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Supercritical CO2 Power Cycles and Technologies for High Temperature Waste Heat to Power Conversion

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Abstract

The recovery of waste heat from existing industrial facilities is one of the most promising approaches to improve their energy efficiency, reduce energy consumption and Greenhouse Gas Emissions and create new business opportunities. However, despite intensive research effort and interest in recent years, there are still challenges in the exploitation of industrial waste heat sources. The availability of waste heat, temperature and composition of the heat carrier, the intensity or modality of supply, and the ease or economic feasibility of its utilisation are critical factors in the selection, design and implementation of the Waste Heat Recovery (WHR) technology.

For the recovery of low temperature waste heat in the range between 100 – 300 ^{o}C and its conversion to electrical power, technologies such as the Organic Rankine Cycle (ORCs) are commercially available. For higher temperature operation, however, ORC technologies are limited by the non-availability of working fluids that can operate safely and efficiently at these temperatures. To address this technology gap for a number of years now the Brayton cycle using Carbon Dioxide in the supercritical state has been under consideration.

Carbon dioxide has very good thermo-physical properties. It is a non-toxic, non-flammable and thermally stable compound and in its supercritical state, has properties, including high density, that can lead to high cycle efficiencies and a substantial reduction in size of components compared to alternative heat to power conversion technologies.

This plenary presentation provides an overview of sCO_2 power cycles for high temperature waste heat to power conversion. It outlines the state of development of the technology and research and development challenges that still need to be overcome to facilitate the commercial application of the technology.