

# Development of a CO<sub>2</sub> Chiller Heat Pump for Multiple North American Applications

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## Research Challenge

- Heat pumps deployed in the US use high global warming potential (GWP) refrigerants
  - Pose long-term environmental, safety, and societal concerns
- Most industrial-scale HVAC&R products are purpose-built for a specific application
  - Does not allow for manufacturing efficiencies
- Proposed chiller heat pump concept
  - Deploys a CO<sub>2</sub> refrigerant solution (GWP = 1)
  - Enables the delivery of heating, cooling, and domestic hot water
  - Modular design enables manufacturing and application efficiencies

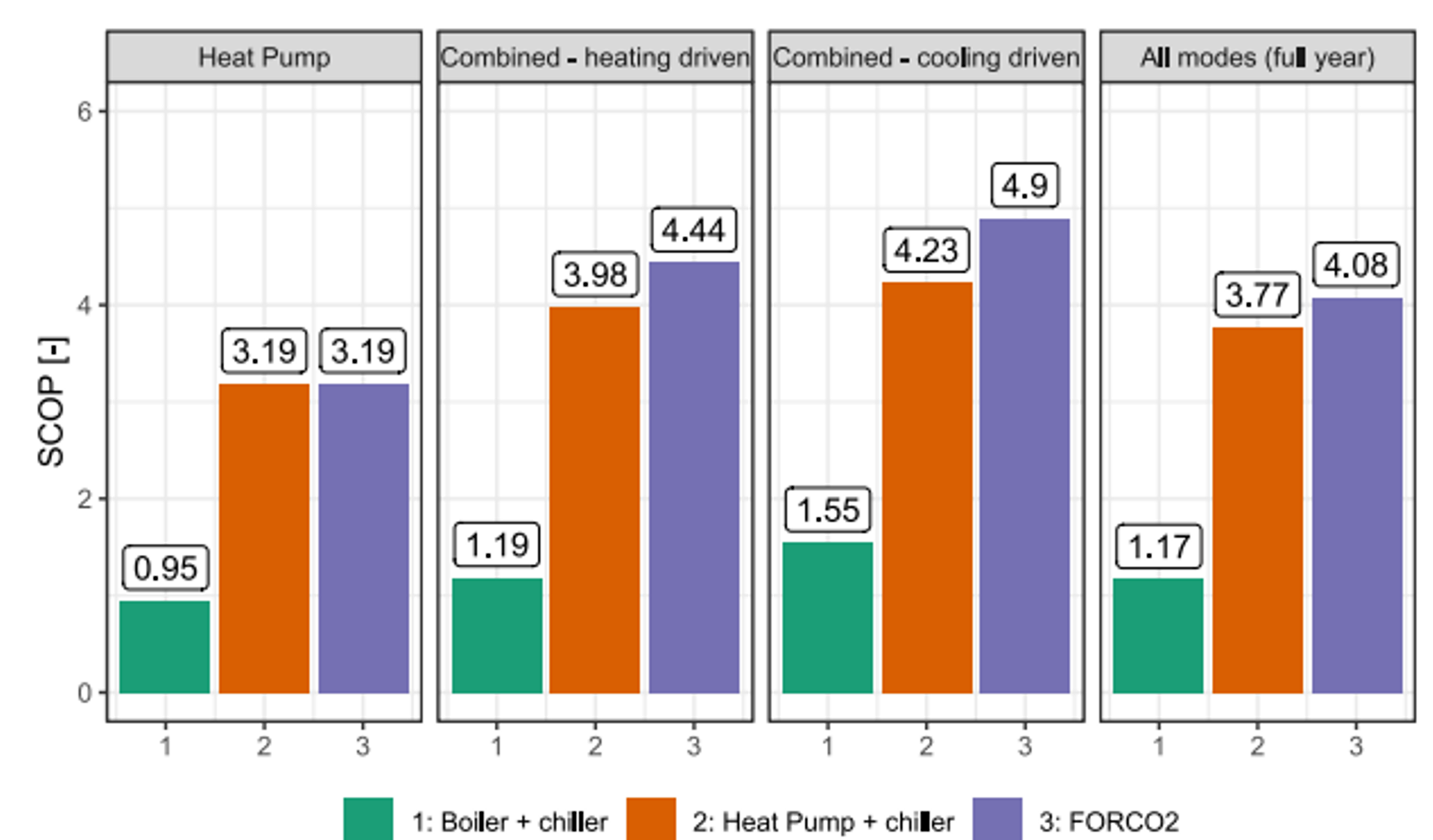
## Current Research

- US market is cooling-dominated with more extreme hot ambient temperatures
- Investigate several advanced technologies to improve cooling efficiency of CO<sub>2</sub> systems in hot climates
  - Include advanced CO<sub>2</sub> vapor compression technologies, gas and liquid ejectors, pressure exchangers, direct vapor injection, and advanced thermal storage capability
- Define conceptual design
  - System configuration, compression technology, heat exchanger design, advanced technology, controls architecture, thermal energy storage, and system-level analyses
- Develop commercialization plan

## Planned/Future Research

- Complete final design
  - Define piping and instrument diagram (P&ID), bill of materials, electrical schematics, controls architecture, and sequence of operations
- Fabricate full-scale system and conduct performance evaluation
- Conduct pilot-scale system evaluation at a commercial site

Current state-of-the-art: CO<sub>2</sub> chiller heat pumps comparison of combined coefficient of performance (COP) for three different systems



Proposed CO<sub>2</sub> chiller heat pump concept

