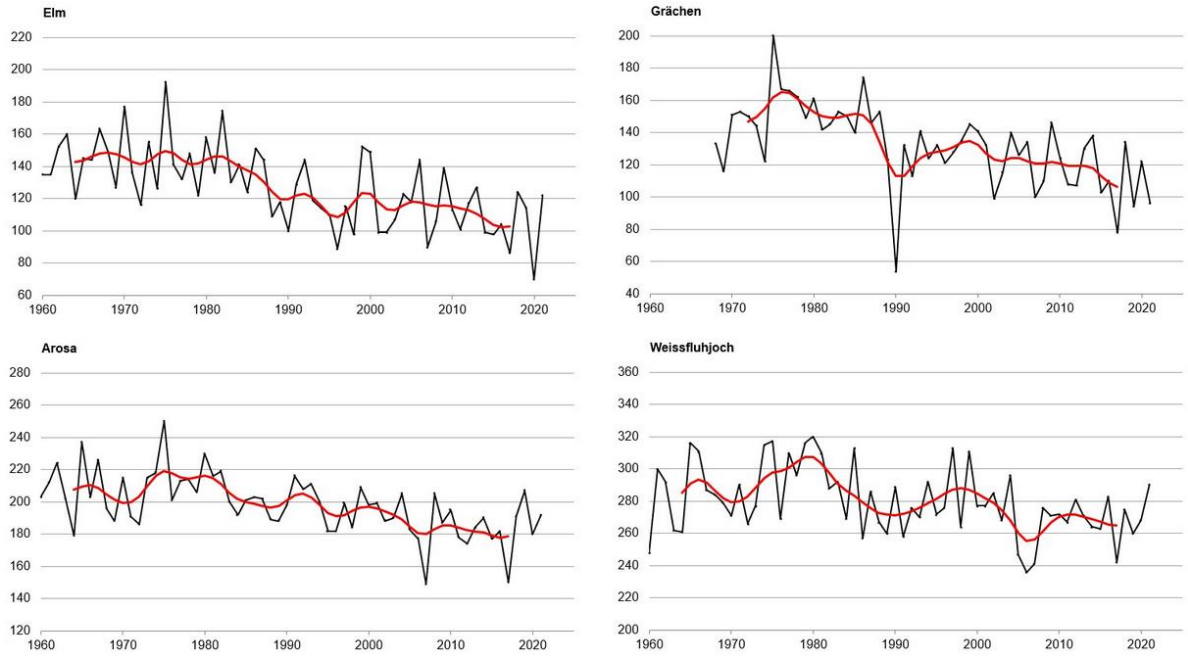

Figure 2:Number of snow days (snow cover of 1 cm) during the period from August to July[2]

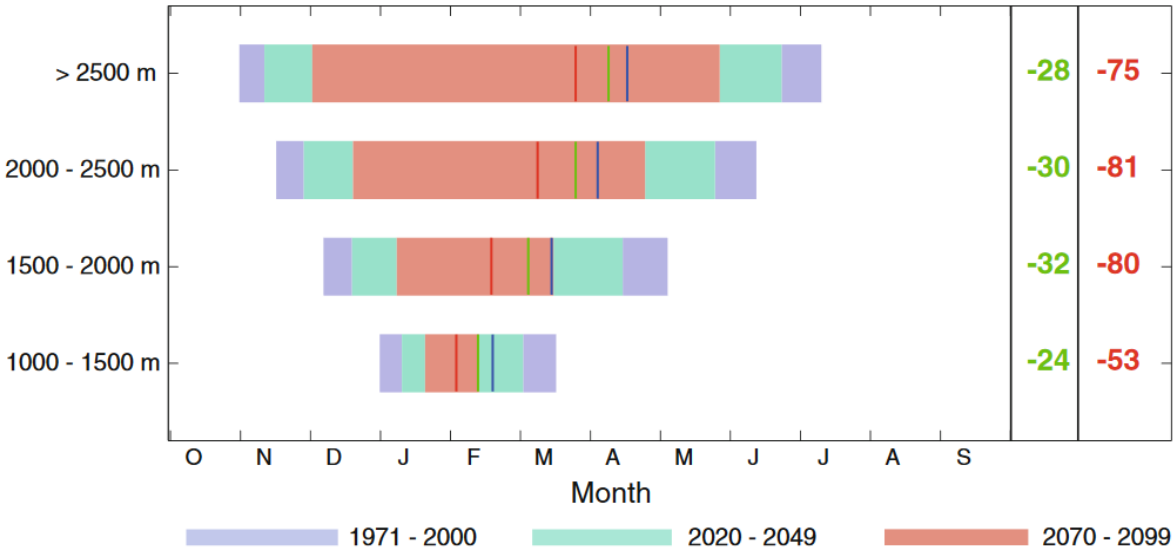

Figure 3: Mean duration of the continuous snow cover period[3]

However, the long-term climate trend induced by increasing GHG emissions will be significantly influenced by natural climate variability. Short-term (yearly) and medium-term (20 to 30 years) fluctuations can enhance or weaken the long-term trends in temperature and snow cover regionally (Fig. 4; Becker et al., 2022).

[2] Number of snow days (snow cover of 1 cm) during the period from August to July at the Elm (958 m.a.s.l.), Grächen (1,605 m.a.s.l.), Arosa (1,878 m.a.s.l.) and Weissfluhjoch (2,540 m.a.s.l.) weather stations. The red line indicates the 10-year moving average. Adopted from NCCS, 2018.

[3] Mean duration of the continuous snow cover period in four altitude classes. The blue bar indicates the period 1971–2000 whereas the green bar represents the period 2020–2049 and the red bar the period 2070–2099. The vertical lines within the bars show the average occurrence of peak snow water equivalent. The numbers in the two right columns indicate the change (in days) in the continuous snow cover duration for the periods 2020–2049 (green) and 2070–2099 (red) relative to the control period 1971–2000. Adopted from: Steger et al., 2013.

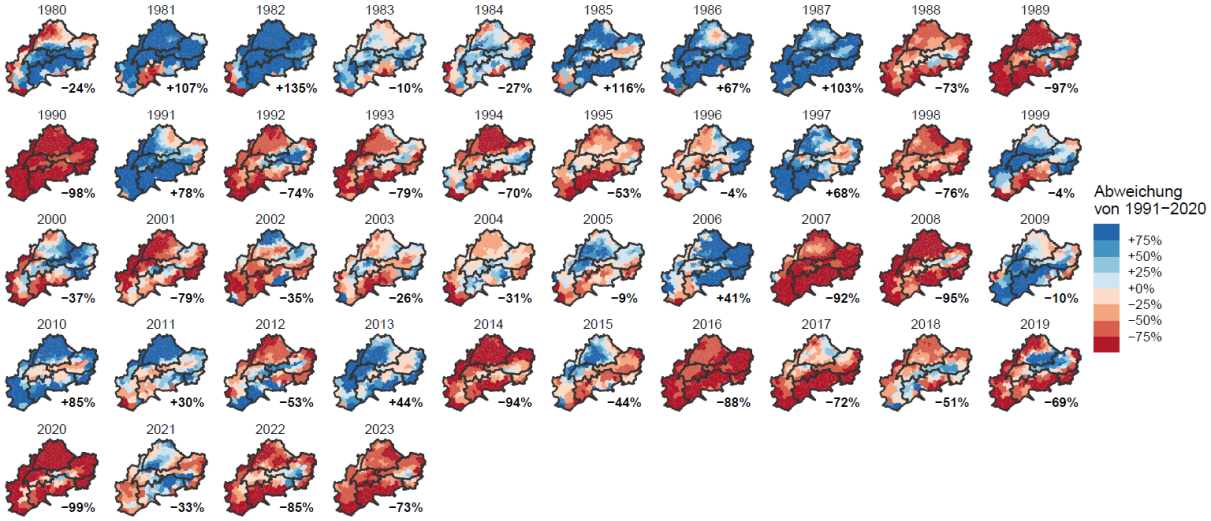

Figure 4: The annual differences in average snow depth during winter (Dec-Feb)[4]

Regarding winter precipitation, natural variability is notably high, making it challenging to observe clear trends in many areas. Nevertheless, current climate scenarios present robust signals indicating an increase in winter precipitation in the Alpine region and an intensification of brief, intense precipitation extremes. However, an anticipated decline in snowfall is expected in the mid-altitude areas of the Alps and mountainous regions due to the increased likelihood of precipitation falling as rain instead of snow, driven by higher temperatures (Becker et al., 2022).

With the steadily decreasing duration and strength of snow height, adoption strategies have long been implemented. The most prominent of which is snow production. But with warmer climate the number and duration of potential snowmaking periods are expected to decrease as well (Becker et al., 2022).

Consequently, the warming effect will have profound implications for the winter tourism industry as the number of ski fields that are snow reliable with or without snowmaking will diminish with every degree of warming temperatures (Fig. 5).

François et al. (2023) even state that, without snowmaking over half (53%) and basically all (98%) of European ski fields are at very high-risk regarding snow supply in warming models of 2◦C and 4◦C, respectively.

[4] The annual differences in average snow depth during winter (Dec-Feb) from the period of 1979/80 to 2022/23 compared to the current climate conditions (1991-2020) in the European Alpine region. The percentage below depicts the average deviation across the entire area. Adopted from Olefs, 2023.

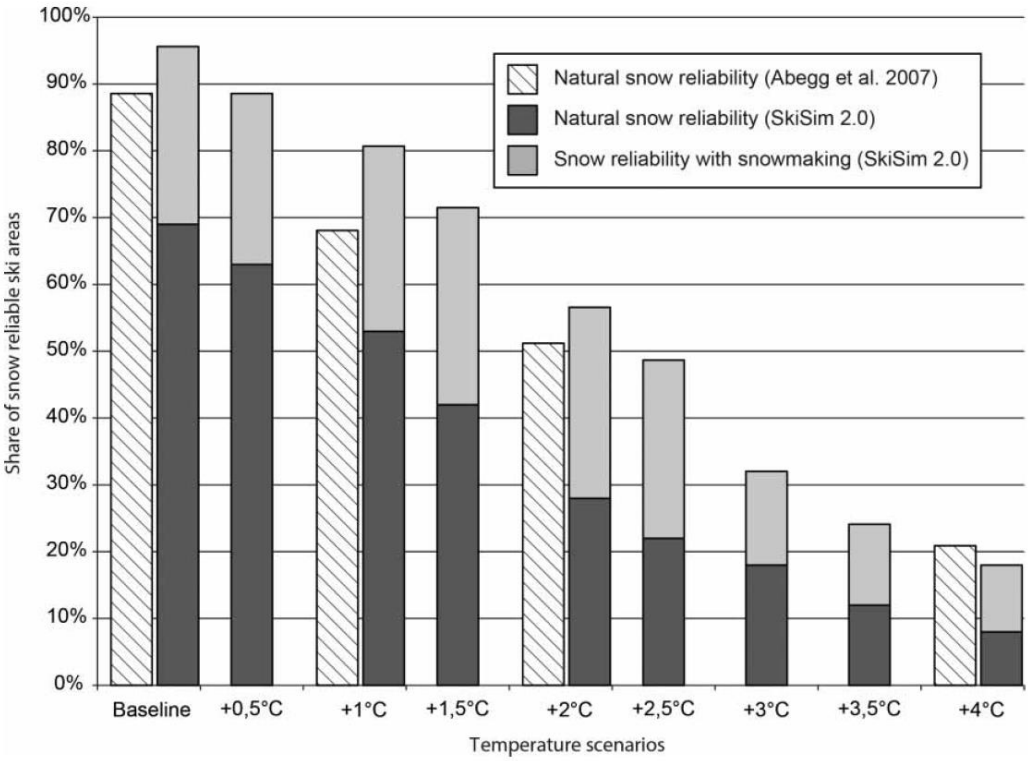

Figure 5: Share of snow-reliable ski areas with and without snowmaking (100-day indicator)[5]

[5] Share of snow-reliable ski areas with and without snowmaking (100-day indicator). Adopted from: Steiger & Abegg, 2013.

Fields of Action regarding snowboarding's carbon dioxide (CO2) impact

Measuring the environmental footprint of snowboarding amid diverse mountain sports poses a formidable challenge. The directional movement—whether going face first or sideways—has no impact on gas emissions. Snowboarders extensively utilize identical lift systems and mountain infrastructure shared among skiers and other winter sports enthusiasts. Consequently, our pursuit involves identifying nuanced indicators that offer insights into whether the snowboarding community diverges in its behaviours from the broader mountain sports community. Our focus encompasses comprehensive assessments across various domains: Travel Patterns, Energy Consumption, Resource Utilization, Production condition, and Organisational Practices.

Transport and mobility

When it comes to tourism, which winter sport is for a lot of people, going to a different place is inherent to the activity. Throughout every trip GHG emissions are created at various inflection points. From travel to accommodation, catering and by taking part in onsite activities (WWF, 2009). Although the shares of the different inflection points may vary, especially by what mode of transportation is used, it is consensus among experts that the action of travelling itself creates by far the highest share of GHG emissions. Fig. 6 underscores that by showing the CO2e shares with different idealised trip configurations. Different Studies estimate the share of travelling on your trip emissions from 70-80% (François et al., 2023; Duprez & Burget, 2007), to over 90% (Neger et al., 2021). Neger et al. (2021, p. 3) even state that personal transport is "the single most important economic activity causing the emissions generated by tourism [...], which makes up 94.8% of the industry's CO2 emissions and 92.2% of its CO2e."

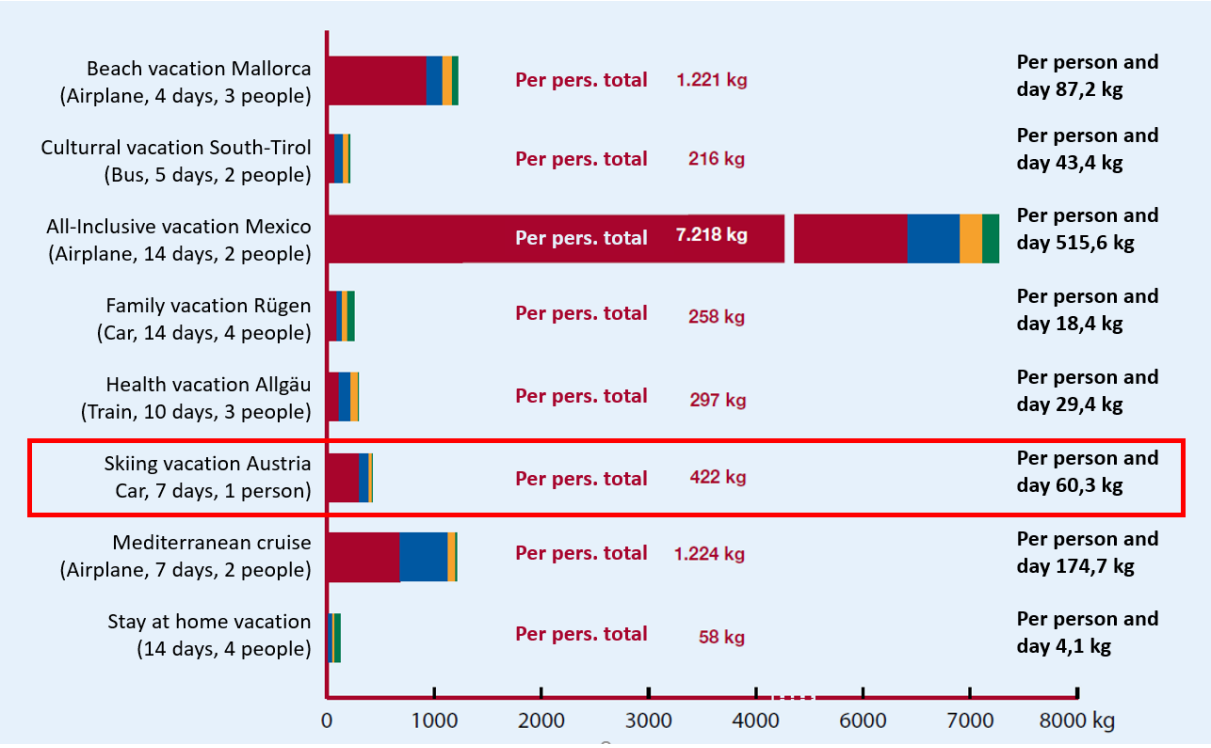

Figure 6: CO_2 Emissions per person and travel (as CO2 equivalent)[6]

Austria as one of the worlds most visited and pristine winter sport destinations attracts a lot of travel and will serve as an example for the winter sport industry in the alps. As can be seen in Fig. 7, by far the most often used mode of transportation is the passenger car with reaching a share of over 90% from visitors from the Netherlands.

[6] CO2 Emissions per person and travel (as CO2 equivalent). Red represents travel emissions, blue represents accommodation, yellow represents catering and green represents onsite activities. Adopted from: WWF, 2009.

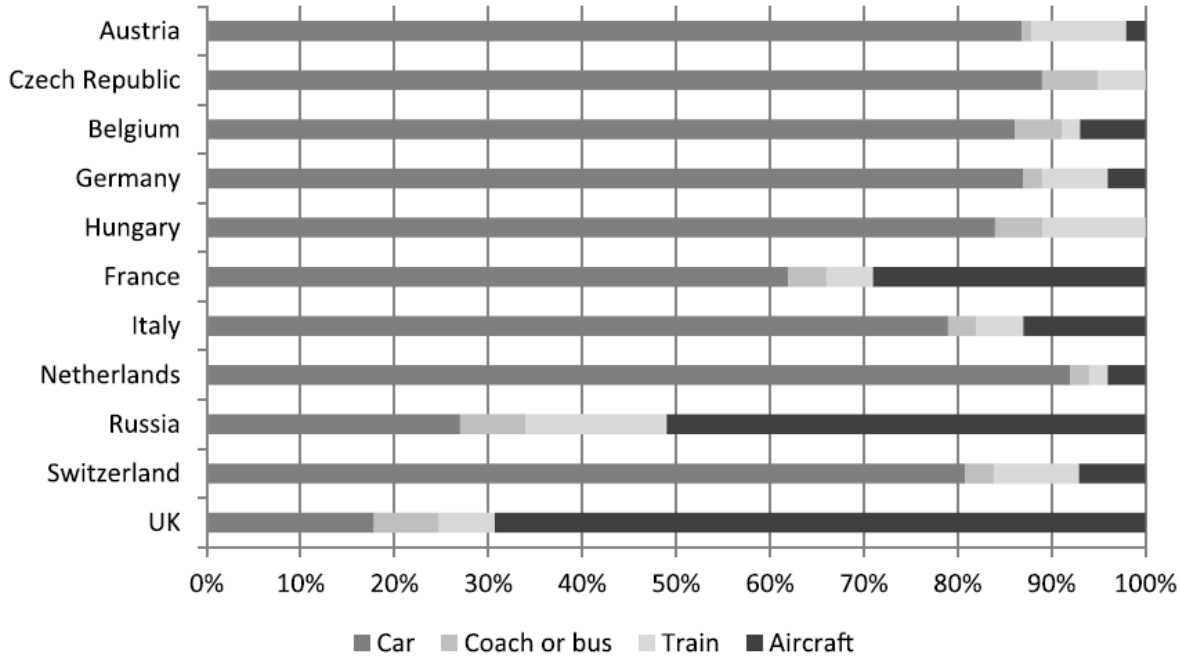

Figure 7: Shares of different modes of transport among tourists in Austria from selected countries of origin (tourism year 2017/18).[7]

In that study it was estimated, that tourist travel alone amounted to 35 Mt in CO2e for the year 2018. (Neger et al., 2021).

In Germany, according to the BMVI (2017), leisure travel comprises 28% of overall traffic, accounting for approximately 71 million trips daily. Around 6% of these journeys in passenger traffic are explicitly for engaging in sports, including winter sports.

Subsequently, mobility represents the largest energy consumer and emitter of greenhouse gases in sports. Particularly in winter sports due to longer travel distances and the need to transport equipment (Roth, 2023). The distance and especially the frequency of travel, therefore, exert substantial influence on environmental impact.

Wicker (2018) for example found, that even though the two examined clusters exhibited no significant differences concerning socio-economic attributes and environmental consciousness, skiers and boarders showed substantial distinctions in sport profiles. Frequent travellers were significantly more inclined towards boarding, while occasional riders were associated more with skiing. This difference in snow sport-related travel behaviour explained the differences in the annual carbon footprint between skiers and boarders. Among them, the carbon footprint of boarders (M = 519.2 kg CO2e) surpassed that of skiers (M = 332.2 kg CO2e) and individuals engaging in both sports (M = 463.3 kg CO2e).

[7] Adopted from: Neger et al. 2021.

In that logic, efforts to understand and mitigate the environmental impact of snowboarding and winter sports must factor in the substantial influence of travel and transportation choices. François et al. (2023) even say reduction on CO2 footprint will depend on massively cut down on transportation emissions. Despite the relatively small share of snow-sport-related travel in an individual's total carbon footprint, the frequency, mode, and distance of travel wield significant influence over the environmental impact of travelling.

Efforts to mitigate the environmental impact of snowboarding and winter sports encompass a range of strategies, some of which are already underway. One notable trend is the growing offering of environmentally friendly travel options, particularly the adoption of public transportation, especially train travel. Factors like the availability of new, more affordable tickets such as the 49€ Ticket will probably substantially influence the shift towards emphasizing the importance of accessibility and cost in choosing sustainable travel options.

Countries like Switzerland have taken progressive steps by integrating railway tickets into lift passes, fostering an integrated approach to travel and skiing. Likewise, in Germany, initiatives like Winter-Rail have been introduced to incentivize long-distance travellers to opt for winter holidays by train. These initiatives not only promote sustainable travel but also make it more accessible and economically feasible, presenting viable alternatives to conventional transportation methods.

Furthermore, promoting carpooling, whether through private arrangements or commercial platforms, stands as another practical strategy to reduce the environmental impact linked to travel to alpine destinations. Carpooling not only proves to be cost-effective but also significantly enhances the efficiency of car travel, thus reducing CO2 emissions per person travelled. Given that cars remain the primary mode of transportation to alpine destinations, encouraging carpooling presents a substantial opportunity to diminish the environmental impact while maintaining the convenience of personal vehicle usage.

These ongoing initiatives signify a significant shift in the mindset of winter sports enthusiasts, showcasing a growing awareness and inclination towards environmentally conscious travel options. The integration of travel solutions with winter sport packages aligns with sustainable practices and serves as an exemplary approach to reducing the environmental impact associated with winter sports travel.

Energy, Resources and Infrastructure

Another field of action regarding snowboarding's influence on GHG is energy, resources and infrastructure. Even though it is one of the most prominent points of criticism of winter sports

(Schaiger et al., 2017) recent studies estimated that the operations of a ski resort, which include snow management, snow production and lift operations, to correspond to not more than 2% to 4% of the carbon footprint of a destination (Duprez & Burget, 2007; Neger et al., 2021).

As stated in other publications (François et al., 2023) the data concerning water demand, energy consumption and the inherit CO2 emission is mostly on a local scale from individual ski fields to single countries, but not up to the international realm.

In one of the most extensive studies François et al. (2023) found that in the 12 main countries, accounting for 95% of the ski resorts' surface area, during the period from 1961 to 1990, with a snowmaking fractional coverage of 50%, the median annual water demand for snowmaking was estimated at 103 Mm3, equivalent to around 13% of the total annual precipitation in areas equipped with snowmaking facilities. However, projections suggest a decrease in water demand in November due to rising temperatures, while overall annual water demand is anticipated to increase at higher global warming levels. The median annual electricity demand for snowmaking in these 12 countries during the same period was approximately 309±103 GWh, corresponding to an average of 1.5±0.5 kWh per skier visit.

These numbers are higher when you look at the national cable car Associations. In Germany a skier day is estimated to be equivalent of 16 kWh whereas in Austria it's estimated to be 18 kWh. That equates roughly to driving a car that consumes 7 litres of fuel per 100 kilometres for about 26 km (Roth, 2023; WKO Cable Cars, 2023).

Forecasts indicate an expected rise in electricity demand by 18% and 24% for +2◦C and +4◦C global warming, respectively. Considering the carbon intensity of electricity, the annual carbon footprint for snowmaking in these countries was estimated at 78±26 ktCO2e for the reference period and is projected to escalate with higher global warming levels, reaching 93±31 ktCO2e and 97±32 ktCO2e at +2◦C and +4 ◦C, respectively (François et al. (2023).

Rixen et al (2011) found that, energy consumption for snowmaking frequently fell below the expected levels, suggesting promising efficiency improvements likely attributable to technological advancements. Contrastingly the water consumption for snowmaking surpassed projected estimates. This is, because actual water and energy consumption per year is dependent on a lot of different factors that can vary year to year.

This can be exemplified by one Ski field, the WAG, whose water and energy consumption for snowmaking for the 2022/23 season rose up 40% from the previous year and 25% compared to the five-year average because of extremely unfavourable water conditions (WAG, 2023).

Here snowboards direct impact is the least detectable as it these are the basic infrastructural needs for winter sports that snowboarding relies upon just as every other winter sport. Savings Opportunities for the individual in this field of action can lie in the research and selection of ski

fields. Choosing one that has ambitious emission goals and is transparent about its current status as well as providing low energy and so low GHG emission housing.

Hardgoods and production

The snowboarding industry, originating from a rebellious spirit that aimed to create an alternative mountain culture, displays encouraging signs of embracing sustainability and progressiveness. Building upon this ethos, a look into the industry suggest that this sector is moving faster towards achieving sustainability and carbon neutrality compared to the broader winter sports industry. Notably, the German foundation "Safety in Ski sport" acknowledged capita with its 2022 Eco award, recognizing its dedicated sustainability endeavours (SIS, 2023). In continuing their commitment to eco-conscious practices, snowboard brands are industry leading with three brands having already achieved carbon-free production. Jones and Nitro exclusively utilize solar energy for manufacturing while also compensating 100% of their remaining emissions. Jones is additionally associated with "Protect Our Winter" (POW) and actively supports numerous climate campaigns as well as providing extensive Life Cycle Assessments of their boards (Jones, 2023).

On the other hand, Capita established a wholly sustainable headquarters in Austria, powered entirely by hydropower. Moreover, they have pledged to prioritize local production by sourcing 98% of their board materials from the surrounding area, within a 5-hour car travel radius. Additionally, they facilitate the production of around 100,000 carbon-free boards annually, offering their facility for use by other board companies (Capita, 2023).

Burton, the leading brand in the snowboarding industry, has embraced an extensive sustainability strategy. This includes but does not end at plans to bluesign all its clothing, aiming for a 55% reduction in supply chain emissions per unit of value added by 2030, and targeting a 42% reduction in absolute Burton-related emissions by the same year. Furthermore, they have already compensated for 204 tonnes of CO2 emissions (Burton, 2022).

These concerted efforts underscore a collective commitment within the snowboarding industry to not just advocate for eco-friendly practices but actively implement them.

Individuals can significantly contribute in this field by researching and supporting brands committed to genuine sustainability, choosing longevity over fast fashion, and making informed purchasing decisions.

Organisation/ Best practice

In another field of action, the focus shifts to the organisational level, where professional snowboarders and grassroots-level boarders converge. While it's important to note that these organisations may not represent the entire snowboarding community, their influence remains significant, particularly through the prominence of their professional boarders. They wield substantial power in shaping much of what is adopted by the wider snowboarding community.

Figure 8: Collection of Good Practise Examples of Partner Organisations by the ZERO Project

The ZERO-Project collected a list of good practise examples from the partner organisations that exemplify the impact organisations can have on GHG emission and the environment. The good practises come in five categories (Fig. 8). The full collection of best practise examples can be found on the WSF-Website.

Summary

The snowboarding industry, integral to the European winter tourism market, heavily relies on snow availability. With over 50% of the world's ski resorts located in Europe, winter tourism significantly contributes to the economic growth of alpine regions. However, snowboarding, like all winter sports, faces the direct repercussions of climate change.

Alpine regions are projected to experience a rise in temperatures, leading to a substantial decline in snowfall and snow duration, thereby adversely affecting the snowboarding industry. Despite adaptation strategies like snow production, warmer climates and diminishing snow reliability pose a significant challenge.

Examining snowboarding's CO2 impact across various domains reveals transportation as a key contributor to GHG emissions. Traveling constitutes the most substantial portion of emissions linked to snow sports, primarily from personal transportation. Efforts to reduce carbon footprint depend significantly on transportation choices. Initiatives promoting sustainable travel options, such as railway integration and carpooling, present promising approaches to mitigate emissions.

Furthermore, the snowboarding industry's impact on energy, resources, and infrastructure, while significant, comprises only a fraction of the overall carbon footprint of ski resorts. Snow production, lift operations, and snow management contribute around 2% to 4% of a destination's carbon footprint. However, these numbers are subject to variations driven by factors like technological advancements and changing weather conditions.

In the realm of production and brands, there's a notable shift towards sustainability within the snowboarding industry. Brands like Burton, Capita, Nitro, and Jones have been recognized for their eco-friendly practices, including carbon-free production methods, renewable energy usage, and local material sourcing.

Snowboarding is not the primary cause of climate change, yet it is profoundly impacted by it. The collective efforts within the snowboarding industry signal a commitment to embracing eco-friendly practices. Individuals can play a pivotal role by supporting brands committed to sustainability, making informed purchasing decisions, and prioritizing longevity over fast fashion. Despite the challenges posed by climate change, the industry's proactive measures demonstrate a concerted effort to address its environmental impact.

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