Contribution ID: **267** Type: **Oral Presentation**

Title: Mathematical modeling of the coefficient of performance of a Carnot's Air source heat pump water heater

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Abstract content
   (Max 300 words)

In South Africa, there is an ongoing constraint on the electricity supply at the national grid to meet the demand. Eskom is implementing various measures such as the Integrated Demand Management (IDM) and the encouragement of the use of efficient energy devices like air source heat pump (ASHP) water heater for replacement of high electrical energy consumption utility (conventional geysers) in sanitary hot water production. The ASHP water heater market is fast gaining maturity. A critical mathematical model can lead to performance optimization of the system that will further result in the conservation of energy and significant reduction in global warming potential. ASHP is an electro-mechanical device that operates on the principles of vapour compression refrigerant cycle. The ASHP water heater comprises of an ASHP and a hot water storage tank. A DAS monitors the temperature at the evaporator, condenser, hot water and the ambient temperature in the vicinity of the evaporator. This work focuses on using the mathematical equation for the Coefficient of Performance (COP) of an ideal Carnot's heat pump (CHP) water heater and writing basic computation in M-file of Matlab and Simulinks software to model this system based on two reservoir temperatures, viz., evaporator temperatures (TE) of 0℃ to 45℃ (equivalent to ambient temperature, TAMB) and condenser temperatures (TC) at 55℃, 60℃, 65℃ and 70℃ (set point temperature of hot water in the tank). From the modeling results it can be deduced that at 0℃ TE, the COP is unity irrespective of the set TC. Between the range 0℃<TE<15℃, the COP increases linearly at constant rate of 0.02/℃. Above 27℃ TE, the rate of change of COP increases exponentially with the best COP manifested for TC of 55℃. Finally the paper will present an analytical comparison of CHP water heater to practical ASHP water heater and the multi benefits of setting the hot water temperature at 55℃.

Apply to be
 consider for a student
   award (Yes / No)?

Yes

Level for award
 (Hons, MSc,
   PhD)?

MSc

Main supervisor (name and email)
and his / her institution

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Would you like to
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Yes

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