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Case Study on Developing a Comprehensive Voluntary Environmental Performance and Process Standard for Alpine Resorts Using Four Business Management Principles

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In 2018, Jackson Hole Mountain Resort (JHMR) in Teton Village, WY, USA, discontinued its International Standards Organization 14001 environmental management system. JHMR needed a replacement voluntary environmental program (VEP) that would empower resort employees to directly mitigate climate change, reduce waste and pollution, minimize water use, and restore biodiversity, along with improving building, education, and purchasing. I developed the Model for Alpine Resort Sustainability (MARS) based on 2 research objectives of improving existing industry-specific VEPs and empowering employees to directly mitigate resort environmental impacts through their work. MARS involves 4 business management principles: (1) use ski industry-specific criteria to drive accountability comprehensively across 25 resort departments; (2) quantify greenhouse gas emissions, using both absolute and intensity or normalized bases, and apply quantification to solid waste production and water consumption; (3) employ modern management techniques and software to focus on action over documentation; and (4) strategically align with the core business objective of alpine resorts to provide profitable outdoor recreation by decreasing costs and increasing revenues. MARS provides the most comprehensive, research-based accounting to date of alpine resort environmental impacts and mitigation indicators. MARS could be applied to larger resorts receptive to change.

Keywords: *alpine resorts; environmental management systems (EMSs); Climate Challenge; ski areas; sustainable tourism; Sustainable Slopes; voluntary environmental programs (VEPs).*

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Introduction: what is MARS?

Jackson Hole Mountain Resort (JHMR) is based in Teton County, WY, USA. Teton County is distinguished by its remote location far from cities and by its expensive real estate market adjacent to North America's most photographed mountain range (Farrell 2020). Although JHMR's setting is unique (Figure 1), the resort, being privately held and independently run, is otherwise characteristic of many snow-dependent global resorts.

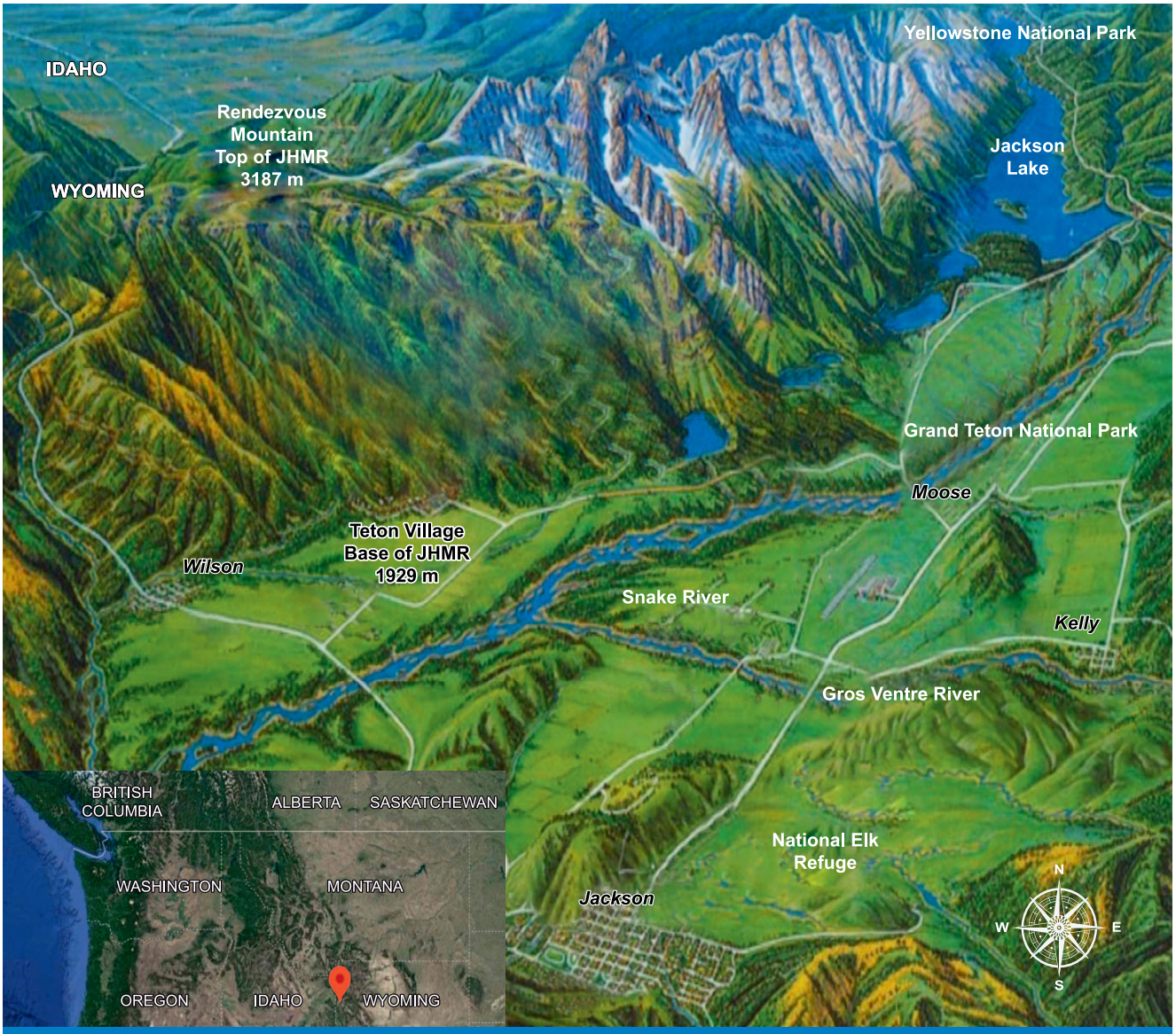
In 2008, senior executives and resort owners hired me to develop a voluntary environmental program (VEP). This VEP was intended to mitigate the resort's 4 major impacts: greenhouse gas (GHG) emissions, natural habitat loss, waste generation, and water use. To structure the VEP, I employed the International Standards Organization (ISO) 14001 standard (ISO n.d.), the world's most widely used environmental management system (EMS) standard, employed by more than 250,000 for-profit businesses globally (Sartor et al 2019). The European Union (EU) Eco-Management and Audit Scheme (EMAS) (EC n.d.) also builds upon ISO 14001.

However, ISO 14001 registration from 2008–2018 was insufficient for developing initiatives to mitigate the resort's environmental impacts. Some of my initiatives at JHMR were limited in space and irregular in time, rather than being comprehensive and consistent, such as converting only 3 resort vehicles to 100% biodiesel and only using microbial degreasing machines (as opposed to petroleum naphtha) in 1 of 4 maintenance shops (chairlift, gondola, tram, and vehicle). Other initiatives were simply fortuitous, such as eliminating retail plastic bags because of a countywide ban and reducing GHG emissions on an intensity or normalized basis (per winter visitor) because of growth.

VEPs typically involve either process standards such as ISO 14001 (with generic procedures) or performance standards such as Leadership in Environmental and Energy Design (LEED) for building construction (with industry-specific criteria and indicators). VEP standards of either type require periodic surveillance assessments or audits, which may be conducted by the certified or registered entity (first party), the standard-setting body (second party), or an assurance provider or validation and verification body (third party). Demand for performance standards in particular has exploded over the past 2 decades, with nearly 500 now used

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FIGURE 1 Location of JHMR in Teton County, WY, USA.



Jackson Hole Mountain Resort (JHMR, 43.59°N, 110.83°W) opened in 1966 and was purchased by its current owners, the Kemmerer family, nearly 30 years ago. The resort today contains 13 above-surface ski lifts, including 1 tram, 2 gondolas, and 4 high-speed quad chairs. JHMR's iconic tram from Teton Village to the Rendezvous Mountain peak still provides the longest continuous vertical drop in the United States for boarders and skiers of 1258 m (4127 feet). JHMR's in-bounds Special Use Permit area is 850 ha (2100 acres), with 57% of that area maintained as piste and 11% covered by snowmaking.

Average annual precipitation at the base is 762 mm (30 inches), with a January mean temperature of –8.2°C (17.2°F) and a July mean temperature of 19°C (66.2°F). Weather conditions change rapidly between the base and the summit due to the steep Teton Fault. Rendezvous Peak, for example, has received over 12,700 mm (500 inches) of recorded total snowfall in each of JHMR's last 5 winter seasons.

Teton County, Wyoming (including the towns of Jackson, Kelly, Moose, Teton Village, and Wilson) has approximately 25,000 permanent residents but over 1.5 million annual visitors. Over half of these visitors arrive during the summer to visit nearby Grand Teton and Yellowstone National Parks.

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globally (Yokessa and Marette 2019) to signal environmental attributes to potential buyers (Spence 2002). Performance standards may be necessary to overcome adverse selection or information asymmetry (Akerlof 1970) between buyers and sellers, but the rigor of those standards determines whether they are sufficient. For example, research by Blumroder et al (2020) and Morgans et al (2018) found that the Forest Stewardship Council and the Roundtable on Sustainable Palm Oil, despite claims, provide few ecological benefits in naturally regenerated boreal forests and tropical palm oil plantations, respectively. Side-by-side comparisons of similar companies with and without ISO 14001 registration indicate that ISO 14001 typically reduces internalized costs such as energy consumption and associated GHG air pollution (Zobel and Malmgren 2016). However, it does not necessarily reduce air pollution from nitrous oxides, particulate matter, sulfur oxides, and volatile organic chemicals (Zobel 2016).

After JHMR ended ISO 14001 registration in 2018, I spent a year developing a combined process and performance environmental standard potentially applicable to multiple alpine resorts. Other researchers have taken this same approach of applying combined process and performance standards to a specific industry (eg restaurants, in the case of Maynard et al 2020). I had 2 research objectives: (1) Could I improve the rigor of the Climate Challenge (NSAA n.d. a) and Sustainable Slopes (NSAA n.d. b) VEPs from the US-based trade organization National Ski Areas Association (NSAA) to which more than 150 alpine resorts already subscribe? (2) Could I build a VEP that would replace outsourcing—via charitable donations and political campaigns—with insourcing to empower resort employees to directly mitigate environmental impacts in their work?

The combined performance and process standard I developed I call the Model for Alpine Resort Sustainability (MARS). "Model" refers to the conceptual model of the internal EMS, and "alpine resort" refers to any mountain-based for-profit business providing outdoor recreation services that are primarily snow dependent. "Sustainability" refers to the Sustainability Accounting Standards Board (SASB 2020) definition—creating enterprise value over the long term—with financial discounting to bias value toward the present (Frederick et al 2002). MARS is structured around 4 business principles discussed in detail later: (1) environmental indicators organized by department to drive accountability, with application comprehensively across all 25 resort departments; (2) financial year absolute and intensity accounting for GHG emissions, waste production, and (when appropriate) water use; (3) Deming cycles employed for continual process improvements; and (4) strategic alignment with other business initiatives by decreasing costs and increasing revenues.

What is the structure of MARS?

Business management principle 1

Comprehensive criteria across resort departments: Participation in Sustainable Slopes requires that resorts pledge to incorporate sustainability into all aspects of their resorts (NSAA n.d. b). Sustainable Slopes has historically suffered from nonbinding weakness (Rivera et al 2006), lacking penalties or rewards based on periodic assessments (Steelman and Rivera 2007). Nonbinding weakness enables some alpine resorts to free-ride or pool by adding their signatures to the pledge without changing their business practices, leading to greenwashing accusations (Berwyn 2005). Greenwashing involves both lies of deed and word decoupling (Walker and Wan 2012), and half-lies of attention diversion or selective disclosure (Lyon and Montgomery 2015; De Jong et al 2020), such as providing compostable food service containers but no compost collection.

Sustainable Slopes underwent major improvements in 2020. Signatories can now earn badges biennially for up to 10 specific criteria if they submit documents to the NSAA demonstrating fulfillment of various indicators. However, badges remain optional, so Sustainable Slopes signatories may choose none, only one, or multiple.

In contrast, MARS takes the comprehensive approach that within 5 years, resorts must fulfill all 7 standard criteria (Table 1), with each resort department also satisfying mitigation indicators (Table S1, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-20-00078.1.S1). The 25 resort departments covered by indicators include administration, such as accounting; guest services or revenue centers, such as food and beverages; and mountain operations, such as lift maintenance.

The 7 MARS criteria in Table 1 differ from NSAA Sustainable Slope 2020 in four regards: (1) MARS consolidates 3 closely related Sustainable Slopes criteria of climate change action, energy management, and transportation emissions; (2) MARS replaces all subject titles with action titles to spur implementation (eg replacing "Supply Chains" with "Environmentally Preferable Product Purchases based on Performance and Price for Pollution Prevention"; (3) MARS adds Global Reporting Initiative 300 series standard requirements of reduced raw material use to diminish consumption, and environmental legal compliance to distinguish regulatory requirements from voluntary initiatives (GRI n.d.); and (4) MARS includes planetary boundaries established by Röckstrom et al (2009) and Steffen et al (2015) of life-supporting ecosystem services that have declined during our 70+ years in the Anthropocene epoch.

MARS also diverges from Sustainable Slopes in terms of indicators. MARS indicators are derived from scholarship and organized by department. Subjective materiality or significance weighting scores from 1 (low) to 3 (high) involve size (spatial), frequency (temporal), and type (severity) categories from ISO 14001:2015 A.6.12 (Table S1, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-20-00078.1.S1). These materiality scores pertain to positive mitigation as opposed to negative impact. After each monitoring period, departments may earn a score of 0 for no progress, 0.5 for half progress, or 1.0 for full progress of mitigation indicators. Progress is then multiplied by indicator materiality for a maximum resort achievement score of 300 at the bottom of Table S1 (*Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-20-00078.1.S1). Excluding the overarching environmental department, both guest services and mountain operations in Table S1 (*Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-20-00078.1.S1) have the highest materiality scores to correspond with revenue generation and cost reduction strategies for MARS.

Climate change mitigation and air quality (CCMAQ): Climate change will reduce visitation over the next few years by an estimated >8% at the largest resorts and >20% at the

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TABLE 1 7 MARS criteria in relation to NSAA Sustainable Slope badge criteria, GRI 300 series environmental reporting standards, and planetary boundaries.

MARS 7 criteria (2021+)	NSAA Sustainable Slopes badge criteria (2020+)	GRI 300 series standards (2016+)	Planetary boundaries (Röckstrom et al 2009; Steffen et al 2015)
1. CCMAQ and energy efficiency*, including legal compliance	Climate change action and advocacy (alternative paths to action and advocacy, climate challenger) Energy management (energy efficiency and equipment, renewable and clean energy) Transportation emissions (fleet vehicles and equipment, guest transportation)	Energy Emissions	Accelerated climate change Atmospheric loading of aerosols and particulate matter Continued stratospheric ozone depletion Ocean acidification from air pollution
2. WRD and reduced raw material use*, including legal compliance	Waste and recycling (recycling, waste reduction)	Effluent and waste Environmental compliance Materials	Chemical pollution, including heavy metals Endocrine disrupters, including plastics and radiation
3. WCQ*, including legal compliance	Water management (facility water use, landscaping and summer activities, snowmaking, runoff, stormwater management)	Water and effluent	Global freshwater depletion Nitrogen and phosphorus pollution
4. NHCR, including legal compliance	Forest health and habitat (fish and wildlife, forest health and vegetation)	Biodiversity	Biodiversity loss (marine, terrestrial) Land use change, including deforestation
5. EBDC	Building design and construction (green building certification)	NA	NA
6. EEO	Education and outreach (communication and outreach, employee and visitor education)	NA	NA
7. P7	Supply chain (sourcing, purchasing and disposal—cradle-to-grave life cycle assessment)	Supplier environmental assessments	NA

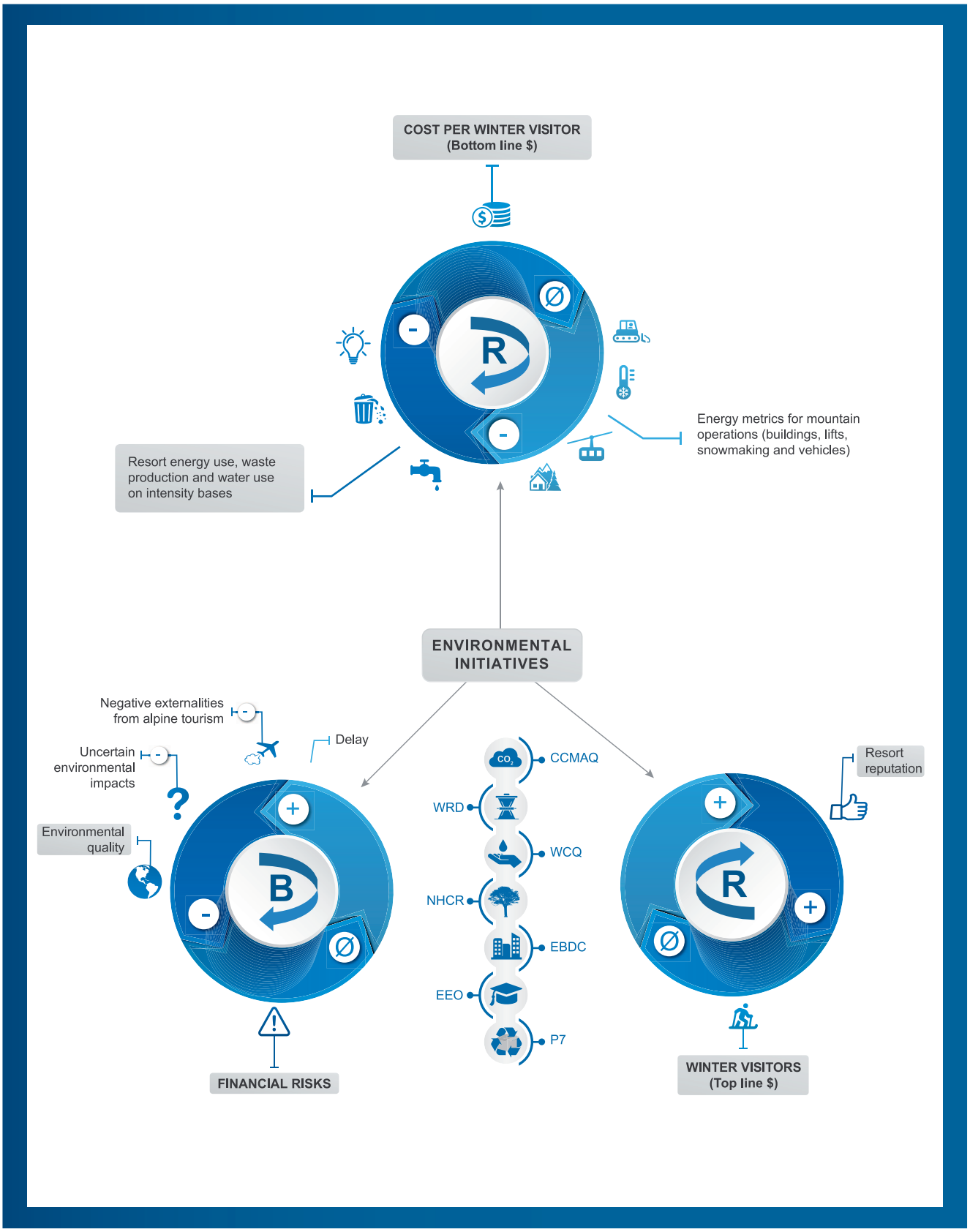
Note: MARS designates the first 3 criteria marked by asterisks (*) for resortwide absolute- and intensity-based financial year reporting relative to historical baselines. CCMAQ, Climate Change Mitigation and Air Quality; EBDC, Environmental Building Design and Construction; EEO, Environmental Education and Outreach; NHCR, Natural Habitat Conservation and Restoration; P7, Environmentally Preferable Product Purchases based on Performance, Pollution Prevention, and Price; WCQ, Water Conservation and Quality; WRD, Waste Reduction and Diversion; NA, not applicable.

smallest resorts according to Rutty et al (2017), who analyzed visits during a +3.6°C (+6.5°F) anomalous winter in Ontario, Canada. Remaining visitors will congregate at resorts located at the highest latitudes and elevations (Dawson and Scott 2013; Gilaberte-Burdalo et al 2014) and at resorts with the most extensive snowmaking (Damm et al 2014). All 4 competing alpine resort conglomerates in North America—Alterra, Boyne, Powdr, and Vail, representing 71 resorts—agree that "climate change is the most critical issue we face as business leaders" (Alterra Mountain Company et al 2021). Aspen, as part of Alterra, and Vail have developed off-site but direct mechanisms to mitigate GHG impacts: coal mine methane capture with electricity conversion (Arena 2016) and renewable power purchase agreements (Best 2019), respectively. JHMR in financial year 2019–2020 undertook a 10-year contract with Lower Valley Energy to purchase 100% of the resort's electricity from the closest wind farm on the same power grid at Horse Butte, ID. The purchase reduced JHMR's combined scope 1 and scope 2 GHG emissions by 62%, representing 4158 metric tons (Mg) of carbon dioxide equivalent (CO_2e) in 2019–2020. Scope 1 represents direct emissions from on-site fuel use for buildings and vehicles, and scope 2 represents indirect emissions from off-site electricity generation. MARS indicators for the climate change mitigation and air quality criteria include direct reductions of scope 1 and 2 GHG emissions, efficiency monitoring to reduce energy expenses (see top loop of Figure 2), and reduced wood burning both inside (such as fireplaces) and outside (such as slash piles) to reduce particulate matter (Naeher et al 2007).

Waste reduction and diversion (WRD): Teton County waste volume crests during summers from surges of construction and deconstruction and torrents of national park tourism (Cottier 2019). Every week, all year, Teton County trash trucks travel 316 km (196 miles) roundtrips because of the 3-decade-old closure of the county's landfill from leachate contamination (Cottier 2019). JHMR participates in Teton County's Road to Zero initiative to increase its diversion of municipal solid waste above 60% by 2030. JHMR also produces commercial waste (eg lift sheave wheels and used lumber) and hazardous waste (eg batteries, electronics, oil-based paints, and vehicle fluids) that should undergo waste reduction and diversion (eg used lumber repurposed as mulch and electronic components disassembled at R2-certified recycling facilities) (SERI n.d.). Plastic has become a persistent and ubiquitous pollutant as recycling chains capture less than 10% of global plastic production (Geyer et al 2017), resulting in plastic rain on remote public lands

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FIGURE 2 Causal logic loops of financial benefit outcomes from MARS in terms of reducing costs, increasing revenues, and ameliorating risks. Efficiency metrics for the top loop and environmental initiatives for the bottom 2 loops create either reinforcing (R) positive feedback or balancing (B) negative feedback. CCMAQ, Climate Change Mitigation and Air Quality; EBDC, Environmental Building Design and Construction; EEO, Environmental Education and Outreach; NHCR, Natural Habitat Conservation and Restoration; P7, Environmentally Preferable Product Purchases based on Performance, Pollution Prevention, and Price; WCQ, Water Conservation and Quality; WRD, Waste Reduction and Diversion.



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(Brahney et al 2020), atmospheric transport of microplastics to oceans (Liu et al 2019), and inadvertent human ingestion of thousands of potentially toxic microplastic particles per year (Cox et al 2019). Biodegradable and oxobiodegradable plastics do not decompose in field trials (Napper and Thompson 2019) and therefore resorts should only supply, if not recyclable or reusable materials, compostable plant plastics certified by the Biodegradable Products Institute. Aseptic cartons, although neither compostable nor recyclable, have lower GHG footprints than glass because of lower breakage and lighter weight (Pasqualino et al 2011).

Water conservation and quality (WCQ): Snowmaking is a voracious water consumer at alpine resorts, consuming at least 500 L of water to produce 1 m^3 of manufactured snow (SMI Snow Makers n.d.). Water losses from evaporation, sublimation, and off-piste wind drift total only 10% at wet bulb temperatures $\leq$10°C and windspeeds <5 m/s but rise to 30% at wet bulb temperatures $\leq$4°C and windspeeds >10 m/s (Grunewald and Wolfsperger 2019). For storage, Weiss et al (2019) suggest a concrete curing thermal blanket on the ground, the manufactured snow pile, plastic sheeting, 24 m^3 of wood chips as thermal mass, and then a reflective blanket on top. Some resorts have copious water supplies: for example, JHMR overlies the 60-m-deep Snake River reservoir (Wright 2013). Water conservation and quality indicators for water use reduction therefore apply only to resorts at high water depletion risk according to the World Resources Institute's (WRI's) Aqueduct Atlas (WRI n.d.).

Natural habitat conservation and restoration (NHCR): All wild animals, except rodents, respond negatively to winter recreation in terms of fecundity declines, increased mortality, increased physiological stress, and reduced habitat occupancies (Larson et al 2016). The negative impact of winter recreation on wild animals is even stronger within resort boundaries, not only because of the density of human activity and roadways but also because of summer grooming—machine-grading runs to level terrain and remove rocks and woody debris. Summer grooming compacts and scarifies topsoil, thereby suppressing vegetative succession (Burt and Rice 2009; Roux-Fouillet et al 2011; Burt and Clary 2016). This subsequently reduces thermoregulatory refugia and predator shelters for vertebrates from reptiles in the Australian Alps (Sato et al 2014) to ground-nesting birds in the European Alps (Caprio et al 2011). To balance these ecological disadvantages against snowmaking efficiency advantages, MARS requires protection of $\geq$25% of the piste area from summer grooming. Another natural habitat conservation and restoration indicator under MARS involves piste restoration, such as adding diminutive and resilient native forbs (eg those from *Asteraceae, Boraginaceae,* and *Lamiaceae* families) (Burt 2012) into grass–legume seed mixes to boost biodiversity. Hydroseeding provides superior erosion resistance compared with straw or wood chip mulch (although application vehicles must be weed free) (Prats et al 2013) and provides habitat for grasshoppers and ground-dwelling beetles (Matteo et al 2013). Arbuscular mycorrhizal fungi inoculation with reseeding could also accelerate regeneration, both by providing hyphal access to phosphorus and by improving soil aggregation (Delavaux et al 2017). Finally, extensive wildfires with severe intensity and frequent recurrence in recent years (Halofsky et al 2020) require that resorts undertake wildfire risk mitigation.

Environmental building, design, and construction (EBDC): In-use energy contributes more than three quarters of total building energy consumption over a building's 50-year cradle-to-grave projection (Chau et al 2015); therefore, all 4 international environmental building standards (the Building Research Establishment Environmental Assessment Method, Green Globes, Green Star, and LEED) prioritize energy use (eg building-wide light emitting diode [LED] lighting and window-to-wall ratios <33%) (Marino et al 2017). Other priorities include indoor environmental quality (minimum efficiency reporting value for air filters of 13+) and waste diversion or reduction (>50% by weight or volume) (Mattoni et al 2018; Varma and Palaniappan 2019). A recent innovation for low-rise commercial buildings involves using composite laminated lumber for interior structural post-and-beam mass as opposed to steel or concrete to save >25% of entire-building embodied energy (Chau et al 2015). The final environmental building, design, and construction indicator in MARS includes using the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 2019) recommendations for commercial building airtightness (<1 L/s·m^2 @ 75 Pascals) and insulation: above-grade assembled wall U values <0.047 (R values >20), warm roof U values <0.027 (R values >37), and fenestration U values <0.3 (R values >3.3) for US climate zone 7.

Environmental education and outreach (EEO): Collaboration between public land management agencies, local environmental education centers, and ski resorts through environmental education and outreach can lead to appealing guest stations such as the Nature Discovery Center yurt at the top of Eagle Bahn Gondola at Vail. In terms of outreach, simple resort environmental messaging, although bold and catchy, may be misleading compared with more complex proactive communication (Hudson and Miller 2005). Is a carbon-neutrality marketing claim substantiated by direct GHG emission mitigation, as opposed to indirect and uncertain offset credit and renewable energy credit (REC) purchases (Schendler 2021)? Is a zero-waste marketing claim substantiated by diversion of not only municipal but also commercial and hazardous waste?

Environmentally preferable product purchases based on performance, pollution prevention, and price (P7): The P7 criterion refers to high performance and low price as prerequisites and pollution prevention as a starting point via safety data sheets. Typical criteria for supply chain replacement include biodegradability, incorporation of recycled materials, and reduced life cycle GHGs and toxins. For janitorial departments, P7 initiatives involve certified (eg EcoLogo, Environmental Working Group, or Green Seal) disinfectant products with active ingredients of hydrogen peroxide, hypochlorous acid, and isopropyl alcohol, rather than more widely used chlorine bleach or sodium hypochlorite (which causes mucous membrane and skin inflammations) (Slaughter et al 2019) and quaternary ammonium compounds (which cause respiratory tract irritation) (Bellier et al 2015). For retail departments, P7 initiatives involve apparel and footwear manufacturers who bypass 24 toxins identified by the Zero Discharge of

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TABLE 2 Scope 1 (direct) and scope 2 (indirect) GHG emissions for the 14 largest alpine resorts (>400,000 winter visits) participating in the Climate Challenge.

USA alpine resort participating in 2017 NSAA Climate Challenge	Scope 1 and 2 self-reported absolute GHG emissions (CO_2e Mg)	November 2016–April 2017 estimated winter visits based on lift pass use (no.)	Intensity-normalized emissions (CO_2e Mg per winter visit)
1. Mammoth and June Mountains, CA	14,400	1,500,000	0.010
1. Steamboat Ski and Resort Co., CO*	12,400	1,200,000	0.010
2. Stratton, VT	8160	775,000	0.011
3. Alta Ski Area, UT	5140	400,000	0.013
3. Jackson Hole Mountain Resort, WY*	7230	560,000	0.013
4. Mt Bachelor, OR	6370	400,000	0.016
5. Aspen-Snowmass Skiing Co., CO*	23,400	1,400,000	0.017
6. Squaw Valley and Alpine Meadows, CA*	13,100	750,000	0.018
7. Deer Valley Resort, UT	10,100	500,000	0.020
8. Killington Resort, VT	15,800	700,000	0.023
9. Copper Mountain Ski Resort, CO	24,400	850,000	0.029
10. Telluride Ski Resort, CO	16,200	450,000	0.036
11. Snowbird Ski and Summer Resort, UT	18,100	425,000	0.043

Note: The resorts are ranked by estimated emissions intensity or normalization. Absolute emissions were self-reported by resorts for financial years summer 2016–summer 2017, except for resorts marked with asterisks, which reported for calendar years. JHMR switched to financial-year reporting in financial year 2020–2021.

Hazardous Chemicals Foundation, including per- and polyfluorinated alkyl substances ("forever chemicals") conventionally used for durable water repellants such as Gore-Tex and used in many ski waxes (Carlson and Tupper 2020). Apparel certified to Blue Angel, Bluesign, Cradle-to-Cradle Silver+, Global Organic Textile Standard, and Oeko-Tex should be preferred for both employee uniforms and retail sales because of low life cycle impacts (Diekel et al 2021).

Business management principle 2

Both absolute and intensity or normalized environmental accounting: NSAA summarizes the Climate Challenge as 5 steps: inventory, target, reduce, advocate, and report. Participants receive initial training on carbon footprint inventories with the WRI GHG Corporate Accounting and Reporting Standard (Ranganathan et al 2004: 7–9). However, the Climate Challenge satisfies only the first of the 5 WRI GHG accounting principles of accuracy (presumably), but not completeness, consistency, transparency, or relevance. In terms of "completely accounting for all GHG emission sources within inventory boundaries," the Climate Challenge does not require emission factors for renewable power generation, such as a conservative 0.00003 Mg CO_2e/kWh for land-based wind power (Kumar et al 2016; Bhandari et al 2020). In terms of "using consistent methodologies to allow for meaningful performance tracking," the Climate Challenge allows resorts to set their own absolute reduction targets without consistent and meaningful minimum percentage requirements (such as 7% year over year from EU Paris-Aligned Benchmarks). In terms of "transparently disclosing all relevant assumptions," the Climate Challenge allows resorts to include both offsets and RECs to meet their goals without clearly distinguishing market-based accounting from location-based accounting. Finally, in terms of "ensuring that GHG inventories serve relevant decision-making needs of both internal and external users," the Climate Challenge does not require intensity (normalized per winter visit) reporting. Absolute emissions matter from a climate change perspective, but intensity emissions matter from a management perspective. For example, the SASB requires intensity reporting so that data are "decision-useful" by enabling comparisons between companies within the same industry (SASB 2020). Both Aspen and Vail resorts publicly report absolute and intensity GHG emissions data. Intensity emissions empower resorts to make comparisons between years despite winter visitor fluctuations. EU benchmarks of 140 L of water use (excluding grounds and pools) and 0.6 kg of municipal solid waste production per guest night enabled Heras-Saizarbitoria et al (2020) to identify gaps between symbolic claims from EU-EMAS certifications and actual environmental performances of various hotels in the EU. Table 2 lists both reported absolute and estimated intensity GHG emissions from the 14 largest resorts in NSAA's 2017 Climate Challenge to illustrate the utility of intensity-based data. MARS requires both absolute and intensity reporting per financial year of not only GHG emissions but also waste production and, when applicable, water consumption. Only Vail publicly reports its absolute municipal solid waste production and diversion, and no North American alpine resorts publicly report net water use (Vail Resorts n.d.).

Business management principle 3

Focus on action over documentation: The core component of an ISO 14001 EMS is the Deming cycle (Deming 2000), which

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requires data collection for continual improvement in 5 formal steps: observe, plan, do or implement, check or study, and act or revise. So integral is this continuous improvement cycle that ISO 9001 quality registration built around the Deming cycle typically precedes ISO 14001 EMS registration (Allur et al 2018). The Deming cycle has both business and environmental applications, because it forms the basis for both the Six Sigma manufacturing improvement process (Eby 2021) and the Conservation Measures Partnership adaptive management standard (CMP 2020). The Deming cycle may incidentally reduce errors in and increase quality of guest services for resorts (Molina-Azorin et al 2015) and has been recommended for ski areas in the form of an EMS by Williams and Todd (1997) and Duglio and Beltramo (2016).

MARS retains the Deming cycle with biannual assessments (one remote and one on site). To make the evaluative process more collaborative and less confrontational compared with my experience with ISO 14001, MARS changes the assessment term "auditing" to "monitoring" and moves the on-site locations to managers' offices rather than central administration meeting rooms. MARS also encourages opening meetings with highlights of achievements as opposed to criticisms of deficiencies and breaking large objectives into multiyear phases. To add technical value to the process, MARS includes quantification of the first 3 criteria of energy use, waste diversion, and (when applicable) water use. In addition, as a financial incentive, MARS decreases monitoring cost and frequency to annually, or even biennially, based on resort achievement scores (Table S1, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-20-00078.1.S1), as opposed to invariant monitoring frequency under ISO-14001.

A weakness of ISO 14001 at JHMR was that the documentation proxy became the performance target (also identified by Boiral et al 2018). To alleviate the documentation burden, MARS proposes departmental environmental objectives (improvements over time, like graduated dials) or tasks (one-time permanent changes, like on–off switches) for managers to accept or revise. MARS also employs the objective and key result (OKR) approach that ties qualitative departmental objectives directly to quantitative results ("I will achieve this [objective] as measured by these [key results]") (Doerr 2018). To emphasize aspiration and dynamism, the key results are frequently revised, are ambitious in scope, have specific metrics, and are transparent to others (FAST) (Sull and Sull 2018), as opposed to specific, measurable, attainable, realistic, and timely (SMART). Finally, MARS employs Smartsheet cloud-based project management software to share information remotely among multiple staff members in a continually updated form. Smartsheet serves as an electronic hub for the internal EMS.

Business management principle 4

Causal logic loops to align with financial objectives: Financial benefits are required to offset the cost of EMS implementation—return on investment—and to align with the core purpose of resort businesses to generate profits from outdoor recreation. Wortman's (2014) review of 115 US alpine resorts found those undertaking environmental initiatives were correlated with at least 15% higher profits before taxes (3.5% of gross revenue). Wortman used Willard's (2012) financial advantage factors in 3 categories to explain the correlation: (1) decreased costs because of more efficient energy and water use, (2) increased revenues from guests because of positive publicity, and (3) reduced financial risks. Figure 2 shows MARS outputs (in noncapitalized gray boxes) as the proximal results of environmental initiatives ("the practical what"): reduced energy use, waste production, and water use; improved reputation; and improved environmental quality. It also shows outcomes (in capitalized gray boxes) as the distal financial results ("the financial why") (Mills-Scofield 2012): decreased bottom line costs; increased top line revenues; and reduced financial risks.

Reduced costs: The top center loop in Figure 2 shows operating cost reduction from electricity and fuel use efficiency in accordance with the Porter hypothesis, whereby environmental innovation lowers costs (Porter and van der Linde 1995). MARS requires departmental energy use reporting and thereby drives efficiencies via (1) energy use intensity per building square area per cooling or heating degree day; (2) vertical transport meters per hour of electricity use for lifts; (3) snowmaking efficiency index of electricity, labor, and water costs for snow production at wet bulb temperatures; and (4) distance for light-duty vehicles or hours for heavy-duty vehicles per volume of fuel use. Electrical and fuel use efficiency improvements also require monitoring absolute resort GHG emissions to avert Jevon's paradox or rebound effects (Polimeni et al 2008), whereby decreases in per-unit costs spur increases in total unit outputs.

Increased revenues: The bottom right loop in Figure 2 shows increased winter visit revenue from customer loyalty. Oliver (2010: 34) defines customer loyalty as "a deeply held commitment to rebuy or repatronize a preferred product or service consistently in the future." Guest satisfaction precedes loyalty (Merli et al 2019): hospitality services must provide a baseline of amenities, cleanliness, safety, and service no lower than that of competitors before gaining additional loyalty from environmental initiatives (Han 2015). To gauge loyalty, alpine resorts commonly use a net promoter score survey question of "How likely is it that you would recommend our service to a friend or colleague?" (Reichheld 2011). Interviews by Needham and Little (2013) with 429 skiers and snowboarders at Mt Bachelor in Oregon, USA, revealed that most chose Mt Bachelor based on accessibility, affordability, scenic beauty, skiing terrain, and/or snow conditions. However, 10% reported feeling pulled to Mt Bachelor by the resort's positive environmental reputation from biodiesel use, extensive recycling, and LED conversions. The comprehensive nature of MARS may increase its utility for customer engagement. Multiple and recurring cues, as opposed to isolated environmental initiatives, drove repatronage intent at eco-branded hotels in India according to guest surveys from Gupta et al (2019). However, Sato et al (2017) found that Japanese alpine resort visitors focused on only one salient issue, such as reduced GHG emissions.

Risk amelioration: The bottom left "save the Earth" loop in Figure 2 shows financial risk amelioration through improved environmental quality. Ecoterrorism represents risk to "social license to operate" (Williams et al 2007) for resorts on crown and national forestland. This risk was exemplified

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by the 1998 building and lift arson at Vail Mountain in Colorado, USA, and possibly the 2019 and 2020 lift sabotage of the Sea-to-Sky Gondola in British Colombia, Canada. The bottom left loop is distinct from the others not only because it is balancing but also because this loop includes uncertainties, externalities, and delays. In terms of uncertainties, environmental impacts from human activities can be complex. The Earth Liberation Front ecoterrorists prosecuted for the Vail fires claimed they were acting on behalf of the lynx (Glick 2001), yet a 7-year reintroduction of more than 200 lynx (*Lynx canadensis*) by Colorado Parks and Wildlife ended with a self-propagating population in 2006 (Devineau et al 2010), even while Vail Mountain rebuilt and expanded. Lynx proved highly adaptable, both in prey switching from the more preferred snowshoe hare (*Lepus americanus*) to the more abundant red squirrel (*Tamiasciurus hudsonicus*) and in behavior modification by concentrating their hunting activity at dawn and dusk to avoid humans (Peers et al 2014). In terms of global externalities, tourism contributes 8% of total GHG emissions (Lenzen et al 2018), but only approximately 3% comes from scope 1 and 2 emissions within resort boundaries, whereas the remaining 5% comes from scope 3 employee and guest travel, as well as supply chains (Lenzen et al 2018). In terms of local externalities, for example, JHMR has connected all of its buildings to Teton Village sewers and has reduced its nitrogenous munitions for avalanche control by installing Gaz-Ex propane and oxygen tubes. Nonetheless, the nearby Trout Creek suffers eutrophic algal blooms and *Escherichia coli* impairment along its entire length because of livestock and septic tanks outside resort boundaries (Eddy-Miller et al 2016; Koshmrl 2020). Finally, in terms of delays, GHGs of carbon dioxide, nitrous oxide, and halocarbons have warming lifetimes beyond a century, so current emission reductions may not be felt for decades.

Application of MARS

Limited to larger resorts

Overall, companies with high scores for environmental–social–governance (ESG) tend to financially outperform low-scoring companies (Eccles et al 2012; Albertini 2013; Busch and Friede 2018). However, these studies did not control for self-selection; per Hart's (1995) natural resource-based theory of the firm, companies already financially outperforming may invest in ESG to widen their competitive moats. Indeed, Clarkson et al (2011), in reviewing financial data of companies in heavily polluting sectors (chemicals, metals, petrochemicals, and pulp) against public pollution data, found that higher profitability in terms of returns on assets preceded lower toxin releases. Similarly, Wang et al (2018) found that nearly two thirds of 5-star hotels implemented energy conservation projects, whereas no 2- or 1-star hotels did so. Given this role of ESG in widening competitive moats for already-profitable companies, MARS likely applies to larger alpine resorts (500,000+ winter visitors per year) with higher resort profit margins (Moreno-Gene et al 2018) and lower normalized costs (Kuscer and Dwyer 2018) because of economies of scale. The expense of implementing and monitoring initiatives across 25 departments also limits MARS to larger resorts.

Limited to resorts receptive to change

All resorts have organizational inertia (Porter and van der Linde 1995), a strong form of path dependency, because of staff who resist change, including (Oreg 2003) cognitive rigidity to new ideas ("Environmental products never work!"), emotional defensiveness ("Don't tell me how to do my work!"), avoidance of short-term personal costs for long-term organizational gains ("What's in it for me?"), or entrenched work routines ("This is how I have always done it!"). MARS applies to resorts whose managers already signal their receptiveness to change via EU-EMAS registration, Green Globe tourism certification (Green Globe n.d.), or EarthCheck destination certification (EarthCheck n.d.) and other schemes endorsed by the Global Sustainable Tourism Council (GSTC n.d.). To overcome resistance to change, MARS requires 4 steps, following Oreg et al (2011): (1) obtain senior administration and resort owner endorsements, (2) demonstrate technical competence in drafting departmental OKRs, (3) engage managers in the change process in accepting or revising OKRs, and (4) build trust via appointment reliability, periodic communication, and on-site monitoring in managers' offices, with emphasis on achievements over deficiencies.

MARS may be justifiably criticized as enabling weak sustainability, whereby human capital partially substitutes for natural capital (Hartwick 1978; Solow 1993), as opposed to hard sustainability, whereby firm ecological limits constrain economic growth (Daly 1992; Milne and Gray 2013) (eg by setting carbon budgets for guests and employees to curb scope 3 emissions). However, MARS may also be viewed as step 3 of a 4-step progression. Roberts (2003) characterizes corporate responses to environmental degradation as (1) denial, (2) reputational enhancement, (3) responsible management system change, and (4) transformational business model change. NSAA, via its Climate Challenge and Sustainable Slopes initiatives, has moved resorts from denial to reputational enhancement. MARS attempts to take the next step to move resorts beyond messaging to changing management systems and performance indicators. However, from NSAA's viewpoint, even this third step goes too far, as NSAA continues to view constructive criticism of its Climate Challenge and Sustainable Slopes VEPs reactively and defensively (using Clarkson's 1995 terms), as opposed to accommodatingly and proactively.

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REFERENCES

Akerlof GA. 1970. The market for "lemons": Quality uncertainty and the market mechanism. *Quarterly Journal of Economics* 84:488–500.

Albertini E. 2013. Does environmental management improve financial performance? A meta-analytical review. *Organization and Environment* 26:431–457.

Allur E, Heras-Saizarbitoria I, Boiral O, Testa F. 2018. Quality and environmental management linkage: A review of the literature. *Sustainability* 10:4311.

Alterra Mountain Company, Boyne Resorts, POWDR, Vail Resorts. 2021. *Climate Collaborative Charter.* Denver, CO, Petoskey, MI, Park City, UT, and Broomfield, CO: Alterra Mountain Company, Boyne Resorts, POWDR, Vail Resorts. https://www.alterramtnco.com/assets/Climate-Charter-Pledge.pdf; accessed on 27 October 2021.

Arena B. 2016. Coal barons and ski bums: An unlikely alliance? Exploring potential solutions to waste mine methane. *Colorado Natural Resources Energy & Environmental Law Review* 27(1):44–69.

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ASHRAE [American Society of Heating, Refrigeration and Air-Conditioning Engineers]. 2019. *Achieving Zero Energy: Advanced Energy Design for Small to Medium Office Buildings*. Atlanta, GA: ASHRAE.
Bellier M, Barnig C, Renaudin JM, Sbinne B, Lefebvre F, Qi S, de Blay, F. 2015. Importance of specific inhalation challenge in the diagnosis of occupational asthma induced by quaternary ammonium compounds. *Journal of Allergy and Clinical Immunology: In Practice* 3:819–820.
Berwyn B. 2005. Ski areas' "green" image not backed by action. *High Country News*. 4 April 2005. https://www.hcn.org/issues/295/15403; accessed on 27 October 2021.
Best A. 2019. How to view the purchase of wind power by Vail Resorts. *Mountain Town News*. 5 March 2019. https://mountaintownnews.net/2019/03/05/how-to-view-the-purchase-of-wind-power-by-vail-resorts/; accessed on 27 October 2021.
Bhandari R, Kumar B, Mayer F. 2020. Life cycle greenhouse gas emissions from wind farms in reference to turbine sizes and capacity factors. *Journal of Cleaner Production* 277:123385.
Blumroder JS, Hoffmann MT, Ilina O, Winter S, Hobson PR. Ibisch PL. 2020. Clearcuts and related secondary dieback undermine the ecological effectiveness of FSC certification in a boreal forest. *Ecological Processes* 9:10.
Boiral O, Guillaumie L, Heras-Saizarbitoria I, Tene CVT. 2018. Adoption and outcomes of ISO 14001: A systematic review. *International Journal of Management Reviews* 20:411–432.
Brahney J, Hallerud M, Heim E, Hahnenberger M, Sukumaran S. 2020. Plastic rain in protected areas of the United States. *Science* 368:1257–1260.
Burt JW. 2012. Developing restoration planting mixes for active ski slopes: A multi-site reference community approach. *Environmental Management* 49:636–648.
Burt JW, Clary JJ. 2016. Initial disturbance intensity affects recovery rates and successional divergence on abandoned ski slopes. *Journal of Applied Ecology* 53:607–615.
Burt JW, Rice KJ. 2009. Not all ski slopes are created equal: Disturbance intensity affects ecosystem properties. *Ecological Applications* 19:2242–2253.
Busch T, Friede G. 2018. The robustness of the corporate social and financial performance relation: A second-order meta-analysis. *Corporate Social Responsibility & Environmental Management* 25:583–608.
Caprio E, Chamberlain DE, Isaia M, Rolando A. 2011. Landscape changes caused by high altitude ski pistes affect bird species richness and distribution in the Alps. *Biological Conservation* 144:2958–2967.
Carlson GL, Tupper S. 2020. Ski wax use contributes to environmental contamination by per- and polyfluoroalkyl substances. *Chemosphere* 261:128078.
Chau CK, Leung TM, Ng WY. 2015. A review on life cycle assessment, life cycle energy assessment, and life cycle carbon emissions assessment on buildings. *Applied Energy* 143:395–413.
Clarkson MBE. 1995. A stakeholder framework for analyzing and evaluating corporate social performance. *Academy of Management Review* 20:92–117.
Clarkson PM, Li Y, Richardson GD, Vasvari FP. 2011. Does it really pay to be green? Determinants and consequences of proactive environmental strategies. *Journal of Accounting and Public Policy* 30:122–144.
CMP [Conservation Measures Partnership]. 2020. *Open Standards for the Practice of Conservation*. Version 4.0. Environment. http://conservationstandards.org/wp-content/uploads/sites/3/2020/12/CMP-Open-Standards-for-the-Practice-of-Conservation-v4.0-English.pdf; accessed on 27 October 2021.
Cottier C. 2019. Teton County trash soars, smashing decade-old record. *Jackson Hole News and Guide*. 14 August 2019. https://www.jhnewsandguide.com/news/town_county/teton-county-trash-soars-smashing-decade-old-record/article_13c2a40e-b535-5476-bb04-a902779d2292.html; accessed on 27 October 2021.
Cox KD, Covernton GA, Davies HL, Dower JF, Juanes F, Dudas SE. 2019. Human consumption of microplastics. *Environmental Science & Technology* 53:7068–7074.
Daly HE. 1992. Allocation, distribution, and scale: Towards an economics that is efficient, just, and sustainable. *Ecological Economics* 6:185–193.
Damm A, Koberl J, Prettenthaler F. 2014. Does artificial snow production pay under future climate conditions? A case study for a vulnerable ski area in Austria. *Tourism Management* 43:8–21.
Dawson J, Scott D. 2013. Managing for climate change in the alpine ski sector. *Tourism Management* 35:244–254.
De Jong MDT, Huluba G, Beldad AD. 2020. Different shades of greenwashing: Consumers' reactions to environmental lies, half-lies, and organizations taking credit for following legal obligations. *Journal of Business and Technical Communication* 34:38–76.
Delavaux CS, Smith-Ramesh LM, Kuebbing SE. 2017. Beyond nutrients: A meta-analysis of the diverse effects of arbuscular mycorrhizal fungi on plants and soils. *Ecology* 98:2111–2119.
Deming WE. 2000. *Out of the Crisis*. Reprint (1st edition 1982). Boston, MA: MIT Press.
Devineau O, Shenk TM, White GC, Doherty PF Jr, Lukas PM, Kahn RH. 2010. Evaluating the Canada lynx reintroduction programme in Colorado: Patterns in mortality. *Journal of Applied Ecology* 47:524–531.
Diekel F, Mikosch N, Bach V, Finkbeiner M. 2021. Life cycle based comparison of textile ecolabels. *Sustainability* 13:1–23.
Doerr J. 2018. *Measure What Matters*. New York, NY: Portfolio.
Duglio S, Beltramo R. 2016. Environmental management and sustainable labels in the ski industry: A critical review. *Sustainability* 8:851–864.
EarthCheck. n.d. Certification: Sustainable Destinations. *EarthCheck*. https://earthcheck.org/products-services/certification/sustainable-destinations/; accessed on 27 October 2021.
Eby K. 2021. Six Sigma for Beginners. *Smartsheet*. https://www.smartsheet.com/all-about-six-sigma; accessed on 27 October 2021.
EC [European Commission]. n.d. Eco-Management and Audit Scheme. *Environment*. https://ec.europa.eu/environment/emas/index_en.htm; accessed on 27 October 2021.
Eccles RG, Ioannou I, Serafeim G. 2012. *The Impact of Corporate Sustainability on Organizational Processes and Performance*. Working Paper No. 17950. Cambridge, MA: National Bureau of Economic Research.
Eddy-Miller CA, Sando R, MacDonald MJ, Gerard CE. 2016. *Estimated Nitrogen and Phosphorus Inputs to the Fish Creek Watershed, Teton County, WY, 2009–15*. No. 2016-5160. Reston, VA: United States Geological Survey.
Farrell J. 2020. *Billionaire Wilderness: The Ultra-wealthy and the Remaking of the American West*. Princeton, NJ: Princeton University Press.
Frederick S, Loewenstein G, O'Donoghue T. 2002. Time discounting and time preference: A critical review. *Journal of Economic Literature* 40:351–401.
Geyer R, Jambeck JR, Law KL. 2017. Production, use, and fate of all plastics ever made. *Science Advances* 3:1–5.
Gilaberte-Burdalo M, Lopez-Martin F, Pino-Otin MR, Lopez-Moreno JI. 2014. Impacts of climate change on the ski industry. *Environmental Science and Policy* 44:51–61.
Glick D. 2001. *Powder Burn*. New York, NY: Public Affairs.
Green Globe. n.d. 5 steps to Green Globe certification. *Green Globe*. https://www.greenglobe.com/green-globe-certification; accessed on 27 October 2021.
GRI [Global Reporting Initiative]. n.d. The global standards for sustainability reporting. *GRI*. https://www.globalreporting.org/standards/; accessed on 27 October 2021.
Grunewald T, Wolfsperger F. 2019. Water losses during technical snow production: Results from field experiments. *Frontiers in Earth Science* 7:1–13.
GSTC [Global Sustainable Tourism Council]. n.d. Why become a certified destination? *GSTC*. https://www.gstcouncil.org/certification/become-certified-destination/; accessed on 27 October 2021.
Gupta A, Dash S, Mishra A. 2019. All that glitters is not green: Creating trustworthy ecofriendly services at green hotels. *Tourism Management* 70:155–169.
Halofsky JE, Peterson DL, Harvey BJ. 2020. Changing wildfire, changing forests: The effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecology* 16:4.
Han H. 2015. Travelers' pro-environmental behavior in a green lodging context: Converging value–belief–norm theory and the theory of planned behavior. *Tourism Management* 47:164–177.
Hart SL. 1995. A natural-resource based view of the firm. *Academy of Management Review* 29:986–1014.
Hartwick JM. 1978. Substitution among exhaustible resources and intergenerational equity. *Review of Economic Studies* 45:347–354.
Heras-Saizarbitoria I, Boiral O, Garcia M, Allur E. 2020. Environmental best practice and performance benchmarks among EMAS-certified organizations: An empirical study. *Environmental Impact Assessment Review* 80:1–8.
Hudson S, Miller GA. 2005. The responsible marketing of tourism: The case of Canadian Mountain Holidays. *Tourism Management* 26:133–142.
ISO [International Organization for Standardization]. n.d. ISO 14001:2015. *Store*. https://www.iso.org/standard/60857.html; accessed on 27 October 2021.
Koshmrl M. 2020. Two prized Jackson Hole streams polluted by *E. coli*. *Jackson Hole News and Guide*. 15 January 2020. https://www.jhnewsandguide.com/news/environmental/two-prized-jackson-hole-streams-polluted-by-e-coli/article_eeaf7da2-57ee-5932-a325-3a128e192673.html; accessed on 27 October 2021.
Kumar I, Tyner WD, Sinha KC. 2016. Input–output life cycle environmental assessment of GHG emissions from utility scale wind energy in the United States. *Energy Policy* 89:294–301.
Kuscer K, Dwyer I. 2018. Determinants of sustainability of ski resorts: Do size and altitude matter? *European Sport Management* 19:539–559.
Larson CL, Reed SE, Merenlender AM, Crooks KR. 2016. Effects of recreation on animals revealed as widespread through a global systematic review. *PLoS ONE* 11(12):e0167259.
Lenzen M, Sun YY, Faturay F, Ting Y-P, Geschke A, Malik A. 2018. The carbon footprint of global tourism. *Nature Climate Change* 8:522–528.
Liu K, Wu T, Wang X, Song Z, Zong C, Wei N, Li D. 2019. Consistent transport of terrestrial microplastics to the ocean through atmosphere. *Environmental Science and Technology* 53:10, 612–10, 619.
Lyon TP, Montgomery W. 2015. The means and end of greenwash. *Organization and Environment* 28:223–249.
Marino C, Nucara A, Pietrafesa M. 2017. Does window-to-wall ratio have a significant effect on the energy consumption of buildings? A parametric analysis in Italian climate conditions. *Journal of Building Engineering* 13:169–183.
Matteo N, Rolando A, Barni E, Bocola D, Gianluca F, Freppaz M, Isaia M, Consolata S, Palestrini C. 2013. Differential responses of ground-dwelling arthropods to ski-piste restoration by hydroseeding. *Biodiversity and Conservation* 22:2607–2634.
Mattoni B, Guattari C, Evangelisti L, Biesegna F, Gori P, Asdrubali F. 2018. Critical review and methodological approach to evaluate the differences among international green building rating tools. *Renewable and Sustainable Energy Reviews* 82:950–960.

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Maynard DC, Zandonadi RP, Nakano EY, Botelho RBA. 2020. Sustainability indicators in restaurants: The development of a checklist. *Sustainability* 12(10):4076.
Merli R, Preziosi M, Acampora A, Ali F. 2019. Why should hotels go green? Insights from guest experience in green hotels. *International Journal of Hospitality Management* 81:169–179.
Mills-Scofield D. 2012. It's not just semantics: Managing outputs vs. outcomes. *Harvard Business Review*. 26 November 2012. https://hbr.org/2012/11/its-not-just-semantics-managing-outcomes; accessed 27 October 2021.
Milne MJ, Gray R. 2013. W(h)ither ecology? The triple bottom line, the global reporting initiative, and corporate sustainability reporting. *Journal of Business Ethics* 118:13–29.
Molina-Azorin JF, Tari JJ, Pereira-Moliner J, Lopez-Gamero MD, Pertusa-Ortega EM. 2015. The effects of quality and environmental management on competitive advantage: A mixed methods study in the hotel industry. *Tourism Management* 50:41–54.
Moreno-Gene J, Sanchez-Pulido L, Cristobal-Fransi E, Daries N. 2018. The economic sustainability of snow tourism: The case of ski resorts in Austria, France, and Italy. *Sustainability* 10(9):3012.
Morgans CL, Meijaard E, Santika T, Law E, Budiharta S, Ancrenaz M, Wilson KA. 2018. Evaluating the effectiveness of palm oil certification in delivering multiple sustainability objectives. *Environmental Research Letters* 13(6):064032.
Naeher LP, Brauer M, Lipsett M, Zelikoff JT, Simpson CD, Koenig JQ, Smith KR. 2007. Woodsmoke health effects: A review. *Inhalation Toxicology* 19:67–106.
Napper IE, Thompson RC. 2019. Environmental deterioration of biodegradable, oxo-biodegradable, compostable, and conventional plastic carrier bags in the sea, soil, and open air over a 3-year period. *Environmental Science and Technology* 53:4775–4783.
Needham MD, Little CM. 2013. Voluntary environmental programs at an alpine ski area: Visitor perceptions, attachment, value orientations, and specialization. *Tourism Management* 35:70–81.
NSAA [National Ski Areas Association]. n.d a. Climate Challenge. *Sustainability*. https://www.nsaa.org/NSAA/Sustainability/Climate_Challenge.aspx; accessed on 27 October 2021.
NSAA [National Ski Areas Association]. n.d b. Sustainable Slopes: The sustainability framework for ski areas. *Sustainability*. https://www.nsaa.org/NSAA/Sustainability/Sustainable_Slopes/NSAA/Sustainability; accessed on 27 October 2021.
Oliver RL. 2010. *Satisfaction: A Behavioral Perspective on the Consumer*. 2nd edition (1st edition 1997). Boca Raton, FL: Routledge.
Oreg S. 2003. Resistance to change: Developing an individual differences measure. *Journal of Applied Psychology* 88:680–693.
Oreg S, Vakola M, Armenakis A. 2011. Change recipients' reactions to organizational change: A 60-year review of quantitative studies. *Journal of Applied Behavioral Science* 47:461–524.
Pasqualino J, Meneses M, Castells F. 2011. The carbon footprint and energy consumption of beverage packaging selection and disposal. *Journal of Food Engineering* 103:357–365.
Peers M.L, Wehtje M, Thornton DH, Murray DL. 2014. Prey switching as a means of enhancing persistence in predators at the trailing southern edge. *Global Change Biology* 20:1126–1135.
Polimeni JM, Mayumi K, Giampietro M, Alcott B. 2008. *The Jevons Paradox and the Myth of Resource Efficiency Improvements*. London, United Kingdom: Earthscan.
Porter ME, van der Linde C. 1995. Green and competitive: Ending the stalemate. *Harvard Business Review* 73:120–134.
Prats SA, Malvar MC, Vieira DCS, MacDonald L, Keizer JJ. 2013. Effectiveness of hydro-mulching to reduce runoff and erosion in a recently burnt pine plantation in central Portugal. *Land Degradation and Development* 27:1319–1333.
Ranganathan J, Corbier L, Bhatia P, Schmitz S, Gage P, Oren K. 2004. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*. Revised edition (1st edition 2001). Washington, DC: World Resources Institute.
Reichheld FF. 2011. *The Ultimate Question 2.0: How Net Promoter Companies Thrive in a Customer-Driven World*. Revised and expanded edition (1st edition 2006). Cambridge, MA: Harvard Business Review Press.
Rivera J, De Leon P, Koerber C. 2006. Is greener whiter yet? The Sustainable Slopes program after five years. *Policy Studies Journal* 34:195–221.
Roberts J. 2003. The manufacture of corporate social responsibility: Constructing corporate sensibility. *Organization* 10:249–265.
Röckstrom J, Steffen W, Noone K, Persson A, Chapin F, Lambin E, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ, et al. 2009. A safe operating space for humanity. *Nature* 461:472–475.
Roux-Fouillet P, Wipf S, Rixen C. 2011. Long-term impacts of ski piste management on alpine vegetation and soils. *Journal of Applied Ecology* 48:906–915.
Rutty M, Scott D, Johnson P, Pons M, Steiger R, Vilella M. 2017. Using ski industry response to climatic variability to assess climate change risk: An analogue study in Eastern Canada. *Tourism Management* 58:196–204.
Sartor M, Orzes G, Touboulic A, Culot G, Nassimbeni G. 2019. ISO 14001 standard: Literature review and theory-based research agenda. *Quality Management Journal* 26:32–64.
SASB [Sustainability Accounting Standards Board]. 2020. *Proposed Changes to the SASB Conceptual Framework & Rules of Procedure: Bases for Conclusions & Invitation to Comment on Exposure Drafts*. San Francisco, CA: SASB. https://www.sasb.org/standards/conceptual-framework/; accessed on 27 October 2021.
Sato CF, Wood JT, Schroder M, Michael DR, Osborne WS, Green K, Lindenmayer DB. 2014. Designing for conservation outcomes: The value of remnant habitat for reptiles on ski runs in subalpine landscapes. *Landscape Ecology* 29:1225–1236.
Sato S, Ko YJ, Kellison TB, Harada M, Bizen Y. 2017. Do snow-based sport participants intend to purchase products from environmentally friendly companies? *Journal of Global Sport Management* 2:(3)182–195.
Schendler A. 2021. Opinion guest essay: Worrying about your carbon footprint is exactly what big oil wants you to do. *New York Times*. 31 August 2021. https://www.nytimes.com/2021/08/31/opinion/climate-change-carbon-neutral.html; accessed on 27 October 2021.
SERI [Sustainable Electronics Recycling International]. n.d. Find R2 certified facilities. *SERI*. https://sustainableelectronics.org/find-an-r2-certified-facility/; accessed on 27 October 2021.
Slaughter RJ, Watts M, Vale JA, Grieve JR, Schep LJ. 2019. The clinical toxicology of sodium hypochlorite. *Clinical Toxicology* 57:303–311.
SMI Snow Makers [Snow Machines, Inc]. n.d. Snowmaking basics. *SMI Snow Makers*. https://www.snowmakers.com/snowmaking-basic.html; accessed on 27 October 2021.
Solow R. 1993. An almost practical step toward sustainability. *Resources Policy* 19:162–172.
Spence M. 2002. Signaling in retrospect and the informational structure of markets. *American Economic Review* 92:434–459.
Steelman TA, Rivera JE. 2011. Voluntary environmental programs in the United States: Whose interests are served? *Organization and Environment* 19:505–526.
Steffen W, Richardson K, Röckstrom J, Cornell S, Fetzer I, Bennett E, Briggs R, Carpenter SR, de Vries W, de Wit CA, et al. 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347:736.
Sull D, Sull C. 2018. *With Goals, FAST beats SMART*. Reprint 59432. Boston, MA: MIT Sloan Management Review.
Vail Resorts. n.d. *EpicPromise Commitment to Zero*. http://www.epicpromise.com/environment/commitment-to-zero/; accessed on 18 November 2021.
Varma CRS, Palaniappan S. 2019. Comparison of green building rating schemes used in Asia, Europe and North America. *Habitat International* 89:1–13.
Walker K, Wan F. 2012. The harm of symbolic actions and greenwashing: Corporate actions and communications on environmental performance and their financial implications. *Journal of Business Ethics* 109:227–242.
Wang X, Wu N, Qiao Y, Song Q. 2018. Assessment of energy-saving practices of the hospitality industry in Macau. *Sustainability* 10:1–14.
Weiss HA, Bierman PR, Dubief Y, Hamshaw S. 2019. Optimization of over-summer snow storage at mid-latitude and low elevation. *Cryosphere* 13:3367–3382.
Willard B. 2012. *The New Sustainability Advantage: Seven Business Case Benefits of a Triple Bottom Line*. Gabriola Island, Canada: New Society Publishers.
Williams P, Gill A, Ponsford I. 2007. Corporate social responsibility at tourism destinations: Toward a social license to operate. *Tourism Review International* 11:133–144.
Williams PW, Todd SE. 1997. Towards an environmental management system for ski areas. *Mountain Research and Development* 17:75–90.
Wortman D. 2014. The dollars & sense of sustainability. *National Ski Areas Association Journal* Winter:16–21.
WRI [World Resources Institute]. n.d. *Aqueduct Water Risk Atlas*. Washington, DC: WRI. https://www.wri.org/applications/aqueduct/water-risk-atlas; accessed on 27 October 2021.
Wright PR. 2013. *Hydrogeology and Water Quality in the Snake River Alluvial Aquifer at Jackson Hole Airport, Jackson, WY, Scientific Investigations Report 2013-5184*. Reston, VA: United States Geological Survey.
Yokessa M, Marette S. 2019. A review of eco-labels and their economic impact. *International Review of Environmental and Resource Economics* 13:119–163.
Zobel T. 2016. The impact of ISO 14001 on corporate environmental performance: A study of Swedish manufacturing firms. *Journal of Environmental Planning and Management* 59:587–606.
Zobel T, Malmgren C. 2016. Evaluating the management system approach for industrial energy efficiency improvements. *Energies* 9(10):774.

Supplemental material

TABLE S1 MARS mitigation indicators organized by alpine resort department.

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