Next-generation Refrigerants and Domestic Heat Pump Cycles

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Mechanical vapour compression (MVC) systems are the backbones of modern society. They are the indispensable laboratory facilities for the advancement of science and engineering. The efficiencies of MVC systems reach unprecedentedly high values (<0.3 kW/ton for part-load operations for commercial chillers). Nevertheless, these systems are often the soft targets of environmentalists. Energy efficiency and working fluids of MVC systems are sweet topics to disparage them. On the other hand, energy transport by electrons offers high efficiency and huge flexibility to transform into other commodities, including refrigeration, cooling, heating, desalination, transportation, to name a few. To some, using high-grade energy, i.e., electricity in MVC systems is a pang of guilt regardless of the high conversion efficiency. Meanwhile, refrigerants are permanently tied to environmental issues, while the word "Global Warming" becomes a household vocabulary. Global watchdogs set regulations, and the HVAC&R industry chases for higher efficiency and next-generation refrigerants. Developing a new refrigerant involves multidisciplinary research effort and tremendous resources. Due to the limitations of pure refrigerants, attention is paid to refrigerant mixtures whose thermophysical properties are often not well-established. We will discuss the performance evaluation of next-generation refrigerants from the experimental and thermodynamic perspectives.