

Refrigerant Undercharge Detection: 30% Energy Waste Identified & Corrected via Continuous Monitoring

Mitsubishi MXZ-SM36NAMHZ | Colorado Deployment

<p>UNDERCHARGE</p> <p>40%</p> <p>refrigerant deficit</p>	<p>EFFICIENCY GAIN</p> <p>~30%</p> <p>energy intensity reduction</p>	<p>ANNUAL WASTE</p> <p>~2,400 kWh</p> <p>~\$360/yr at \$0.15/kWh</p>	<p>CO₂ AVOIDED</p> <p>1.26 MT</p> <p>CO₂/yr (eGRID RMPA)</p>
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Temperature-Normalized Energy Analysis: Before vs. After Service

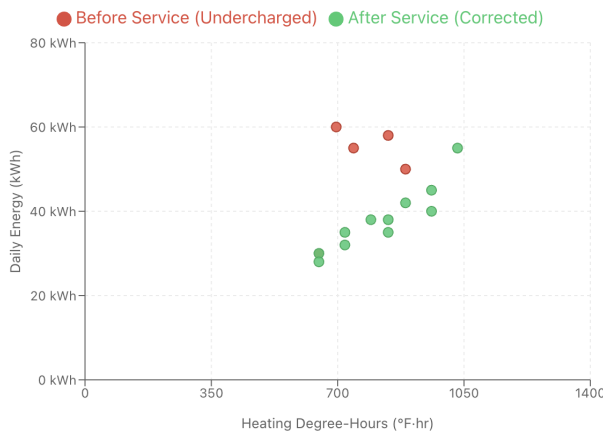


Fig 1: Each point = one day's energy use vs. heating degree-days (base 65°F). Red = undercharged; Green = corrected.

Key Findings

Thalo's continuous cellular monitoring detected anomalous power draw on a Mitsubishi MXZ-SM36NAMHZ VRF heat pump. Field inspection confirmed a **40% refrigerant undercharge**. After correction:

- Energy intensity: 1.59 → 1.11 kWh/°F-day (~30%)
- Monthly winter savings: ~480 kWh (\$72/mo)
- Avoided emissions: ~1.26 MT CO₂/yr (≈ 3,200 mi driving)

This fault would have gone undetected indefinitely without telemetry. Field surveys find 78% of installed systems have charge issues.

Methodology

Daily kWh normalized by heating degree-days (base 65°F). Before/after compared via OLS regression with R² goodness-of-fit. Recovery transient (Jan 30–31) excluded. Emissions use EPA eGRID RMPA factor: 1,159 lbs CO₂/MWh.

Fleet-Scale Impact (24,000 units)

Assuming 25% of units have charge faults at half this severity: ~7.2M kWh/yr wasted, ~\$1.1M/yr excess electricity, and ~3,790 MT CO₂/yr of avoidable emissions.

Why This Matters

Colorado's RMPA grid (1,159 lbs CO₂/MWh) is 43% more carbon-intensive than the national average. Every kWh saved here carries outsized climate impact.

References

- [1] Domanski, Henderson & Payne (2014). NIST TN 1848: Improper installation increases HVAC energy use ~30%. Refrigerant charge identified as leading fault.
- [2] Kim & Braun (2012). Int. J. Refrigeration: 25% undercharge → 15% COP loss; 40% interpolates to 25–40% degradation. Our 30% finding sits mid-range.
- [3] Hu & Yuill (2020). Applied Thermal Engineering: Heat pump COP reductions up to 34% from refrigerant faults within normal safety limits.
- [4] Mowris et al. (2004) / EPA eGRID (2023). 78% field undercharge prevalence (Phoenix). RMPA subregion: 1,158.9 lbs CO₂/MWh (eGRID 2021 data).