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The economic aspects of artificial snow production in the perspective of climate change

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Snowmaking is now used by ski resorts worldwide as a measure to cope with both natural snow reduction and variability. This extensive recourse casts doubt on its sustainability mainly because of the large amount of natural resources being used (energy, water). In the middle to long run, this problem is expected to increase with future climate change triggering the production of more snow. The research field that focuses on the economic aspects of artificial snow production is still in its infancy but potentially covers a wide array of issues. Among these issues, benefits and costs of snowmaking are important ones. On the one hand, benefits arise as snowmaking extends or preserves the operating period of ski areas. Several empirical studies speculate or show that snowmaking considerably reduces the sensitivity of tourism consumption to variations in snow conditions. These benefits have long been neglected in studies analyzing the consequences of climate change for the winter tourism sector. While failing to introduce these benefits, many studies have generated overly high costs of climate change. On the other hand, investments and operating costs of artificial snow production depend upon several factors, such as technology and local conditions. Consequently, costs vary considerably from one location to another and over time, yet indicative values can be found in the literature. In addition, artificial snow production generates external costs, i.e. costs that are not born by those producing it. Typical of these external costs are environmental ones that are related to CO_2 emissions or biodiversity losses. To our knowledge, very little has been done so far to integrate these costs in economic studies. To the extent that vertical integration is absent, it may happen as well that snow production generates important external benefits for different stakeholders at a given ski resort. From an economic point of view, both types of externalities could lead to investment levels that are not optimal in the sense that they do not maximize social welfare. More generally, economic analysis has the potential to explain current investment and snow production levels and to determine optimal ones. It can also predict the evolution of these levels under a warmer climate. For instance, such predictions were carried out for Switzerland as well as for other Alpine countries using a computable general equilibrium model of the world economy with a time horizon up to 2050, the GEMINI-E3 model. With all these points in mind, this presentation aims at reviewing what has been done so far on the economic aspects of artificial snow production and also at identifying avenues for future research.