On the development of a novel energy-cascading system for quad-generation

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Plenary Abstract

Quad-generation encompasses the features of a multiple utility plant, with combined electricity, heat, cooling and potable water but in addition includes the recovery of thermal energy from the exhaust gas with minimum wastage of energy. Key benefits (1) potential for low or zero carbon emissions to produce multiple utilities; (2) reduced operational costs versus separate purchase of electricity, heat, cooling and potable water; (3) maximize the use of all potential resources from gas utilisation to produce useful outputs; and (4) Improved reliability for sustainable utilities production. This presentation focuses on the development of a unique smart quad-generation plant, whereby all four key resources are generated simultaneously using a single, integrated system in an energy efficient manner, through maximizing the recovery of its generated waste energy. Specifically tailored for tropical countries, the plant can contribute to greater energy and cost savings, and is also more space-efficient. It employs a smart temperature cascading method to maximum the utilization of waste heat. More importantly, it can significantly reduce energy consumption by 30 per cent or more and potentially trim the amount of carbon dioxide emitted to the environment by 2 to 4 per cent for countries at business-as-usual levels while meeting varying needs of electricity, potable water, cooling and heating. Such a novel system is particularly suited to countries whereby cooling and water production are essential utilities.

Short biography

Dr Chua Kian Jon is currently an Associate Professor with the Department of Mechanical Engineering, National University of Singapore. He has been conducting research on air-conditioning, refrigeration, and heat recovery systems since 1997. He has conducted both modelling and experimental works for specific thermal energy systems. These include dehumidification, cooling, heat pumping, compact heat exchangers and refined temperature/humidity control. He is highly skilled in designing; fabricating; commissioning and testing many sustainable energy systems to provide for heating, cooling and humidity control for both small and large scale applications. He has more than 200 international peer-reviewed journal publications, 6 book chapters and two recent monographs on advances in air conditioning (https://www.springer.com/gp/book/9789811584763 and https://www.springer.com/gp/book/9783030808426). He was highlighted among the top 1% of scientists in the world by the Universal Scientific Education and Research Network and top 0.5% in the Stanford list of energy researchers. His works has garnered more than 10,900 over citations with a current h-index of 55. Further, he owns more than 10 patents related to several innovative cooling and dehumidification systems. He is the Principal Investigator of several multi-million competitive research grants. Additionally, he has been awarded multiple local, regional, and international awards for his breakthrough research endeavours.

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