Development of a Dynamic PV/T-Driven Combined Cooling, Heating and Power System Model for Use in the Canadian Residential Sector

by

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Abstract

Photovoltaic/Thermal (PV/T) driven combined cooling, heating, and power (CCHP) systems are a promising low-carbon alternative for meeting the energy demands in Canada's residential sector. This research aims to develop a novel topology for this system and provide guidelines for component sizing and control for system operation in various Canadian climate locations. To achieve the objectives set forth in the thesis, a research plan comprising two parts is devised. In the first part of the research, a CFD-based numerical modelling approach is developed to simulate the operation of a PV/T driven domestic hot water (DHW) system under dynamic conditions. Using the case study location of Ottawa, Canada, 48 different scenarios are developed which involve two different working fluids (*i.e.* air and a water-ethylene glycol solution) and two PV/T collector design alternatives (*i.e.* with and without fins) for each month of the year. Key insights from this work are used to assist with design decisions (mainly related to PV/T collector layout and operation) made in the second part of the research. In this part, a dynamic model of a residential-scale PV/T driven CCHP system that includes latent heat thermal energy storage and a lithium bromide absorption chiller is developed.

Bio

Cem Kalkan is a Ph.D. candidate in the Department of Mechanical and Aerospace Engineering of Carleton University. He received his M.Sc. degree from the Mechanical Engineering Department of Dokuz Eylul University in Turkey in 2019. He also received his B.Sc. degrees in Mechanical Engineering and Industrial Engineering from the university.