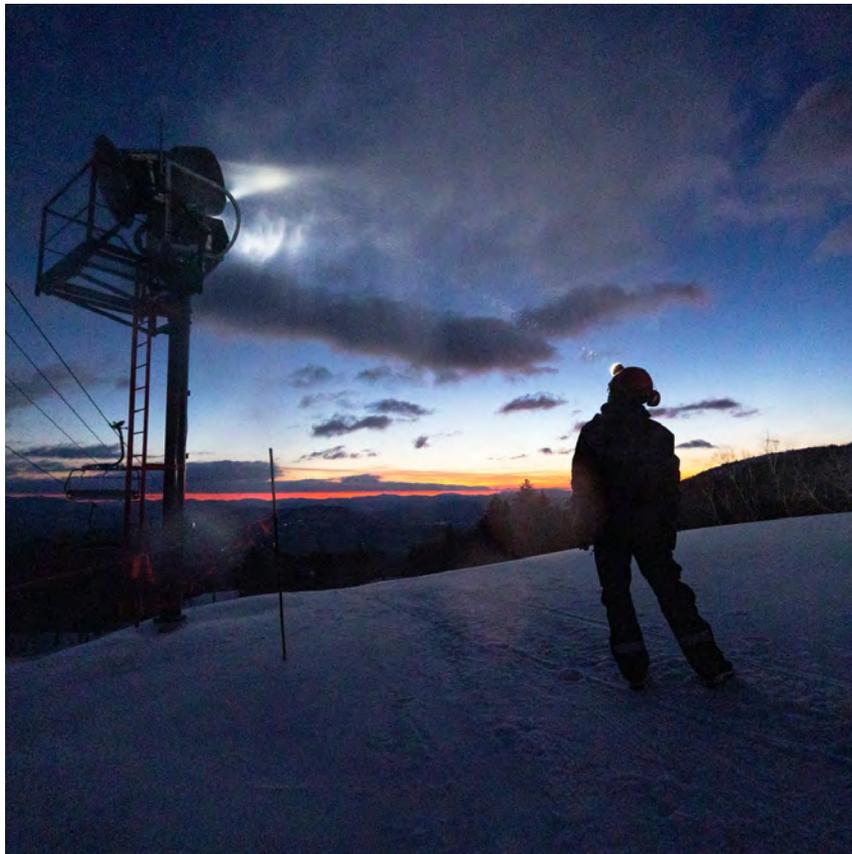


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Ski Resorts Are Spending Big on Snow-Making to Keep Ahead of Climate Change

New technology and automation allow snowmakers to combat warmer and wetter winters



Snow-making supervisor Ian McCluskey inspects an automated snow gun as the sun rises at Sunday River Resort in Maine.

By [Eric Niiler](#) | Photographs and Video by Joe Klementovich for The Wall Street Journal
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NEWRY, Maine— An hour before dawn, Ian McCluskey adjusts his goggles and plunges the sleeve of his jacket into a spray of ice crystals arcing out of a nearby fan-shaped snow-making machine.

Mr. McCluskey is testing the quality of machine-made snow—as the spray settles on his sleeve “you can tell whether you are getting wetter snowball snow, or something that is very dry and good for resurfacing a trail,” shouts Mr. McCluskey, a 28-year-old snow-making supervisor at Sunday River Resort in western Maine. On this night, the machine-made snow is clumpy and won’t spread evenly. The air is too warm and humid to run this brand-new automated snow-making machine, or snow gun, for more than a few minutes.

As [winters have become warmer](#) across the U.S. and natural snowfall has become more scarce, resorts such as Sunday River are investing in automated snow-making technology to keep the trails open. Even with newer technology, some ski areas along the East Coast have a tough time operating snow-making equipment, as record warm nights and rainy days this season make for unfit operating conditions.

Snowmakers hike downhill to connect mobile snow guns to air and water hoses on a steep trail at Sunday River.

The ideal temperature for this device is 26 degrees Fahrenheit, but the thermometer is already climbing toward 30 degrees. “It has been marginal,” Mr. McCluskey said about the winter season. “We really have to hammer on the guns whenever we have the temps and get them on when we can.”

It isn’t just the Northeast. The Western U.S. and the Rocky Mountains have seen a [23% decline in annual snowpack](#) between 1955 and 2022, according to the U.S.

Environmental Protection Agency, while the length of the snowpack season decreased by about 18 days since 1981, forcing Western resorts to embrace snow-making as well.

At the same time, a lack of natural snow has pushed [European ski resorts](#) to move trails to higher elevations and switch to summer sports such as mountain biking, while an Italian firm has developed a device that can make snow at nearly 70 degrees, albeit using a lot of electricity.

For now, the \$4.6 billion U.S. winter-resort industry continues to grow, buoyed by increasing sales of multi-resort season passes and overall annual revenue growth of 5.5% since 2018, according to IBISWorld, a Los Angeles-based consulting firm. The cost of upgrading snow-making equipment to devices that make more snow with less energy is passed on to consumers. Daily lift tickets can top \$250 at some larger resorts.

Some industry representatives warn that the future of skiing and snowboarding is at risk from a warming climate.

“Technology is getting better and better,” said Nick Sargent, president of Snowsports Industries America, a Park City, Utah-based trade association. “But climate change is the biggest threat to this industry and will be for the foreseeable future.”

In Maine, Mr. McCluskey and his crew work the night shift to keep the flow of compressed air and water moving through the resort’s network of 2,000 snow guns spread across 870 acres of trails. Air and water are mixed into each snow gun, forced through tiny nozzles and injected into the cold night air to form a layer of snow on the trails below.

This summer Sunday River will install additional high-efficiency snow guns, higher-capacity water pipes and a bigger pump station that will allow the resort to make more snow in a shorter amount of time, according to Brendan Ryan, vice president of snow-surface management and design at Boyne Resorts, a Michigan-based firm that owns Sunday River and nine other ski areas. The resort wants to cover the trails quickly, especially during the early season.

“If we can design systems to have as close to 100% of our terrain open at Christmas, that is a ton of insurance,” Mr. Ryan said. “The more we can open our terrain, it allows our guests to book with confidence.”

That confidence has been tested this winter. Maine and six other Northeastern states experienced their warmest January since record-keeping began in 1895, while New York and Pennsylvania had their second-warmest January on record, according to the National Oceanic and Atmospheric Administration. In the first three weeks of February, the entire Northeast region averaged 6 to 15 degrees above normal, according to NOAA figures.

The average annual temperature in Maine has risen almost 3.5 degrees since the beginning of the 20th century. Since the mid-1990s, [average winter temperatures](#) have increased about twice as fast as average summer temperatures, according to NOAA’s National Centers for Environmental Information.

This abnormally warm winter is closer to what the Northeast might experience each year toward the end of the century, according to Elizabeth Burakowski, research assistant professor at the University of New Hampshire’s Earth Systems Research Center. She bases her estimates on a group of 29 climate models known as the Localized Constructed Analogs data set, also published in the Fourth National Climate Assessment, a congressionally mandated report by the [U.S. Global Change Research Program](#).

“By the end of the century, the snow-making days on average across the Northeastern United States will be cut in half if we don’t act on climate,” said Dr. Burakowski. “If we do act on climate, and work to reduce the emissions of greenhouse gases, it is only a 25% decline in snow-making days.”

Resorts that are farther north and at higher altitude will fare better, Dr. Burakowski said.

Resorts in the mid-Atlantic region farther south are already feeling the heat. Some of Pennsylvania's 26 ski resorts have canceled youth ski races and are wondering if they will be able to keep trails operating into early March.

"Something is changing, and we as the industry have to react to it," said Nick Delich, mountain operations director at Blue Mountain Resort in northeastern Pennsylvania.

Mr. Delich has kept Blue Mountain trails open using a new automated software program that allows him to remotely control several hundred snow guns, each with its own built-in weather station. That means less startup time to pump water from a reservoir up the mountain to each snow gun.

"If you had a manual system, it would take an hour or two," Mr. Delich said. "I can have this system ready to make snow in 20 minutes."

Tractor-like machines that groom ski trails are now outfitted with ground-penetrating radar that can tell the driver how deep the snow is on each trail. That data feeds into the resort's snow-making platform and determines which guns should be running. Investments in snow-making and automation have cut labor costs, reducing the number of seasonal snowmakers at Blue Mountain from 10 workers to five over the past decade, Mr. Delich said.

At Sunday River, automation has cut the number of snowmakers from 35 a night two decades ago, to around 13 per night currently, according to Brian Heon, the resort's general manager.

The resort has also cut its snow-making energy consumption by 60%, downsizing from nine massive air compressor stations, each using one megawatt of electricity, to four. Sunday River plans to install new equipment each year through 2030, Mr. Heon said.

"The first thing you are going to see every year is snow-making upgrades," Mr. Heon said. "We will never be done making snow."