



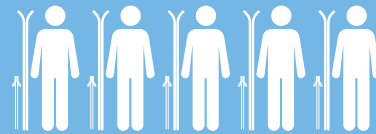
SUSTAINABILITY GUIDE FOR SKI RESORTS

CLIMATE CHANGE PRESENTS A MAJOR CHALLENGE FOR SKI RESORTS

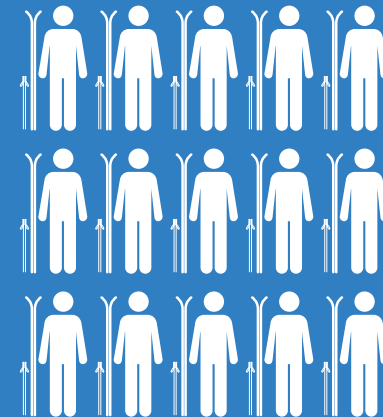
In [2022](#), the Ski Vacation market reached an estimated \$5.0 billion and is projected to hit \$15.0 billion by 2032, with a compound annual growth rate (CAGR) of 8%. Plus, the majority of this industry is centred around ski resorts, which draw over 100,000 skier visits annually, as reported by the [2022 International Report on Snow & Mountain Tourism](#). As skiing continues to surge in popularity, drawing enthusiasts to the slopes, ski resorts have become crucial advocates for a more sustainable and responsible approach to winter sports.

With an appreciation for and respect for nature, skiers and ski resorts often champion sustainable progression through innovative practices and adaptive measures, seeking to preserve the natural world and mitigate climate change.

2022
\$5.0 BILLION



2032
\$15.0 BILLION



Estimated ski vacation market value

THE IMPACT OF RISING GLOBAL TEMPERATURES ON THE SKI INDUSTRY

Earth's average temperature has increased by 0.14°F (0.08 °C) per decade, resulting in a total rise of 2°F (1°C) from 1980 to 2023, as reported by [The National Oceanic and Atmospheric Administration](#). 2023 was the eighth-warmest year on record, and all of the ten hottest years in documented history have occurred since 2010.

To provide context, atmospheric carbon dioxide (CO₂e) has risen by approximately 33.2% over a lifetime, spanning from [1958](#) to [2022](#). Simultaneously, Earth's annual average temperature has increased by [2.3°F \(1.2°C\)](#) during this period.

Under these warmer conditions, in the United States, there has been an 86% decline in April snowpacks in certain regions, as documented between 1955 and 2022 by the [Environmental Protection Agency](#).

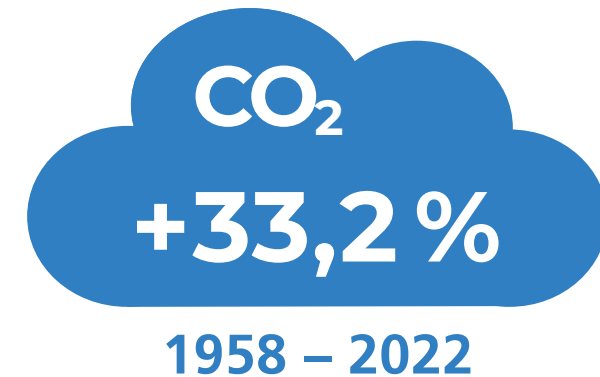
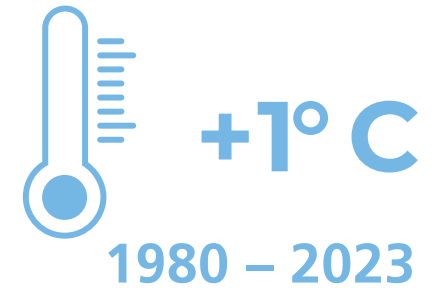
And in Europe, 53% of Europe's ski resorts will be at "very high risk" for snow supply cover under the 2-degree temperature rise limit set by the [Paris Agreement](#), according to a study published by [Nature Climate Change](#).

These statistics are important and should be used to guide adaptation, investment, and progression. That is, measures can be implemented to ensure the future stability of operations by limiting further temperature rise.



CLIMATE CHANGE IS THE NUMBER ONE ENVIRONMENTAL CONCERN NOW FACING MOUNTAIN COMMUNITIES."

Dr. Tobias Luthe, professor of sustainability science from the [Sustainable Mountain Tourism Alliance](#)



THE IMPACT OF THE SKI INDUSTRY ON CLIMATE CHANGE AND WILDLIFE

On average, a skier contributes 48.9kg of additional CO₂e emissions, as estimated in a 2022 guide by [République Française](#). Moreover, without proper management, the ski industry can harm nature by disrupting natural habitats.

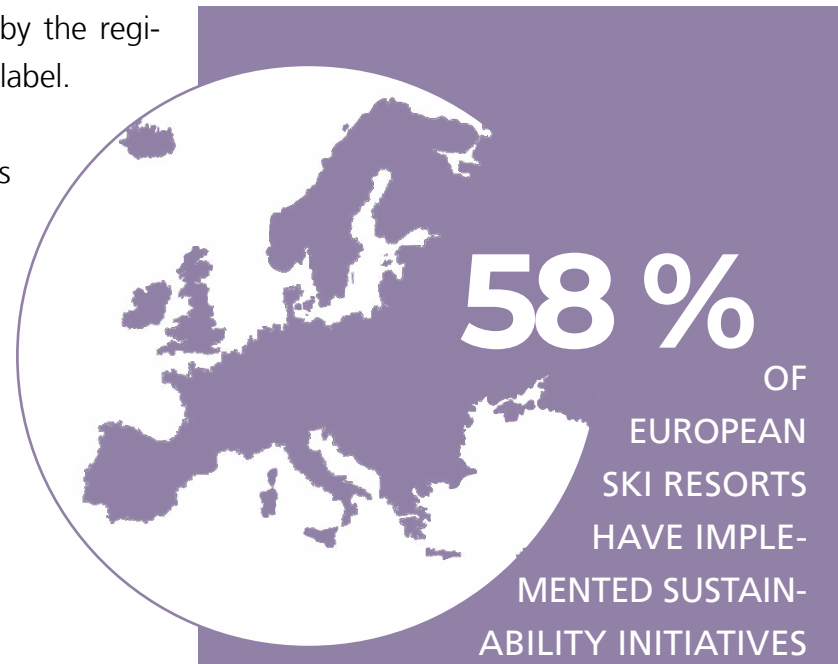
SKI RESORTS AS A DRIVER FOR SUSTAINABLE PROGRESSION

Yet, despite these challenges, skiers and industry professionals often champion environmental protection and climate change mitigation. This drive comes from their firsthand experience with the repercussions of natural degradation. As such, ski resorts across the globe lead the way in promoting sustainable development and innovation, striving to mitigate the industry's impacts to ensure the sport's longevity.

That is, across Europe, 58% of ski resorts have implemented sustainability initiatives, 12% actively measure their carbon footprint, and 15% have set targets to reduce emissions, as reported by the [2022 Luxury Ski Trends report](#). In France, 21

Ski resorts are now certified by the region's [Flocon Vert](#) sustainability label.

For the U.S., over [200](#) ski areas are committed to the continent's unique [Sustainable Slopes](#) certification designed by the [National Ski Areas Association \(NSAA\)](#).



SUSTAINABILITY MAKES ECONOMIC SENSE

78% of consumers prioritise sustainability, and 84% state poor environmental credentials would alienate them from a company. Consequently, sustainable business practices have demonstrated a positive correlation with business profitability, as evidenced in 80% of cases surveyed by the [Harvard Business Review](#). These trends are applicable to the ski industry.



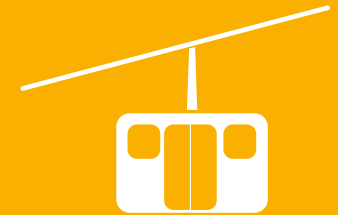
WE'VE SURVEYED TOUR OPERATORS AND 62% SAY THAT THEY WOULD MORE LIKELY BE INTERESTED IN A DESTINATION IF IT CARRIES A SUSTAINABLE OR ENVIRONMENTAL LABEL."

Anne Dorte Carlson, manager of Sustainable Destination Norway

This ski sustainability guide lays the foundation for an effective sustainability program that minimises the carbon footprint of operations, while also supporting biodiversity and wildlife conservation, for the preservation of the natural world and global winters.

SUSTAINABILITY GUIDE FOR SKI RESORTS – 14 INITIATIVES

INITIATIVE #1: REDUCE THE ENERGY CONSUMPTION AND CARBON FOOTPRINT OF SKI LIFTS



Ski lifts are energy-intensive assets, driven by either diesel or electric motors. Operating a ski lift is estimated to consume the same amount of energy as powering [3.8](#) households annually.

Per skier, [rough](#) calculations indicate that it takes approximately 871 watts to lift a person weighing 70kg up to an elevation of 1,000 feet. In [2007](#), the French government agency and NGO Mountain Rider discovered that 2% of emissions per skier originate from lift services and pistes.

With these figures in mind, ski resorts must work to reduce the energy consumption of ski lifts to lower business emissions. Options include:

- **Solar Panel Installation:**

Integrate solar panels onto ski lifts to draw energy from renewable sources with zero emissions. [Les Gets](#) in Switzerland champions this initiative by replacing diesel generators with solar panels on ski lifts. On a global scale, this technology switching - from diesel-powered mini-grids to solar - has the potential to yield annual global CO₂e emission reductions of up to [470 million metric tonnes](#). This is approximately equivalent to the annual CO₂e emissions of Brazil.

- **Optimising Lift Speed:**

Operate lifts at a slower speed during off-peak periods. Serre Chevalier in France has adopted this measure, resulting in a [20%](#) energy saving.

- **Establishing a Renewable Energy Mix:**

Employ a renewable energy mix to power ski lifts and other resort facilities, as elaborated below in initiative #2.

INITIATIVE #2: ATTAIN 100% GREEN ELECTRICITY USING A RENEWABLE ENERGY MIX



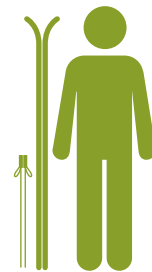
Switching from fossil-fuel-powered operations to renewable energy is vital for resorts to decrease carbon emissions. The CO₂e savings achieved are substantial, as demonstrated by Snow Space Salzburg:

“ In the winter season 2019/20, 4,149.1 tonnes of CO₂e were produced by our ski operations. That is 2.30 kg CO₂e per skier per day (calculated with 1.8 million ski days). 2.30 kg CO₂e corresponds to a car journey of 7.14 km, or 2.5 washing cycles in a washing machine at 60 °C or the production of a “lady steak” from 180 g beef. By using 100% green electricity, we are already saving 9,800 tonnes of CO₂e compared to the current electricity mix in Austria. That’s over 70%!”

Snow Space Salzburg, CO₂e balance of the [Snow Space Salzburg Cable Car Company](#)

Achieving 100% green electricity, akin to Snow Space Salzburg, involves the on-site installation of renewable energy technology.

For instance, [Whistler Blackcomb’s Fitzsimmons Renewable Energy Project](#), a non-intrusive hydroelectric plant, generates 33.5 gigawatt-hours annually, powering both summer and winter operations. This is equivalent to supplying renewable energy for 3,000-4,000 houses yearly.



**2.30 kg CO₂e
/day**



7.14 km
CO₂e equivalent of 1 day skiing

INITIATIVE #2: ATTAIN 100% GREEN ELECTRICITY USING A RENEWABLE ENERGY MIX

In another example, [Jiminy Peak Mountain Resort's Zephyr wind turbine](#) produces 4,600,000 kilowatt-hours of renewable power each year. This prevents 7,100,000 pounds of CO₂e from entering the atmosphere annually.

And showcasing a diverse renewable energy mix, [Serre Chevalier](#) utilisés wind, hydro, and solar sources to meet 50% of its electricity needs with renewables, targeting a 50% carbon reduction by 2030.

On-site renewable energy infrastructure options include:

- **Cogeneration Plants**
- **Hydroelectric Plants**
- **Solar Farms**
- **Wind Turbines**
- **Geothermal Energy Plants**

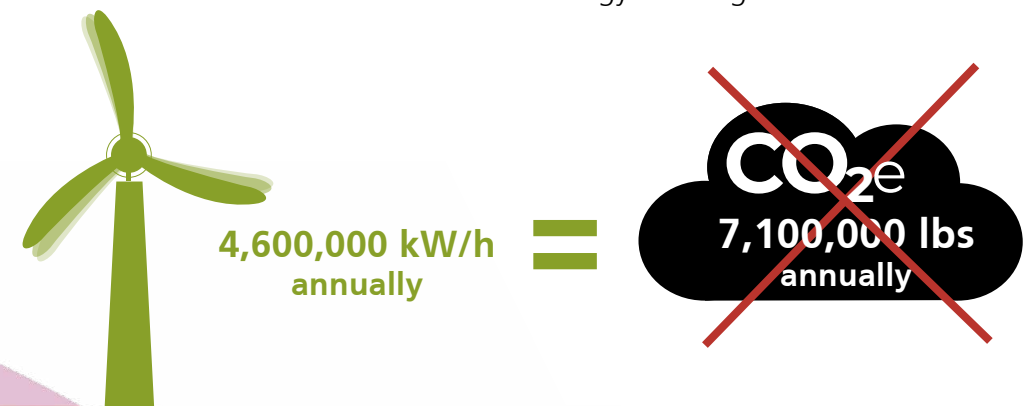
For resorts unable to install on-site renewable energy technologies, there are alternative options for achieving 100% renewable energy generation. These include:

- **Renewable Energy Credits (RECs):**

RECs offer a financial means to invest in external renewable energy projects, offsetting on-site CO₂e emissions. Boyne Resorts, for example, fully offsets emissions by purchasing RECs from CMS Enterprise.

- **Switch to a Renewable Energy Provider:**

Resorts can transition to a renewable energy provider. It's important to note that such providers contribute to the overall energy mix for the region, making it challenging to determine the exact proportion of renewable electricity obtained. Yet, these investments support the progression of green technology, increasing the overall contribution of renewable energy to the grid.



INITIATIVE #3: SET A NET ZERO GOAL FOR 2050



For net-zero status, ski resorts must both minimise emissions where feasible and offset any unavoidable emissions. Achieving net zero involves addressing the following areas:

- **Onsite Emissions (Scope 1):**

This covers emissions from on-site activities like fuel burning in company vehicles or wood-fired heating. Aim to eliminate scope 1 emissions from operations.

- **Electricity-Related Emissions (Scope 2):**

This encompasses emissions from purchased electricity, which is addressed in Initiative #2. Switch to electric energy instead of the direct burning of fossil fuels where possible, e.g. use electric vehicles. Implementing initiative #2 will ensure electricity is obtained from renewable and clean energy sources.

- **Supply Chain Emissions (Scope 3):**

This covers emissions throughout the supply chain, e.g. emissions from the activities of suppliers and partners. Work with suppliers and partners who share similar net-zero and sustainability goals.

INITIATIVE #3: SET A NET ZERO GOAL FOR 2050

Ski resorts need to quantify their carbon footprint (Scope 1, 2, and 3 emissions) to identify emission hotspots. Next, achieving net zero means reducing these emissions as much as possible. To do this, focus on conservation, competence, and clean practices across each emission scope:

- **Conservation:**
Educate staff and consumers on energy-saving behaviours, such as turning off lights and reducing travel. Plus, reduce wasted energy, for example, by improving building insulation.
- **Competence:**
Achieve more with less energy by adopting energy-efficient systems (e.g., Energy Star-certified appliances and LED light bulbs).
- **Clean:**
Embrace renewable energy, as detailed in initiative #2.

To achieve net zero, any unavoidable emissions must then be offset. Carbon offsetting involves removing an equivalent amount of CO₂e emissions from the atmosphere as is released by the same given entity. This makes that entity's net emissions zero. Ski resorts can invest in diverse offset projects like renewable energy and tree planting regimes.

Demonstrating initiative #3 in action, [Boyne Resorts](#) employs carbon offsetting to attain net-zero emissions across its resorts by 2030.

In addition, Alta Ski Area in Utah operates the [Alta Environmental Centre \(AEC\)](#), which works to offset the resort's emissions and impact using land conservation and tree-planting projects. Plus, 98 solar panels have been installed to offset 94 tonnes of CO₂e emissions over five years.

INITIATIVE #4: ADOPT AN EFFECTIVE PISTE MANAGEMENT PLAN



[Studies](#) indicate that piste bashers (or snow groomers) can harm surrounding live vegetation and alter soil composition, negatively impacting natural habitats.

Additionally, piste-bashing machines consume a significant amount of energy, contributing to a resort's carbon footprint. For example, a diesel snow groomer can account for up to [94%](#) of CO₂e emissions for a given resort. Illustrating these figures, Snow Space Salzburg has [documented resort emissions](#), revealing the tonnes of CO₂e released from operations. The emissions from piste machines (1,802 tonnes of CO₂e) surpass other sources, such as the resort's vehicle fleet (510 tonnes of CO₂e), ski bus (329 tonnes of CO₂e), and staff travel (5,881 tonnes of CO₂e).

To mitigate the environmental impact of piste bashing, implement an effective and sustainable piste management plan, incorporating the following measures:

- **Conduct Piste Mapping:**

Piste mapping is the scientific study of ski areas by documenting plant and animal occurrences. Areas that inhabit many species of plants and animals are tagged to be biodiverse. The goal is to steer clear of these zones. Plus, habitats damaged from ski operations must be identified to then implement an effective restoration plan.

- **Introduce More Ungroomed and Off-Piste Runs:**

Follow the example of [Avoiaz Resort](#) in France, winner of the [Green Key](#) award, which offers varied pistes, including non-groomed runs.

INITIATIVE #4: ADOPT AN EFFECTIVE PISTE MANAGEMENT PLAN

- **Conduct Thorough Planning and Vegetation Ecology Mapping:**

Undertake [herpetological planning](#) (mapping amphibians and reptiles) and map vegetation throughout the resort. Use these maps to choose piste courses that preserve natural environments.

- **Remove and Transplant Existing Vegetation Soils:**

Preserve top layers and high-value vegetation parts by removing and transplanting them.

- **Construct Basins for Water Regulation:**

Implement basins at strategic locations to regulate water flow during heavy rain.

- **Operate Groomers on Clean Energy:**

Introduce snow groomers powered by clean energy, such as:

- **Electric Snow Groomers:** Models like those by CM Duplon can achieve savings of up to [80 tonnes](#) of CO₂e per year per groomer.
- **Groomers Powered by Sustainable Fuels:** Implement groomers powered by fuel derived from waste, fats, and used vegetable oils. Such groomers have been successfully tested at French resorts Les Arcs and La Plagne. They demonstrate a remarkable [90%](#) reduction in CO₂e emissions compared to their diesel counterparts.
- **Hydrogen-Powered Snow Groomers:** Explore hydrogen-powered options like The Husky eMotion groomer by the Italian company Prio, which claims [zero CO₂e emissions](#) during use.

INITIATIVE #5: CONSERVE NATURAL HABITATS



Make a positive impact on the natural world by conserving and dedicating areas for wildlife and conservation, particularly in places where piste runs cannot be detoured. Conservation measures include:

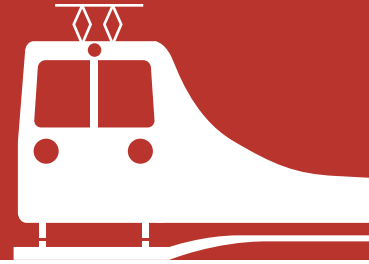
- The restoration and construction of natural habitats, such as amphibian pools, bog-like wetlands, reptile structures, stepped forest edges, and grouse habitats, to mitigate any negative environmental effects of ski operations.
- Being responsible stewards of fish and wildlife habitats, managing forests and vegetation to support ecosystems, and investing in tree-planting regimes as carbon sinks for CO₂e emissions.
- Designing facilities and trails to minimise human impact on the natural landscape, while also ensuring people stick to these marked paths.

- Giving special consideration to sensitive animal species like wood grouse, black grouse, common toad, grass frog, and the alpine newt, as well as rare plant species like orchids and gentians.

Demonstrating the successful implementation of this initiative is Alta Ski Area. The [Alta Environmental Center \(AEC\)](#) has effectively planted native trees to counter deforestation, while also reclaiming wetlands to offset the impact of the resort's ski lift. These initiatives not only contribute to environmental preservation but also provide additional activities for guests to engage with. For instance, Alta runs unique programs for consumers, including opportunities like [Birding on Skis](#) and [Snowshoe with a Naturalist](#).

Similarly, [Salzburg Snow Space](#) designed a service point with a green roof housing native vegetation, showcasing innovative design to conserve natural habitats.

INITIATIVE #6: ENCOURAGE SUSTAINABLE TRAVEL



A report by the French Government Agency and Mountain Riders found that skier travel to a resort accounts for 57% of the resort's total emissions. Emission reduction strategies must therefore encourage skiers to avoid plane travel and use other, less carbon-intensive forms of transportation, such as trains. For instance, a skier who travels by train would need to take a ski holiday every winter for the next four years to match the carbon footprint of another skier who flies just once.

To encourage sustainable travel, implement the following steps:

- **Educate:**
Use business as a platform for education. Provide blogs, newsletters, infographics, social media, and informative posters to educate skiers about the impact of travel and the more sustainable options.
- **Promote Public Transportation:**
Encourage visitors to use public transportation, such as buses or trains, to reach the resort. Establish partnerships with transportation providers to offer discounts for more sustainable travel options.
- **Support Carpooling and Ridesharing:**
Collaborate with rideshare and carpooling platforms to promote shared transportation among visitors.

INITIATIVE #6: ENCOURAGE SUSTAINABLE TRAVEL

- **Provide Shuttle Services:**

Offer convenient and frequent shuttle services within the resort area to minimise the need for personal vehicle use.

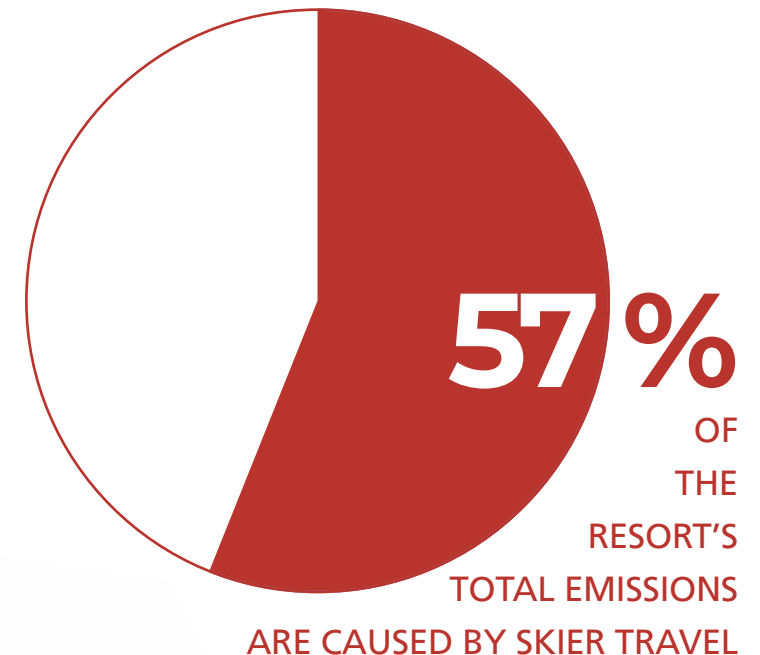
- **Provide Eco-Friendly Vehicle Options:**

Offer preferential parking or discounts for visitors using electric or hybrid vehicles. Install electric vehicle charging stations at the resort.

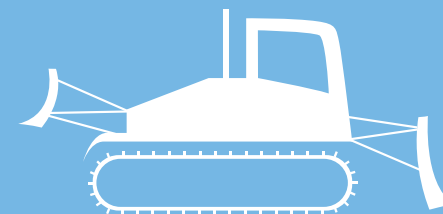
- **Offer Incentives for Sustainable Travel:**

Provide incentives to choose more sustainable travel options. For instance, the French ski resort Morzine offers skiers a 10% discount on ski passes for travelling to the resort by train.

Championing this initiative, [Zermatt Bergbahnen AG](#) is a car-free village, using only electric-powered transport plus traditional horse and sleigh taxis. The village itself is reachable by train. Another popular resort, [Saas Fee](#), has been car-free since 1951 and operates using electric vehicles. Plus, the resort [St. Johann-Alpendorf](#) provides a shuttle bus at the train station to take skiers to their preferred destination.



INITIATIVE #7: INTRODUCE SNOW FARMING PRACTICES



Snow farming has revolutionised snow management in winter sports, introducing an innovative method to preserve snow from the previous season. In this process, snow is collected from the slopes and strategically insulated in specialised warehouses or depots. Thermal insulation, often with materials like sawdust or wood shavings, protects the snow, preserving it during warmer months.

Snow farming reduces snow-making demand, enables an earlier start to the ski season, provides a workaround for snow shortages, eliminates dependency on weather conditions, and helps slow down the melting of glaciers.

Ski resorts can implement snow farming by following a systematic approach that involves planning, implementing the right technology, and environmental considerations. Presented below are key actions to help ski resorts adopt sustainable snow farming processes:

- **Assess Suitability:**
Evaluate the suitability of the resort's terrain and climate for snow farming. Identify practical storage locations for preserving snow during the off-season.
- **Invest in Technology and Infrastructure:**
Invest in technology and infrastructure for efficient snow collection and storage. Acquire snow farming equipment, such as snow groomers and snow collection systems.
- **Apply Effective Insulation Techniques:**
Determine effective insulation techniques to cover and protect the stored snow. Common insulation materials include sawdust and wood shavings.
- **Construct or Repurpose Storage Facilities:**
Construct or repurpose storage facilities like warehouses or depots to preserve the collected snow. Ensure the facilities are well-insulated and can maintain the desired temperature.

INITIATIVE #7: INTRODUCE SNOW FARMING PRACTICES

- **Develop a Storage Plan:**

Develop a strategic plan for storing the collected snow to minimise volume loss. Consider factors like snow compaction and the distribution of stored snow.

- **Conduct an Environmental Impact Assessment:**

Assess the environmental impact of snow farming, including potential effects on local ecosystems. Implement measures to mitigate any negative environmental impacts.

- **Train Staff:**

Train resort staff on snow farming techniques, equipment operation, and maintenance. Educate staff on the environmental benefits and objectives of snow farming.

- **Monitor and Adjust:**

Implement a monitoring system to track the effectiveness of snow farming. Make adjustments based on the performance and environmental impact assessments.

Notable examples of snow farming in action include the Swiss resorts Diavolezza, Zermatt, Saas-Fee, and Schilthorn. In these resorts, snow farming complements technical snowmaking. Another resort, Davos-Klosters, stands out as a pioneer, having employed snow farming successfully for over a decade, particularly for cross-country ski trails.

In another example, the Levi Ski Resort in Finland is dedicated to employing environmentally conscious snow preservation methods. The LEVI Project focuses on recycling and repurposing snow each season to reduce snowmaking demand during the warmer initial stages of the following season. Since the initiation of snow farming practices in 2016, a variety of materials have undergone testing to minimise the loss of preserved snow. Today, snow mounds are shielded using both geotextile blankets with a fleece-like texture and a novel preservation technology developed by Snow Secure, which incorporates Finnfoam insulation material commonly used in construction. Compared to traditional technologies where snow loss can range from 30-50%, Finnfoam insulation reduces melting to a significantly lower range of 10-20%.

INITIATIVE #8: IMPLEMENT SNOW PUMP TECHNOLOGY WITH LOWER EMISSIONS AND WATER USAGE



Snowmaking dominates water usage in ski areas. According to some estimates, covering one acre with a snow depth of one foot requires 200,000 gallons of water. This equates to nearly half the volume of an Olympic-sized swimming pool. Lutsen Mountain Ski Resort in the U.S. state of Minnesota sprays approximately 50 gallons of water per minute across 75 snow guns.

In addition, a study conducted by the University of Waterloo in Canada and the University of Innsbruck in Austria found that 130,095 tonnes of CO₂e are released from the generation of 42 million cubic metres of man-made snow.

Yet, despite these challenges, it's possible to design more sustainable snowmaking processes. This requires the use of sustainable sources of water and energy while reducing snowmaking demand.

REDUCE CO₂e EMISSIONS DURING SNOWMAKING

As technology advances, new systems have entered the market to decrease emissions caused by snowmaking. For example, the EU-funded SnowRESolution project is working on creating a solar-powered snow cannon. The snow cannon has entered stage 1 of a feasibility study.

However, before this technology becomes viable, CO₂e emissions from snowmaking will continue to be an issue. For this reason, ski resorts must minimise the amount of snowmaking they employ, by:

- Utilising weather forecasting and monitoring systems to optimise the timing and quantity of snowmaking.
- Using snow groomers with built-in GPS monitoring systems. These systems can determine the height of the snow cover, to send this information to the control centre of a snowmaking machine. In response, snowmaking is controlled to prevent overproduction.
- Implement snow farming practices as discussed under initiative #7.

INITIATIVE #8: IMPLEMENT SNOW PUMP TECHNOLOGY WITH LOWER EMISSIONS

REDUCE WATER USE DURING SNOWMAKING

Considering water use, new standards for snow machines enhance efficiency. That is, modern machines are capable of using just 12 gallons of water per minute.

Additionally, some resorts are sourcing reclaimed water to create snow. For instance, Salzburg Snow Space uses storage ponds to collect runoff meltwater. This water is then purified using UVB light to meet drinking water quality standards.

Ski resorts should also consider closing the loop and utilising wastewater for snowmaking. With this in mind, Bridger Bowl Ski Resort is collaborating with the Montana Department of Civil Engineering on a pilot project to test the effectiveness of artificial wetlands in treating wastewater. The resort directs wastewater through two underground trenches lined with rubber, followed by drainage pipes, and covered with gravel and sand where sedges and rushes grow. Microbes in the roots of the-

se plants break down ammonia, organic compounds, and other waste components. The wastewater is circulated until it becomes clean. This innovative technology offers a scalable alternative for wastewater treatment. Implementing such a system would significantly reduce the water consumption from snowmaking.

In another example, the LEVI project (implemented at Levi Ski Resort in Finland) uses automatic snow canons to reduce water and energy use during snow-making processes. Thanks to cutting-edge weather automation and remote monitoring, this project efficiently generates snow during optimum conditions, responding to alterations in wind direction and other environmental factors, for improved efficiency and to reduce energy and water demand.

INITIATIVE #9: ADOPT AN EFFECTIVE PISTE MANAGEMENT PLAN



Reaching net zero waste involves minimising, repurposing, and reclaiming garbage materials, transforming them into valuable resources while ensuring that no solid waste is sent to landfills throughout the year.

To achieve net zero waste, ski resorts should:

- **Conduct a Waste Audit and Assessment:**

Undertake a thorough waste audit to understand the types and amounts of waste generated. Identify areas where waste reduction efforts can be maximised.

- **Source Reduction Opportunities:**

Encourage and collaborate with suppliers to minimise packaging and use eco-friendly materials. Promote a zero-waste mindset among staff and visitors, emphasising the reduction of single-use items.

- **Facilitate Waste Reduction Behaviours:**

Ensure resort facilities offer consumers reusable substitutes. For instance, provide reusable options such as bottles and water fountains to avoid single-use plastic bottles.

- **Implement Recycling Programs:**

Establish a robust recycling program for materials like paper, cardboard, glass, plastic, and metals. Clearly label and provide bins for recycling in easily accessible areas.

- **Compost:**

Set up composting systems for organic waste, including food scraps and yard debris. Use compost to enrich soil in landscaping and other resort areas.

- **Implement an Effective Electronic Waste Management System:**

Introduce proper disposal and recycling programs for electronic waste, including old equipment and devices.

INITIATIVE #9: ADOPT AN EFFECTIVE PISTE MANAGEMENT PLAN

- **Introduce Reuse Initiatives:**

Promote the reuse of items, such as equipment rental programs or by encouraging visitors to bring reusable containers. Establish donation or exchange programs for equipment and clothing.

- **Partner With Local Recycling Centres:**

Collaborate with local recycling facilities to ensure that collected materials are properly processed. Explore opportunities for innovative waste-to-energy projects.

- **Aim to Establish Closed-Loop Systems:**

Consider closed-loop systems where materials are recycled and used within the resort, reducing the need for external resources.

- **Extend the Life Cycle of Products:**

Using repair, reuse, and recycling solutions to support closed-loop systems, and extend the use-life of equipment and clothing.

- **Target Waste in Ski and Snowboard Gear:**

Work with partners or suppliers to implement concrete sustainability measures to reduce the environmental impact of ski and snowboard clothing production. Ensure partners have sustainability measures and targets in place to reduce the environmental impact of ski and snowboard equipment.

- **Continuously Monitor and Improve:**

Regularly evaluate waste reduction efforts and adjust strategies based on performance. Encourage innovation in waste management technologies and practices.

The following are examples of resorts leading the way in effective waste management:

- [Taos Ski Valley](#) employs a food waste dehydrator, converting 28,000 pounds of food waste into soil amendment annually.
- [Whistler Blackcomb](#) is committed to [TRUE Zero Waste Certification](#), diverting garbage from landfills and promoting upcycling practices.
- [Squaw Valley Alpine Meadows](#) in California takes a bold step by banning single-use water bottles, providing refillable alternatives. This scheme has removed 421,000 plastic bottles from the resort's waste stream since 2016.
- Vail Resorts, under the [Epic Promise initiative](#), targets zero waste to landfills by 2030. In the fiscal year 2019-2020, the resort diverted [50.6%](#) of waste from landfills, showcasing progress from the previous year's 44.1%.

INITIATIVE #10: COLLABORATE WITH KEY STAKEHOLDERS



Sustainability is a nuanced and comprehensive undertaking that requires the active participation of all stakeholders. This means sustainability extends beyond the boundaries of a ski resort, reaching into the fabric of the local community. Whether that's by fostering job opportunities or providing recreational spaces, ski resorts must support the well-being of the communities they inhabit. This means actively promoting sustainability while recognising resorts as integral parts of the landscape owned by landowners, farmers, and foresters.

Moreover, resorts must cultivate a strong partnership with consumers – the skiers themselves. The effectiveness of most sustainable initiatives hinges on the extent to which they are embraced and adopted by the individuals utilising the resort facilities. With this in mind, the UN initiative [Be a Mountain Hero](#) delineates ten proactive steps that set the standard for the safety and sustainability of skiers and snowboarders globally. Ski resorts, through the promotion of these steps, actively inspire skiers to engage in the preservation of mountain environments.

INITIATIVE #11: DESIGN MORE SUSTAINABLE RESTAURANTS, CAFES, AND BARS



Addressing the environmental impact of food and beverage facilities involves focusing efforts on food waste and emission reduction, plus water conservation. The following suggestions present practical solutions for each area to ensure the sustainability of onsite restaurants, cafes, and bars.

MINIMISING FOOD WASTE

Ensure that initiative #9 for waste reduction is implemented for onsite restaurants, cafes, and bars.

- **Menu Planning and Portion Control:**

Develop a well-thought-out menu that minimises the use of perishable ingredients. Implement portion control initiatives, such as offering sides and small and large plate options for guests.

- **Implement an Effective Inventory Management System:**
Establish a first-in, first-out (FIFO) system to use older ingredients before newer ones.
- **Reduce Menu Size:**
Opt for a smaller menu to enhance inventory management and reduce the likelihood of over-purchasing. This streamlining can also optimise kitchen operations.
- **Work With Local Suppliers:**
Collaborate with local suppliers to minimise food miles and support community businesses.
- **Implement a Food Donation Program:**
Partner with local charities or food banks to donate excess, still-edible food. Offer discounted or free meals to staff to utilise surplus ingredients.
- **Employee Training:**
Train kitchen staff on the importance of reducing food waste and the proper methods of food storage and handling.

INITIATIVE #11: DESIGN MORE SUSTAINABLE RESTAURANTS, CAFES, AND BARS

- **Separate Food Waste for Composting:**

Separate food waste for composting using a dedicated compost bin or a more sophisticated biodigester.

- **Implement a Biodigester to Compost Food Waste:**

Most waste foods, including fats, greases, and animal manure, can be processed via a biodigester. Biodigesters produce biogas which can be used for cooking and heating, and waste organic material which is a nutrient-rich fertiliser.

- **Conduct Regulatory Audits:**

Regularly conduct audits to track the types and amount of food waste. Analyse the data to identify patterns and areas for improvement.

Showcasing effective food waste management is the [Taos Verde Program](#), at the Taos Valley Ski Resort. This program utilises a food waste dehydrator to convert discarded food to soil amendment. In the previous year, this system successfully transformed 28,000 pounds of food into a valuable soil amendment, which was then used by local farmers

REDUCING WATER USAGE

Note that the initiatives below to reduce water use in restaurants, cafes, and bars are applicable and should be applied across the entire resort. This includes public toilets, other leisure facilities, plus onsite hotels and chalets.

- **Install Water-Efficient Equipment:**

Invest in water-efficient dishwashers, faucets, and pre-rinse spray valves to minimise water usage during kitchen operations.

- **Ensure Regular Maintenance of Plumbing:**

Fix any leaks promptly, including faucets, pipes, and toilets, to prevent unnecessary water wastage.

- **Choose Water-Conserving Appliances:**

Select appliances such as ice machines and steamers designed to use water more efficiently.

- **Optimise Dishwashing Practices:**

Operate dishwashers only when fully loaded to maximise efficiency, and consider using a high-efficiency dishwasher model.

INITIATIVE #11: DESIGN MORE SUSTAINABLE RESTAURANTS, CAFES, AND BARS

- **Implement Waterless Urinals:**

In restroom facilities, consider installing waterless urinals or low-flow toilets to reduce water consumption.

- **Educate Staff:**

Train kitchen and cleaning staff on water-saving practices, such as turning off taps when not in use and reporting leaks promptly.

- **Utilise Air-Cooled Equipment:**

Choose air-cooled rather than water-cooled equipment to reduce water consumption in refrigeration.

- **Harvest Rainwater:**

Implement rainwater harvesting systems to collect and reuse rainwater for non-potable purposes like cleaning.

- **Monitor Water Bills:**

Regularly monitor water bills and usage patterns to identify any sudden increases, allowing for quick detection and resolution of issues.

- **Conduct Regular Audits and Benchmarking:**

Conduct regular water audits to identify opportunities for improvement and benchmark water usage against industry standards.

REDUCING THE CARBON FOOTPRINT OF OPERATIONS

Recognise that initiatives #2, #3, and #6 are relevant and should be implemented in onsite restaurants, cafes, and bars. Additionally, consider the following facility-specific actions:

- **Source Local and Seasonal Ingredients:**

Prioritise locally sourced and seasonal ingredients to reduce the carbon emissions associated with long-distance transportation of food. For example, the Andermatt Sedrun Disentis resort in Switzerland reduces emissions from the resort's restaurants by sourcing products locally to minimise food miles. Additionally, a substantial number of vegetarian meals are offered, contributing to further emission savings.

- **Promote Plant-Based Options:**

Introduce and promote plant-based menu options to lower the carbon footprint associated with meat production. Note that 100 grams of beef protein emits 50 kg CO₂e. Compare this to grains (2.7kg CO₂e), soybeans (1.98kg CO₂e) and plant-based meat (0.44kg CO₂e).

INITIATIVE #11: DESIGN MORE SUSTAINABLE RESTAURANTS, CAFES, AND BARS

- **Upgrade Equipment and Appliances:**

Upgrade to energy-efficient appliances and lighting to reduce energy consumption in the kitchen and dining areas. Look for equipment and appliances that are rated A*, A**, or A*** by the [EU Energy Label](#).

- **Optimise Transportation Practices:**

Streamline delivery routes and transportation logistics to minimise fuel consumption and emissions.

- **Engineering Menus to Reduce Food Emissions:**

Design menus that prioritise ingredients with lower carbon footprints, considering factors such as transportation, production, and processing methods.

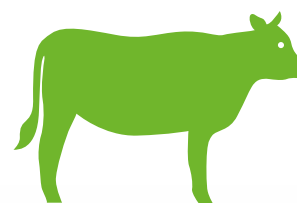
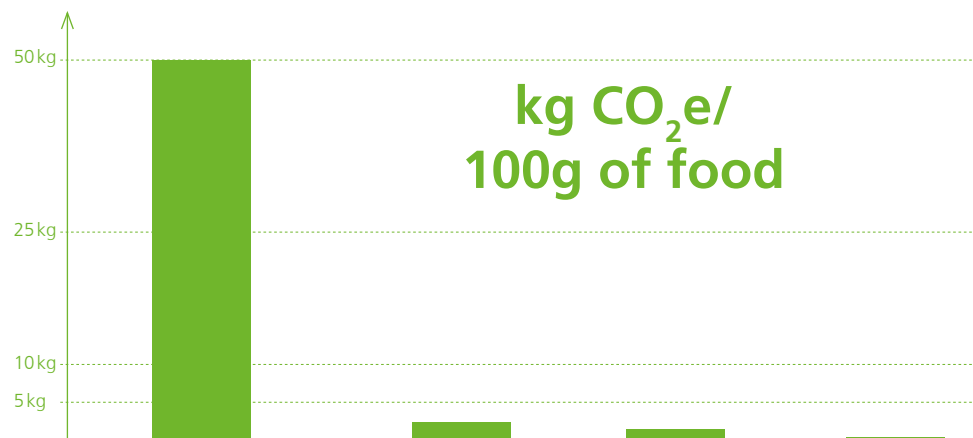
- **Educate Staff and Customers:**

Train staff on sustainable practices and engage customers by promoting the environmental initiatives of the establishment.

- **Green Building Design:**

If possible, invest in eco-friendly building designs with energy-efficient features and sustainable materials. The Leadership in Energy and Environmental Design (LEED) certification can serve as a valuable guide for implementing this action. More on this is discussed under Initiative #13.

Ski resorts should strive to obtain the [Green Michelin Star](#) award for their on-site food and beverage services. This recognition not only holds providers accountable for their ethical and environmental standards but also generates momentum and support to reduce the environmental impact of operations.



100 grams
=
50
kg CO₂e



100 grams
=
2,7
kg CO₂e



100 grams
=
1,98
kg CO₂e



100 grams
=
0,44
kg CO₂e

INITIATIVE #12: DESIGN MORE SUSTAINABLE ACCOMMODATION (HOTELS, CHALETs, AND ALPINE HUTS)




Resort hotels, chalets, and alpine huts face comparable challenges regarding energy, water, and waste management. To enhance the sustainability of these establishments, a comprehensive strategy must be implemented, addressing architecture, energy efficiency, water conservation, and waste management.

SUSTAINABLE ARCHITECTURE:

As mentioned earlier, the [Leadership in Energy and Environmental Design \(LEED\)](#) provides a practical roadmap for designing buildings that are not only healthy and highly efficient but also cost-effective. However, at its core, sustainable architecture involves the seamless integration of buildings within the surrounding landscape.

An essential aspect of this integration is the strategic placement of buildings to maximise renewable energy utilisation (initiative #2). For example, selecting locations with southern exposure can optimise sunlight for solar energy throughout the day. Plus, hotels, chalets, and alpine huts must be constructed using locally sourced natural materials (when appropriate) to fit in with the aesthetics of the environment, as exemplified by Lefay Resort Dolomiti in Madonna di Campiglio.

 The respect for the beauty of places and nature at Lefay Resort & SPA Dolomiti is also reflected in the interior design, which features natural materials mostly coming from the local area: the interiors are distinguished by Italian woods, such as oak for the parquet and chestnut for the furnishings; local stones, including tonalite, a typical stone with a light granite appearance used for fountains in the pastures, and Italian precious natural leathers and wools. All the textiles, including bed linen, are made from natural cotton fibre with no chemical treatment”.

[Greenbook](#), Lefay Resort Dolomiti in Madonna di Campiglio

INITIATIVE #12: DESIGN MORE SUSTAINABLE ACCOMMODATION

Upgrading building insulation to minimise heat loss is also crucial, ensuring that all surfaces are well-insulated. The adoption of ground and/or air-source heat pumps offers a low-emission method for maintaining optimal indoor temperatures.

Consider the new [Monte Rosa](#) hut in Switzerland as another example of sustainable architecture in action. The aim here was to create a self-sufficient alpine hut in terms of energy, water, and waste management.

The building is designed for efficient solar power generation, and excess energy is then stored in battery banks. In addition, water from showers and toilets undergoes filtration for reuse. Plus, to meet water needs, a cistern was carved into the mountain to store ample glacier meltwater for the hut's various requirements.

In terms of waste processing, the hut is also designed to minimise solid waste, avoiding disposal down the hill.

ENERGY EFFICIENCY

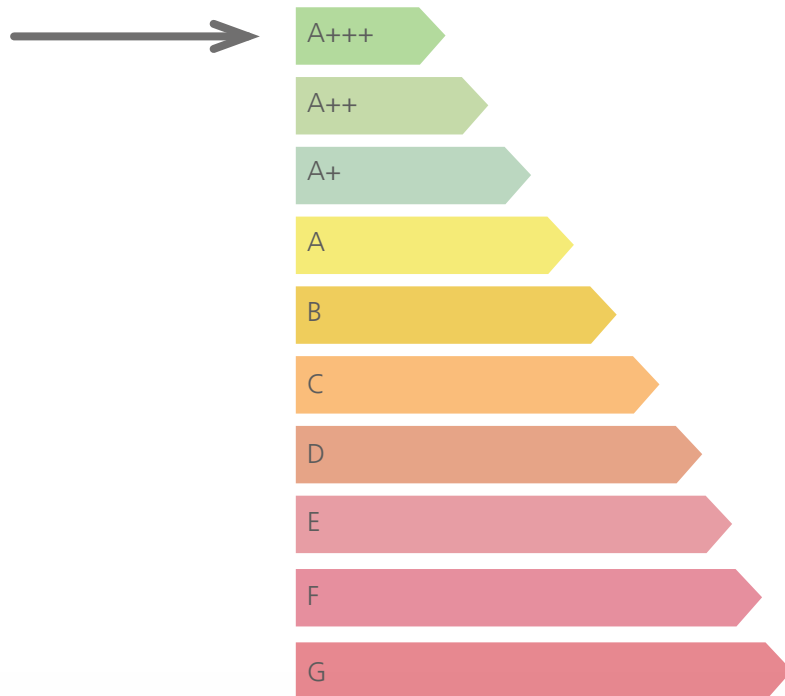
Recognise that initiatives #2, #3, and #6 are relevant and should be implemented in onsite restaurants, cafes, and bars. Additionally, consider the following:

Implementing sustainable architectural design can significantly reduce the energy demand of hotel, chalet, and alpine hut facilities. For example, sufficient insulation minimises wasted heat energy from buildings. Yet, further energy efficiency measures are still needed. For instance, buildings must have smart HVAC systems to adjust heating and cooling based on occupancy and seasonal requirements.

Plus, in public spaces, corridors, and guest rooms, motion sensor timings for lighting and climate control prevent unnecessary energy consumption. And guest room key card controls can offer an automated way to manage lighting and climate settings. LED lighting fixtures should also be installed throughout building spaces for enhanced energy efficiency.

INITIATIVE #12: DESIGN MORE SUSTAINABLE ACCOMMODATION

Optimising laundry services is also crucial. This involves energy-efficient washing machines, drying equipment, and the implementation of load management practices. Upgrade all hotel equipment and appliances with A*, A**, or A*** rating by the [EU Energy Label](#).



WATER CONSERVATION

The water conservation measures introduced under Initiative #12 that are applicable to hotels, chalets, and alpine huts must be implemented.

Laundry processing must be highlighted due to the substantial amount of water and energy used for hot water heating, overall facility operation, drying of linens and towels, and ironing. Plus, the environmental impact of detergents must be addressed.

Enforcing a linen change policy based on specific guest requests will minimise the frequency of bed linen and towel washes. Additionally, the installation of water-efficient washing machines will result in significant water-use reductions. For instance, the Hydrofinity machine has demonstrated an 80% decrease in water consumption, a 50% reduction in energy consumption, and a 50% decrease in detergent usage at specific [hotels](#).

WASTE MANAGEMENT

The waste management measures introduced under Initiative #9 must be implemented.

INITIATIVE #13: SUSTAINABLE EVENTS



While ski resorts hosting events like the World Cup can bring tourism benefits to the local community, it's essential to recognise that such events can also have adverse effects on the local environment. With this in mind, this initiative outlines a sustainable ski event action plan.

SUSTAINABLE SKI EVENT ACTION PLAN

- **Decarbonising Ski Events:**

- Objective:** Achieve fully decarbonised ski events.

- Action Steps:**

- Conduct a comprehensive carbon footprint assessment of the event.
- Explore and invest in renewable energy sources for event operations (see *initiative #2*).
- Collaborate with sponsors and partners committed to sustainability and GHG emission reduction.

- **Green Snow Grooming Machines:**

- Objective:** Implement environmentally friendly fuel for snow grooming machines.

- Action Steps:**

- Monitor and evaluate the performance and environmental impact of the renewable fuel for snow grooming machines (see *initiative #4*).
- Integrate the successful use of renewable fuel into standard operating procedures for future events.

INITIATIVE #13: SUSTAINABLE EVENTS

• Waste Management:

- **Objective:** Improve waste management practices during and after ski races.
- **Action Steps:**
 - Enhance waste collection efforts, particularly on race days.
 - Implement effective waste separation and recycling programs.
 - Engage and educate participants and spectators on responsible waste disposal (see initiative #9).

• Optimal Technical Snow Production:

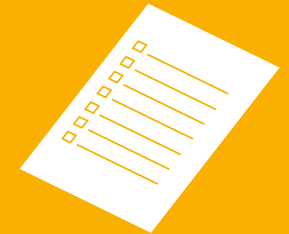
- **Objective:** Optimise technical snow production for each slope.
- **Action Steps:**
 - Utilise detailed technical information from sonar systems, GPS mapping, and meteorological forecasts to adapt snow production to the specific needs of each slope.
 - Implement environmentally conscious snowmaking practices (see initiatives #7 and #8).

• Sustainable Transportation for Spectators:

- **Objective:** Encourage sustainable transportation options for World Cup spectators.
- **Action Steps:**
 - Promote ridesharing through the event website to reduce individual vehicle emissions.
 - For spectators travelling in groups of four or more, offer incentives such as free parking and minibus services to event locations (see *initiative #6*).

By implementing these action steps, ski resorts can foster more sustainable events, reduce their environmental impact, and contribute positively to the communities they serve.

INITIATIVE #14: CREATE A SUSTAINABILITY PROGRAM



Ski resorts need an all-encompassing sustainability program that addresses every operation. This is an actionable roadmap detailing the measures and activities supporting sustainability. Listed below are examples of resorts taking this all-encompassing approach to create greener operations:

- [Megeve](#) Resort offers local produce in its cafes and restaurants.
- The [Tahoe](#) resort has installed 20 new water refill stations and sells reusable bottles designed to fit into a ski jacket pocket.
- [Avoriaz](#) Resort has built an eco-park using wood from naturally fallen trees.
- [Zermatt Bergbahnen](#) resort is involved in renaturation projects to recuperate damaged ecosystems and protect local flora and fauna.
- [Serre Chev](#) resort is stated to be working towards the dematerialisation of their ski passes, cutting down on a whole lot of plastic.
- [Aspen](#) pushes for LEED (Leadership in Energy and Environmental Design) certified buildings, with certification of their Mountaintop Sundeck Restaurant.

Resorts must use their employees to drive the sustainability program through education and set green targets as measures of employee performance. For instance, [Whistler Blackcomb](#), the winner of Canada's Greenest Employer Award, has created a diverse green team named the [Mountain Planning and Environmental Resource](#). This team works to keep the resort's environmental impact minimal.

Third-party certifications are also a good option to maintain momentum. These can help guide resorts to develop a comprehensive sustainability program. Certification criteria will emphasise best practices and industry standards for sustainability. Plus, certification signals a resort's dedication to sustainable practices, ensuring accountability. Explore certification from reputable third-party providers, such as those detailed below:

- [Leadership in Energy and Environmental Design \(LEED\)](#): Design healthy, highly efficient, and cost-saving buildings.
- [Flocon Vert Certification \(France\)](#): This certification, as mentioned earlier, is specific to France and is awarded by the organisation Mountain Riders. It recognises ski resorts that adhere to environmentally responsible practices.

INITIATIVE #14: CREATE A SUSTAINABILITY PROGRAM

- [Austria's Umweltzeichen Certification](#): Austria has its own environmental certification program for tourism businesses, including ski resorts. The Austrian Ecolabel (Österreichisches Umweltzeichen) is awarded to organisations that meet specific environmental criteria.
- [Swiss „Minergie“ Certification](#): In Switzerland, some ski resorts may adhere to the Minergie standard, which focuses on energy efficiency and sustainability in buildings.
- [TRUE Zero Waste Certification](#): Measure and improve waste management to achieve zero waste.
- [B Corp Certification](#): Demonstrate high social and environmental business performance.
- [ISO 14000](#): Establish effective environmental management systems.
- [Green Key Certification](#): Design environmentally responsible and sustainable operations within the tourism sector.
- [Sustainable Slopes](#): Adopt environmentally friendly practices for ski areas, designed by the National Ski Areas Association (NSAA) in the United States.
- [EarthCheck Certification](#): Assess and certify sustainable practices in the travel and tourism sector.
- [Sustainable Tourism Eco-Certification Program \(STEP\)](#): Evaluate the sustainability of tourism businesses, developed by the Sustainable Travel International organisation.
- [Travelife for Accommodation](#): Develop sustainable and socially responsible operations for hotels and other accommodations.
- [Green Restaurant Association \(GRA\)](#): Develop energy, and water-efficient systems in restaurants, plus reduce waste and source sustainable produce.
- [USDA Organic Certification](#): Use organic ingredients in menu items.