Measures for Electricity Reduction in Ice Rinks: Economic and Ecological Impacts

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Management Summary Problem Statement and Research Objective

The central focus of this research is the question of how ice rinks can effectively reduce their electricity consumption and greenhouse gas emissions, and what impact this has on economic aspects. With challenges such as rising temperatures and increasing energy prices, the pressure to act sustainably is increasing. Therefore, it becomes increasingly relevant for owners and operators of ice rinks to find and implement efficient and environmentally friendly solutions. The primary goal of this work is to identify scientifically grounded measures that are beneficial both ecologically and economically.

Relevance of the Research The necessity to reduce energy consumption and environmental impact in ice rinks is essential from various perspectives. Ice rinks are complex facilities with high energy consumption, the operating costs of which can be significantly reduced through energy-efficient measures. Additionally, such measures contribute to achieving climate goals.

Theoretical Framework and Methodological Approach The work was based on current scientific knowledge and research in the areas of energy efficiency and renewable energy. Four key areas were identified as crucial for sustainability in ice rinks: natural refrigerants, heat recovery, energy efficiency, and the use of renewable energy. Furthermore, the factors influencing the energy consumption of an ice rink were identified and subjected to detailed analysis.

The applied methodology combined theoretical exploration with a practical case study. This approach allowed for comparing and validating the theoretically developed fundamentals with the actual conditions and challenges of a real ice rink.

The Grüsch ice rink was subjected to an in-depth analysis as part of the case study to evaluate its existing infrastructure. The evaluation of the facilities contributed to the identification of optimization measures aimed at increasing efficiency and enabling the integration of renewable energies.

Results and Conclusions The research results confirmed the high relevance and practicality of the concepts and recommendations developed in the theoretical framework. It became clear that although initial investments in sustainable measures are often high, they offer long-term economic and environmentally friendly benefits and can significantly reduce energy

consumption. However, due to the individuality of each ice rink, presenting generalizable solutions proves challenging. Integrating another ice rink as a case study could potentially present different measures.

However, this work highlights that amidst the climate crisis, economic challenges, and the importance of sustainable development in the 21st century, ice rinks can leverage both environmental and financial opportunities. The implementation of the presented measures is not only essential for sustainability reasons but also represents an investment in the future of the facility by enabling long-term cost savings.

Furthermore, sustainable operation provides operators with the opportunity to act as role models in their industry and encourage other sports facilities to implement sustainable measures.

Given the urgent challenges and the potential for improvement resulting from the proposed measures, ice rink operators should consider these insights as a call to implement the recommended action points. Only through proactive and innovative approaches can it be ensured that ice rinks can be operated successfully and sustainably both today and in the future.

Conclusions

At the heart of this bachelor thesis was the question of how ice rinks can reduce their electricity consumption and ecological footprint and what economic impacts these actions have. After thorough investigation, four key areas were identified that contribute to the sustainability of ice rinks: the use of natural refrigerants, heat recovery, energy efficiency, and the generation of renewable energies.

The theoretical foundations developed during the work were largely confirmed in the practical implementation of the case study. This demonstrates the relevance of this scientific work and the practicality of the concepts and recommendations developed. The application of the case study methodology proved to be highly suitable in this regard.

Although the initial investments for sustainable measures are often high, the results and discussion section indicate that they offer long-term economic benefits. By reducing energy consumption, operating costs are reduced in the medium term, emphasizing the economic viability of the measures. Furthermore, such measures contribute to achieving climate goals and reducing the ecological footprint.

In summary, it can be stated that ice rinks can significantly reduce their electricity consumption and ecological footprint by implementing energy-efficient technologies and using renewable energies. In doing so, they can save considerable costs in the long term, highlighting the economic viability of these measures. Therefore, ice rinks, governments, and other stakeholders should consider promoting and supporting these measures to reap the ecological and economic benefits.

Critical Reflection

While this thesis addressed a fundamental question regarding the energy efficiency and ecology of ice rinks and provided valuable insights, there are some aspects that need critical reflection.

Firstly, there is a focus on technology. Innovative technologies such as improved cooling systems or renewable energy sources undoubtedly offer undeniable benefits. However, there are also clear limits to their effectiveness and universal applicability. Not every ice rink is positioned in a geographic location where the use of a PV system or a specific system is equally effective, and not all operators have the financial resources for expensive technology upgrades. It would therefore be appropriate to explore alternative and cost-effective solutions for such scenarios. Furthermore, each ice rink will have a base consumption that can hardly be undercut due to factors such as outdoor temperature or the power of the machines. Savings through continuous optimization measures of the infrastructure thus decrease over time, which in turn affects the economic viability and profitability of the investment.

Furthermore, the optimization measures implemented cannot be generalized. The circumstances and distribution of energy consumption as well as the ecological footprint of each ice rink must be individually analyzed before specific measures can be defined.

Finally, there is a lack of in-depth analysis of the human factor. How are maintenance work on the systems carried out in practice? How important is it for the employees to constantly monitor the systems to ensure that they are operated at the optimal energy consumption level? Perhaps the social aspect was underestimated in this work.

Outlook

The future of energy efficiency and ecological awareness in ice rinks looks promising. Given the global climate crisis and increasing public awareness of environmental issues, the sector is expected to continue to move towards greener technologies and practices.

It would be interesting for future studies to examine more closely the role of politics and regulation. What kind of incentives or regulations could governments introduce to accelerate the transition to more environmentally friendly ice rinks?

Furthermore, future research could expand the focus and concentrate on the integration of ice rinks into local communities. For example, how could ice rinks serve as energy producers for their surroundings, or how could they collaborate with other local facilities to achieve synergies in terms of energy efficiency?

In conclusion, this thesis provides a solid starting point for further research. With advancing technological progress and growing awareness of the importance of sustainability, it is hoped that ice rinks will become pioneers in energy efficiency and environmental protection.

Recommendations for Action

Within the scope of this bachelor thesis, recommendations for the implementation of immediate measures during the transitional period, to increase energy efficiency and reduce environmental impact in the treated ice rink, are developed. The recommendations clarify which measures should be taken by whom and are based on solid evidence demonstrating that they will effectively address the present problem.

Implementation of Immediate Measures

It is important to implement immediate measures to adjust the ice thickness, ice temperature, and operating times of the ventilation/dehumidification in the ice rink. Operators and the ice

master should jointly be responsible for monitoring and adjusting the optimal ice thickness and temperature based on external environmental factors. Additionally, the operating times of the ventilation and dehumidification systems should be controlled to operate only when necessary. This recommendation is supported by studies showing that targeted adjustment of these parameters can lead to energy savings without compromising ice quality.

Switching the Power Mix

It is strongly recommended to switch the power mix for operating the ice rink to renewable energy sources. Operators should engage with local energy providers to aim for a switch to the basic supply. This measure will not only reduce costs but also significantly decrease greenhouse gas emissions and environmental impact. The results indicate that transitioning to the basic supply or to renewable energies is an environmentally friendly and economically viable option.

Replacement of the Existing Refrigeration Machine

It is strongly recommended to replace the existing refrigeration machine in the ice rink with a CO2 refrigeration machine with integrated heat recovery. It should be noted that the funding under the "Green Deal" action plan will only be doubled until the end of 2024. The introduction of this technology should be done in close collaboration with energy experts and manufacturers. Studies show that CO2 refrigeration machines have high energy efficiency and represent a sustainable solution to reduce energy consumption while recovering heat for the ice rink's own use.

Utilization of Renewable Energy Sources and Synergies

It is advisable to consider renewable energy sources such as a photovoltaic system and to utilize synergies to make efficient use of the generated waste heat. This requires close collaboration between ice rink operators and energy experts. The installation of a photovoltaic system enables the use of clean energy and can also provide some of the energy for the refrigeration machine. Furthermore, the possibility should be explored to deliver the generated waste heat to other energy-intensive buildings or sports facilities in close proximity. Studies show that the combination of renewable energy sources and efficient use of waste heat can lead to increased yields or savings, thereby reducing overall environmental impact.

These recommendations offer concrete action steps to improve the energy efficiency of ice rinks and reduce environmental impact. Through collaboration between operators, technicians, and energy experts, the proposed measures can be successfully implemented, making a positive contribution to the sustainability and cost efficiency of the ice rink.

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