Are Nanofluids Ready for Prime Time?

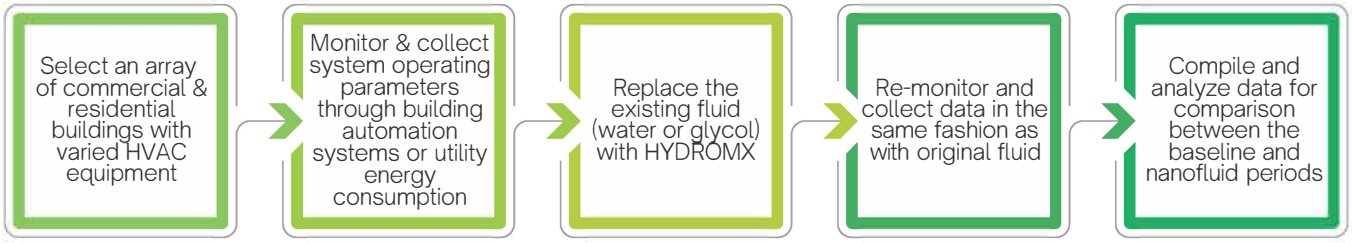
SUMMARY
NANOFLUID TECHNOLOGY

Nanofluids contain suspended nanoparticles that exhibit enhanced thermal conductivity and heat transfer properties compared to standard fluids like water and glycol. While these properties are well documented through scientific experiments, there is less supporting evidence that nanofluid installation results in energy savings in HVAC systems.

PROJECT
GOALS

Case studies claim heating and cooling energy reductions of 10-35% from HYDROMX; a commercially available nanofluid. However, the studies lack an explanation of how the results account for varying weather conditions and occupancy patterns. This project aims to address these gaps through a field study to investigate the energy efficiency potential of HYDROMX in a variety of HVAC systems.

STUDY
PROCESS



SITE SUMMARY
FACILITY TYPES & IMPACTED SYSTEMS

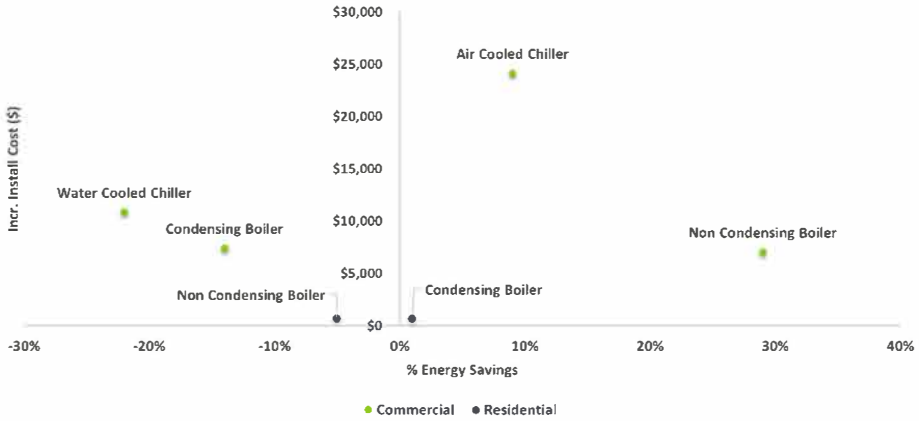
- Municipal Admin Building — Water-Cooled Chiller
- Municipal Admin Building — Air-Cooled Chiller
- Dental Office — Hot Water Boiler (Non-Condensing)
- Healthcare & Rehab Facility — Hot Water Boiler (Condensing)
- Single Family Residential — Hot Water Boiler (Condensing)
- Multi-Family Residential — Hot Water Boiler (Non-Condensing)

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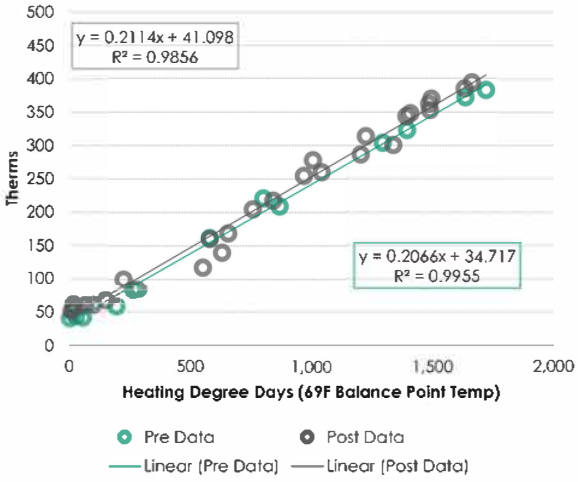
STUDY RESULTS
HIGHLIGHTS

The graph on the right shows the installation costs plotted against the percent of energy savings for each installation.

The two colors represent different site categories.



STUDY
METHODOLOGY DETAILS



The methodology differed between commercial and residential sites.

Commercial sites utilized long-term sub-metered data of HVAC equipment from building automation systems. The data were analyzed to determine the cooling or heating efficiency impacts of HYDROMX across various outdoor air temperatures and loading conditions. The HVAC energy input was compared to the system output to determine the in-field operating efficiency across the range of observed operating conditions.

Residential system performance was evaluated using a whole facility regression model approach since sub-metered data points were not available. Regression curve fits of the monthly natural gas usage against the average monthly temperature were developed for each site before and after the installation of the nanofluids. See example on the left.

PROJECT
LESSONS LEARNED

Building loads were drastically lower than expected due to a lack of occupancy during a significant portion of the monitoring period (COVID-19).

Varying levels of data access inhibited some troubleshooting of BAS data which led to data quality issues.

The project team exceeded the initial budget and timeline for recruiting. We encourage future study providers to consider the challenges of recruiting participants to test emerging technologies.

STUDY
KEY FINDINGS

The study results do not conclusively prove or disprove energy savings resulting from the nanofluid installation.

The technology could still be eligible for utility custom incentives through metering, but prescriptive utility rebates are not recommended at this time.

The best chance for achieving high confidence with results is through laboratory tests to control independent variables.

This study was funded by Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development (CARD) program. Additional project partners include HYDROMX and Gilbert Mechanical.

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