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Name	Hua Tian	
Affiliation	State Key Lab of Engine, Tianjin University, China	
Invited Keynote Lecture		
Presentation Title	CO₂ Ice Rink Technology and Its Applications	
Abstract (Approximately 200 words)	<p>To keep an ice rink frozen, traditional refrigeration systems utilizing a liquid refrigerant, e.g., ammonia or organic fluids, are often used to absorb heat from the source and maintain a low temperature environment. However, traditional refrigerants are often with high global warming potential (GWP). As a natural refrigerant, carbon dioxide (CO₂) is safe, economic, and environmentally sustainable which can be used in heat pump and refrigeration systems especially in trans-critical cycles. To overcome the deficiencies of traditional CO₂ trans-critical cycle with large pressure difference and high adiabatic index, a novel CO₂ trans-critical cycle system is developed, which involves two-stage compression, direct evaporation, and heat reclaim integration. The prototype was first exploited and applied in Beijing 2022 Winter Olympics. The test results suggested that in comparison with traditional R507a ice rink techniques, which was also used in Olympic venue, the developed CO₂ ice rink system utilizing both cooling and heating energy can achieve three times higher energy efficiency. The produced ice was more uniform, and the temperature difference was maintained less than 0.3 °C in comparison with 1.3 °C for traditional ice. A further estimation demonstrated approximately 99% CO₂ emission reduction and 12.5 billion tons of CO₂ storage can be achieved by replacing synthetic refrigerants with CO₂ in China.</p>	
Biographical Sketch (Approximately 200 words)	<p>Prof. Hua Tian is the deputy director of state key laboratory of engines, Tianjin University, and the chief scientist of National Key R&D program. His main research interests include CO₂ power technology and CO₂ refrigeration technology. He has published more than 130 SCI papers, 23 authorized invention patents, and 4 monographs in Chinese and English. He has won the Second Prize of National Natural Science Award, the First Prize of Tianjin Natural Science Award, the Fok Yingdong Young Teacher Award of the Ministry of Education, the Wu Zhonghua Outstanding Young Scholar Award of Chinese Society of Engineering Thermophysics, Highly Cited Chinese Researchers of Elsevier 2021, etc.</p>	