Implementation of a Carbon Dioxide Refrigeration System as a Cogeneration Appliance and Alternative to Halocarbon-based Refrigeration Systems

Perrin, Ethan

Murthy, Sonia

Tevosyan, Sophia

This engineering project seeks to develop a novel refrigeration system implementing carbon dioxide (CO2) as an alternative refrigerant to the hydrofluorocarbons (HFCs) currently in use in domestic settings. HFCs have increasingly gained notoriety for their high global warming potentials, which have been proven to contribute to global climate change. Utilizing a refrigerant with a much lower global warming potential, such as CO2, would thereby reduce the significant greenhouse gas contributions of the refrigeration industry to this imminent global crisis. The engineering process began with the analysis of a current HFC refrigeration system in regards to power consumption, thermal performance, and environmental impact. Metrics gathered from an existing refrigeration unit and knowledge of the chemical properties of each refrigerant were then used to establish the design requirements for a comparable CO2-based system. Performance data acquired from this working prototype led to repeatedly tuning and modifying the design to most closely achieve the performance of the existing HFC system. The prototype created has successfully achieved thermal performance of the pre-existing system in maintaining an internal temperature of 6 degrees Celsius, proving to be a viable refrigeration technology. In terms of power consumption, the prototype operates at a net 80 watts, lower than the 90 watts of the existing HFC system as a result of the cogeneration system which recovers lost energy to heat water. With regards to the environment, the global implementation of the much lower impact CO2 refrigerant will reduce carbon dioxide equivalent emissions by more than 136 million metric tons.

Awards Won:

Third Award of $1,000