



Energy Efficiency

Multifamily Boiler Replacement Executive Summary

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Executive Summary

Air-to-Water Heat Pumps (AWHPs) are electrically driven heating systems that extract heat from outdoor air and transfer it to a building's hydronic distribution system using water as the heat transfer medium. AWHPs can provide space heating (and in some cases space cooling and domestic hot water) by supplying heated water to existing radiators, fan coils, or radiant floor systems. Because they leverage existing hydronic infrastructure, AWHPs can enable partial or full displacement of fossil-fuel boilers without requiring unit-by-unit equipment replacement. This makes AWHPs a potential pathway for electrification of heating.

ComEd initiated this research project to understand the market readiness, technical feasibility, and decarbonization potential of AWHPs as replacements or supplements for natural gas boiler systems in multifamily buildings. AWHPs are gaining attention as a scalable electrification strategy capable of delivering significant carbon emissions savings. Yet, adoption remains limited due to technical uncertainty, cost barriers, and a lack of real-world performance data in cold climates such as northern Illinois.

The purpose of this project was to assess whether AWHPs can serve as a viable near-term electrification measure for multifamily buildings in ComEd's territory, identify where they fit best across the building stock, and determine the conditions that support or hinder successful deployment. This work also positions ComEd to respond proactively to forthcoming changes under the Clean and Reliable Grid Affordability (CRGA) Act, which expands electrification opportunities across both multifamily and commercial buildings.

To achieve these goals, the project team conducted a comprehensive literature review, followed by structured interviews with AWHP manufacturers, utilities, designers, and multifamily building owners. These interviews grounded the research in real-world experience across more than a dozen installations and emerging pilot efforts in similar climates. Findings were synthesized to identify barriers, opportunities, unresolved uncertainties, and actionable program pathways for ComEd.

Key Findings

Research Objective I: Evaluate Market Readiness and Factors Affecting Decision-Making

- The AWHP market is expanding rapidly, with more cold-climate-ready products approaching or entering commercialization. However, contractor familiarity and design expertise lag.

- Market readiness varies widely by building type. Buildings with centralized hot-water systems capable of delivering heat at low supply hot water (HW) water temperature show the strongest near-term feasibility. We estimate that there are 84,000 multifamily living units in ComEd service territory served by boilers. It is unknown what portion of these utilize low supply HW temperatures.
- Decision-making is influenced more by decarbonization goals, system condition, and long-term planning cycles than by short-term payback, especially in affordable housing portfolios.
- Owners and design teams consistently emphasized the need for reliable climate-specific performance data, particularly around cold-weather operation, and hybrid boiler sequencing. This data would increase their confidence that AWHPs would provide reliable heat with potentially acceptable economics.

For more information, see the Literature Review and Market Actor Interviews sections and associated appendices.

Research Objective II: Identify Key Characteristics, Barriers, and Opportunities of AWHP Technologies

- Our analysis quantified likely energy and emissions savings from AWHP installations and demonstrated that buildings with natural gas boilers can leverage an economic switchover temperature for bill savings and calculated total claimable electricity savings of approximately 300 million kWh across the ComEd building stock.
- AWHP performance depends heavily on the building's supply HW water temperature and associated distribution system capacity. Increased opportunity (and conversely decreased barriers) may be found in hydronic systems utilizing low supply HW temperatures.
- High capital costs remain a primary barrier, driven by electrical upgrades, hydronic modifications, space constraints, engineering effort, and installer labor.
- Opportunities include partial displacement configurations, which can avoid costly electrical upgrades and still deliver significant carbon reductions. This contrasts with full displacement which is more likely to incur capital costs associated with electrical and distribution system upgrades.
- The refrigerant transition (away from R-410A) continues to influence product availability and long-term planning for both manufacturers and contractors.
- AWHPs are an approach to electrify space heating in multifamily buildings while still aligning with rider resale.¹

¹ Commonwealth Edison Company, Schedule of Rates for Electric Service, ILL. C. C. No. 10.

For more information, see the Market Actor Interviews section and associated appendix.

Research Objective III: Determine Which Multifamily Typologies Are Best Suited for Full or Partial Boiler Displacement

- Buildings with existing hydronic distribution systems operating below ~150°F supply HW temperature are the primary initial candidates for AWHP retrofits.
- High-rise buildings with water-source heat pump (WSHP) loops present a promising electrification pathway via AWHP integration into the condenser loop.
- Although a small portion of the overall multifamily sector, retrofitting existing electric boilers with AWHPs is economically advantageous.
- Partial displacement is technically feasible across a segment of existing hydronic systems and is likely the preferred entry point for electrification due to lower capital costs and fewer infrastructure upgrades (as compared to full displacement).

For more information, see the Market Actor Interviews and Market Characterization sections and associated appendix.

Research Objective IV: Identify Strategies to Overcome Market Barriers and Support Deployment in Multifamily Buildings

- Stakeholders identified a set of common needs, with differences in emphasis by role. Design assistance and transparent costing benchmarks emerged as cross-cutting priorities, cited by utilities, program implementers, and building owners as essential to reducing project risk and enabling informed decision-making. Technical training and suggested control strategies were raised (with greater urgency) design teams, who view these elements as prerequisites for successful implementation.
- Market transformation will require coordinated piloting efforts to address data gaps in measured performance, comfort outcomes, installation cost variability, and distribution temperature requirements.
- Program designs should emphasize partial displacement, hybrid system optimization, and the alignment of incentives with displacement fraction or decarbonization benefit.

For more information, see the Conclusions and Recommendations section.

Program Recommendations

ComEd can take several actions to encourage AWHP adoption within a rapidly evolving policy and market context:

Build Market Confidence Through Pilots and Demonstrations

Pilot projects are essential for producing local cost and performance data, testing hybrid control strategies, and validating AWHP feasibility under Chicago's winter conditions.

Offer Design Assistance and Electrical Readiness Support

Technical assistance during early project scoping can reduce key barriers around sizing, distribution temperatures, electrical upgrades, and cost variability. This could include preliminary load calculations, distribution system temperature screening, electrical capacity assessments, and order-of-magnitude cost estimating before full design begins.

Develop Workforce Training and Technical Guidance

Contractor training and engineering guidance (e.g., hybrid sequences, sizing tips) will reduce installation risk and improve market capacity.

Prioritize Hybrid Electrification Pathways

Given the high cost and complexity of full electrification, partial displacement strategies provide a lower-cost, lower-barrier method to achieve significant carbon reductions while avoiding major electrical upgrades. For owners that have more aggressive carbon reduction goals, partial displacement can be the first step in a phased full electrification process. Programs can support this planning process through technical assistance and financial support for the planning itself.

Expand to Commercial Buildings Under CRGA

CRGA's carbon valuation and spend-based targets elevates the focus on electrification of commercial hydronic systems. AWHPs may deliver large carbon reductions at scale in schools, offices, and municipal buildings to name a few.

For more information, see the Program Recommendations section.

Phase 2 Recommendations

Phase 2 could move toward quantitative, site-specific analysis capable of informing program design and testing cost-effectiveness.

Develop Accurate Heating Load Profiles Through Building Assessments

This is the most critical remaining data gap. Load profiles determine displacement potential, sizing, hybrid strategy, electrical requirements, and cost-effectiveness modeling.

Compare Partial-Displacement AWHP Scenarios Against Full Electrification Options

Analyze cost, carbon impact, and utility bill implications for AWHP partial displacement versus full displacement. Also analyze versus air source heat pumps (ASHP) mini-splits and other alternatives. Include \$/ton CO₂e saved and identify building size thresholds where AWHPs outperform ASHPs.

Extend Research into Commercial Buildings

CRGA creates new cost-effectiveness pathways for commercial building electrification. Phase 2 could identify promising commercial archetypes and evaluate AWHP retrofit feasibility.

Produce Savings Ranges and Market Potential Estimates

Use measured load profiles and building stock data to develop typology-specific savings ranges and inform territory-wide decarbonization potential.

Align Program Design With Owner Motivations

Phase 2 could examine how AWHPs can serve as a decarbonization strategy, particularly where partial displacement offers a lower-cost, lower-complexity transition path compared to full ASHP electrification. Use the data gathered above to develop program pathways for different owner types and existing building characteristics. Develop the fundamentals of a phased full electrification planning process.

Targeted Outreach Considerations

Findings from the market characterization and technical potential analysis indicate that AWHP outreach should be targeted rather than broad-based. The strongest near-term candidates are multifamily buildings with central hydronic heating systems—particularly mid- and high-rise buildings, affordable housing portfolios, and properties with water-source heat pump loops or fan coil units—where partial displacement can deliver meaningful emissions reductions without requiring full system replacement. These buildings are more likely to have the scale, ownership structure, and capital planning horizons needed to support phased electrification.

Outreach should prioritize owners with planned boiler replacement timelines, portfolio-level decarbonization goals, or mission-driven objectives, and should be coordinated with early design assistance to address uncertainty around distribution temperatures, electrical capacity, and costs. Small multifamily buildings and high-temperature or steam-heated systems are generally less suitable for AWHPs and are better served through alternative electrification pathways.

For more information see the Phase 2 Recommendations section.