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# Feasibility Study on the Utilization of Sea Water Resources for Green Olympic Blue Ice rink

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## ABSTRACT

This paper discusses the feasibility of employing seawater-based initiatives to save fossil fuel energy and reduce carbon dioxide emissions in one of venues – "Green Olympic Blue Ice (GOBI) rink"- of the 2018 Winter Olympics. Seawater will be employed to freeze the ice rink and provide air-conditioning. Seawater–based conditioning systems will save more than 60% of the required energy and 84% of the energy costs; further $CO_2$ emissions will be reduced by approximately 69%. Geo-ocean thermal energy conversion can be used to supply the required electric power, and zero carbon emissions can also be realized by creating underwater seaweed forests.

KEY WORDS: Ocean thermal energy conversion (OTEC), Sea water air conditioning (SWAC), Heat pump, Green Olympic blue ice (GOBI) rink

## INTRODUCTION

The 2018 Winter Olympics in Pyeongchang, South Korea, has been advocated as a "green" Olympics that will endeavor to reduce fossil energy usage, to promote renewable energy development and utilization, and to decrease carbon dioxide uptake. In general, to establish the low-carbon and environment-friendly "green" Olympics Games infrastructure, optimal planning must be conducted taking into account the natural environment, available resources, and infrastructure in and around the venues and stadiums.
Since Gangneung is a coastal city, the plentiful renewable energy that is available from oceans, besides atmosphere or land based sources, can play important roles to realize an environment-friendly event (Ryu et al., 1999). In particular, ocean thermal energy can be utilized for Winter Olympic ice arenas that require a lot of cold heat source all year round, because of low volatility and abundance in the ocean. Gangneung, specified by the government as a green model city, is being built up with all possible initiatives for implementing low carbon activities from 2010 to 2016. It is included to promote ocean thermal energy utilization for district cooling and heating, and downstream usage of seawater intake.
Therefore, the application of ocean thermal energy to the Olympic Stadium, Gangneung Green City, is a reasonable switch or addition to the original plan. The Korean government announced a plan of "Green Olympic Blue Ice (GOBI) rink applied with ocean thermal energy" in December 2011. In this paper, we investigate the atmospheric characteristics and study the feasibility of applying ocean thermal energy to the Olympics; we also examine the design concepts for the development plan and present the results. Further, we discuss economic feasibility assessments based on the performance analysis.

## 2018 WINTER OLYMPIC STADIUM PLAN

In the 2018 Pyeongchang Winter Olympics, 13 winter sport stadiums will be constructed or renovated under the plans proposed to IOC. The stadiums for outdoor snow sports are being in the mountain city of Pyeongchang, and the arenas for ice sports are located in the coastal city of Gangneung (Fig. 1). Among the 4 ice arenas in Gangneung, 1 arena will be located in a district from the coastline in approximately 2 km, which is sufficient distance to supply seawater into the arena through a pipeline (Fig. 2; Kim et al, 2011)).


Fig. 1 Locations of 2018 Winter Olympic arena at Pyungchang and Gangneung

Currently, the energy for ice refrigeration and indoor air-conditioning systems is supplied from ocean thermal and geothermal energy. 100%