Ski resorts are increasingly reliant on snowmaking. But at what cost?

As the climate changes, mountains and nordic facilities have begun relying more on energy and water-intensive machine-made snow.

Gregory Rec/Portland Press Herald via Getty Images

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Published	Feb 26, 2026
Topic	Climate + Energy
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This winter's snow cover is the lowest on record in the Western United States. While that could cause a torrent of trouble come spring — more wildfires, less water for farms and fish — at the moment, there's one thing on many Westerners' minds: skiing.

In Colorado, less than a third of Arapahoe Basin's runs are open. In Washington, Mt. Baker Ski Area canceled an annual snowboard race "due to an unworkable snowpack." In Oregon, Hoodoo Ski Area and Mt. Ashland Ski Area temporarily closed for weeks due to lack of snowfall, while college ski championships were moved from Montana to Utah.

What's a ski resort to do? Make snow, presumably, though details about resorts' snowmaking are scant. Alterra and POWDR, two major ski resort conglomerates, didn't respond to questions. Vail Resorts, which owns and operates 42 ski areas across the globe, said that while the company doesn't share specific snowmaking data, "weather conditions, particularly temperature, influence how much and how long we make snow."

Despite the dismal conditions, Steven Fassnacht, a professor of snow hydrology at Colorado State University, said that it would be difficult for Western resorts to ramp up snowmaking in a major way. Doing so would require resorts to purchase additional water rights, an expensive and complex legal process.

Historically, ski resorts in the West have relied on snowmaking much less than those in other parts of the country. Fewer than 10 percent of the region's skiable acres, on average, are covered by man-made snow, compared to more than 50 percent in the Northeast and around 80 percent in the Southeast and Midwest.

But as climate change makes winters increasingly warm and unpredictable, snowmaking is likely to become more important in the region, bringing with it environmental consequences and other challenges.

of ice on a single run. It only lasted about two weeks, but it gave a group of engineers — and failed ski entrepreneurs — an idea. "Outside their defunct ski factory, they connected a 10-horsepower compressor by garden hose to a spray-gun nozzle that they'd been using to paint skis," wrote John Fry, a ski historian.

Today, snowmaking's core technology remains the same: spraying highly pressurized water into the air, where it freezes. Energy and water use are the main environmental concerns, although the potential impacts range from soil degradation to chemical exposure. There's also Indigenous opposition that generally focuses on the desecration of sacred places by wastewater.

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Lots of energy is necessary to push water uphill and pressurize air. One study of 10 ski areas across the country estimated that snowmaking accounts for 18 percent of a resort's energy use on average.

snowmaking annually, enough to cover about 60 acres of terrain in 1.5 feet of snow," according to the San Francisco Chronicle.

Although 70 million gallons is nothing to sneeze at — it's what 50 American families might use in a year — Fassnacht emphasized that an estimated 80 percent of the water used for snowmaking returns to streams and rivers. The remainder is lost to evaporation.

While that water comes from the same supply used by cities and farms, the demand is at a different time of year, Fassnacht said. Ski resorts typically make snow in the late fall and early winter, and agricultural and municipal needs don't ratchet up until the late spring and summer. And if there ever weren't enough water available, ski resorts are junior rights holders, meaning they would have to get in line behind those with senior water rights. In Colorado, snowmaking accounts for an estimated .05 percent of the state's annual water consumption, whereas agriculture accounts for about 85 percent.

Still, machine-made snow differs from natural snow in an important way: It does not contribute to the regions' water supply at scale. According to researchers at the University of California, Berkeley, 75 percent of the water Westerners depend on comes from mountain snowpack, so even if snowmaking helps snow-hungry skiers, it doesn't make up for dry winters where the water's really needed.

People ski and snowboard at Bear Mountain Ski Resort in December in Big Bear, California. ***Eric Thayer / Los Angeles Times via Getty Images***

"Snowmaking should be considered a temporary storage on the mountain, instead of in a reservoir," Fassnacht said. "The water is not really taken out of the system, just stored somewhere else. It does not replace snow that falls from the sky."

Fassnacht's biggest concern about snowmaking is its timing — when the resorts decide to take water from streams. If the water is taken at times of low flow, he said, it could have a detrimental impact on aquatic life.

treated wastewater. While one conservation group called the practice “a win-win for the health of our rivers and the resort economy,” it can be controversial.

Flagstaff’s ski area, for example, began using wastewater to create machine-made snow in 2013, spraying sewage on a mountain that is sacred to local Indigenous people and members of 13 Native American tribes. The practice — and the protests — continue to this day.

Overall, snowmaking can be seen as an adaptation to climate change, but researchers wonder if it is actually a maladaptation — one that contributes to worsening climate change.

The authors of a 2022 paper in the Journal of Sustainable Tourism concluded that snowmaking’s environmental impacts depend greatly upon a resort’s location. In areas with relatively clean electric grids and high water security, such as Washington, snowmaking has much less of an impact than in states like New Mexico, Colorado, Nevada and Wyoming, where electric grids are more carbon-intensive and water stresses are higher. Although most of those states have plans to decarbonize their grids in the next few decades, water scarcity is projected to increase over that period, too.

The researchers also said that snowmaking’s impact on travel can’t be ignored. On average, they found that skiers have to drive just 36 miles before they emit more carbon dioxide in transit than they do at a ski area. So if snowmaking encourages skiers to stick

In any case, the prognosis for skiing, especially in coastal states and at low elevations, is grim.

"There's a level to which, to put it bluntly, the ski industry is screwed," said Jesse Ritner, an assistant professor of history at Georgia College & State University, who is writing a book on snowmaking. "That said, snowmaking is only going to become more and more important."

The industry sees the writing on the wall. In 2019, Vail Ski Resort bought 421 new snow guns for its mountain in Colorado, a move the resort called the "largest snowmaking expansion in North American history." Other resorts, like Bogus Basin in Idaho, are turning to snowfarming, the practice of collecting and storing snow for the following winter.

But even efforts like these can't completely shield companies from bad winters: Earlier this year, Vail Resorts told investors that dismal snowfall in Western states had led to a 20 percent decrease in visitation across its North American properties.

Snowfarming operations at Bogus Basin, Idaho. Last year, the ski resort covered snow in insulation over the summer. ***Courtesy of Bogus Basin Mountain Recreation Area***

"Bad years were a real rarity, now they're becoming more common," said Michael Pidwirny, an associate professor at the University of British Columbia who studies climate change and skiing. "They're going to even increase more in the future, and if it's too warm, how do you make snow?"

Snowmaking only works when it's cold enough: The "wet bulb temperature," a combination of humidity and air temperature, must be below 28 degrees.

situation where one out of two years are really too poor to support good skiing in about 2050 (or) 2060."

The resorts will just have to adapt, Pidwirny said. "And the way that they'll adapt is they'll recognize that it's not guaranteed that they're going to have a ski season every year."

Perhaps not even snowmaking can change that.

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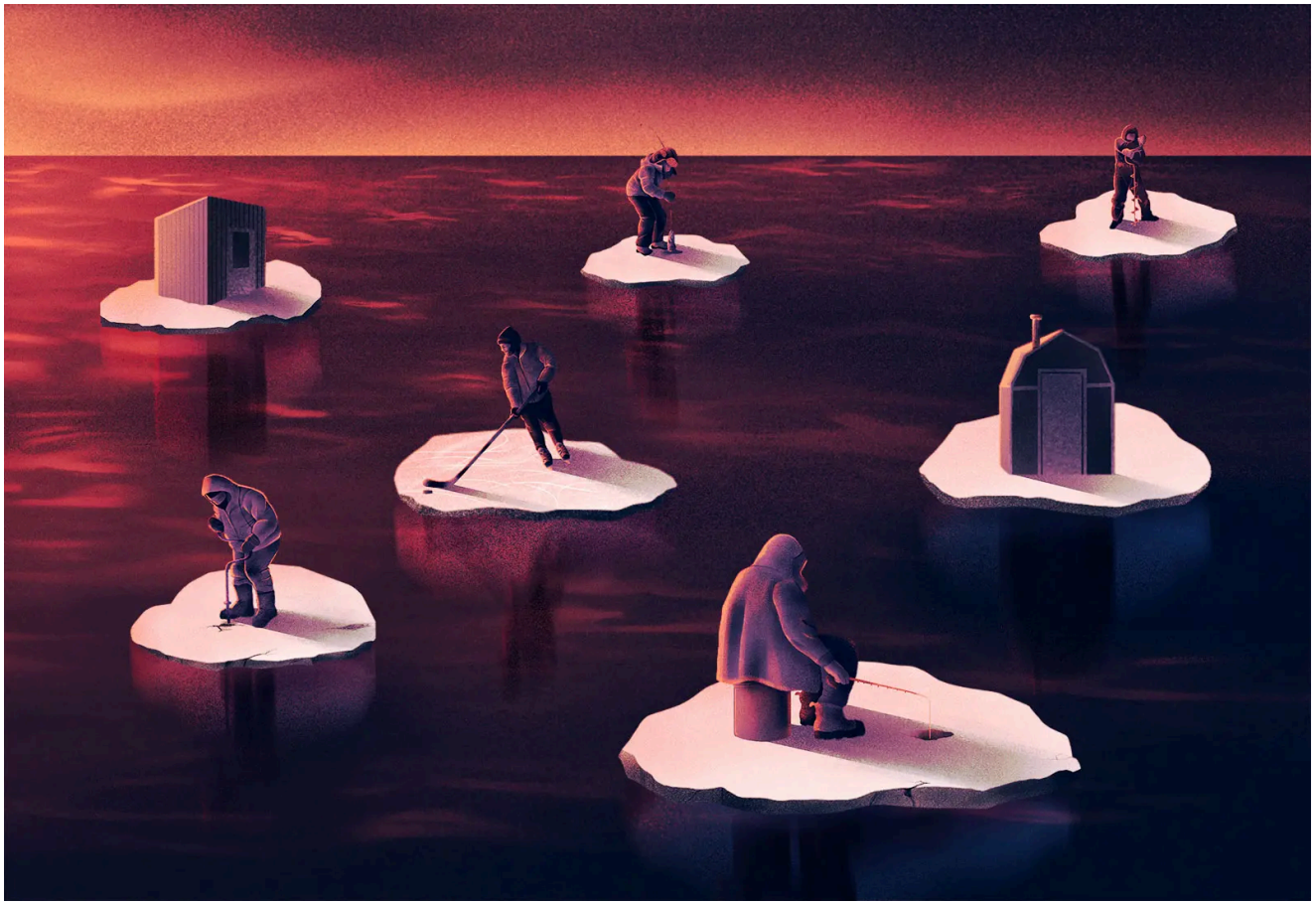

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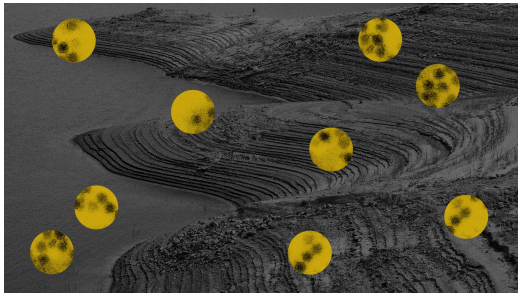

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