Walgreens Net Zero with Transcritical CO$_2$

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1. To evaluate “net zero” technologies.
2. Define the scalability of each independent
Efficient CO₂
Political Volatility of Chemical Refrigerants in the developed world

$2.9 Billion International Investment for Montreal Protocol ODP Projects

Phase-out of R-22 $50 Million Investment for Walgreens Portfolio
• Geothermal loop provides steady condensing temperatures < 15C (60F)

Pink = OA Temp
Blue = Trans-Critical
Orange = PT1
Green = GEO Temp_{in}
Navy = GEO Temp_{out}
Red = GEO power
• Instantaneous HT COPs up to 10, range: 4-6
• Aggregate hydronic COP = 3.4
Summary and Lessons Learned

• Incorporating HVAC into refrigeration rack breaks down historic barrier to innovation
• Geothermal loop adds redundancy and increases operational flexibility
• Aluminum piping is a no-brainer
• US suppliers lack sufficient stock of 80 Bar rated components. UL Certification hurdles.
• Real time monitoring and transparency are vital
Thank you very much!