La Paz Affordable Multifamily Electrification Monitoring and Verification

Post-Retrofit Annual Results – DHW Addendum

Release Date
August 2025

Prepared For
Commonwealth Edison Company

Prepared By
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Acknowledgements

This project was developed as part of the Customer Innovation initiative within the ComEd Energy Efficiency (EE) Program under internal project number P-0547. Dani Ball, Scott Scheutter, Jon Koliner and Justin Sharer of Slipstream produced this report for the Customer Innovation EE Research and Development team with overall guidance and management from Pauravi Shah. The team acknowledges the support of Jes Rivas, Connor Trocke, Adrian Rivera, Allie Cardiel, and Scott Pigg. For more information on this project, contact Customer.Innovation@ComEd.com.

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EXECUTIVE SUMMARY

This project evaluates the full electrification of a 17-unit multifamily building in Chicago's Logan Square neighborhood. It includes measured energy performance, indoor air quality (IAQ), and resident comfort before and after transitioning from natural gas to electric end uses for space heating, domestic hot water (DHW), cooking, and clothes drying.

Project Objectives

1. Quantify the annual energy impacts of electrification across key residential end uses.
2. Assess the implications for indoor air quality.
3. Evaluate the adequacy and efficiency of centralized heat pump water heater (HPWH) systems in meeting hot water demand.

Key Results and Insights

Energy Use and Electrification Performance

- In-unit energy consumption decreased, with an average weather-normalized claimable savings of 5,627 kWh per unit. This was mainly driven by the high efficiency of inverter-driven ducted heat pumps in heating.
- Cooling electricity consumption decreased compared to pre-retrofit estimates.
- Electric ranges and dryers increased electricity consumption but offered operational and IAQ benefits.
- Total site energy use decreased modestly overall, but electricity consumption more than quadrupled, from 3,083 to 15,249 kWh per unit, largely driven by the addition of space and water heating loads.

Cost Impacts

- In-unit utility bills will decrease after including the elimination of fixed charges, but adding the shared cost of electricity for DHW results in a total annual increase per dwelling unit of $336-$552 depending on the assumed natural gas rates.
- Total retrofit costs for the building were $502,405, or approximately $29,553 per unit. Applying assumed market-rate installation costs instead of pilot costs would reduce this to ~$16,342 per unit.

- The retrofit delivered 92,588 claimable kWh of annual savings, at an effective cost of $5.43/kWh—substantially above ComEd's portfolio average for cost-per-kWh.

DHW System Challenges

- The centralized HPWH system saved energy but operated inefficiently, with a system coefficient of performance (COP) of just 0.63 due to recirculation losses and overreliance on electric resistance backup.
- With improved controls and the recirculation pump disabled, we estimate the system could achieve a 25% site energy reduction compared to the gas baseline, and a COP up to 1.0–1.3.
- Without these adjustments, the DHW system alone accounted for more than half of each apartment's annual electric use.

Indoor Air Quality and Comfort

- Post-retrofit IAQ improved overall, with measurable reductions in CO_2 and volatile organic compounds (VOCs). These improvements were most strongly associated with the replacement of gas ranges with electric cooktops.

Hot Water Availability and Resident Impact

- The HPWH system reliably met resident hot water needs, with hot water runouts occurring in just 1% of draws. Most occurred during periods of high usage and cold groundwater temperatures and likely went unnoticed.
- This system's performance and building resident experiences can be further improved through optimization of storage utilization and prioritization of the more efficient SanCO2 HPWH units.

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Conclusions and Recommendations

The La Paz pilot demonstrates that full electrification of multifamily buildings is technically feasible and can yield meaningful energy and IAQ benefits. However, current market costs and system performance challenges—especially related to DHW—limit financial savings for residents and raise questions about scalability.

Table 1 outlines the conclusions and recommendations associated with the whole building. For more details, see Section 12.0.

Table 1: Whole building recommendations

Conclusion	Recommendation
The retrofit effort for the Dickens building was expensive. Future efforts would need to achieve significant cost reductions to approach cost-effectiveness. Residents are likely to see yearly utility cost increases due to significant water heating cost increases.	If cost-effectiveness is a requirement of future beneficial electrification efforts, **ComEd should pursue cost-cutting measures where possible. This may include not electrifying the DHW system**, unless performance improvements beyond this project are achieved.
The retrofit of heat pumps and electric ranges in place of furnaces and gas ranges results in claimable kWh under ComEd's beneficial electrification targets.	Electric ranges, induction cooktops, and heat pumps should be included in the suite of measures ComEd delivers for beneficial electrification, provided they can be delivered cost-effectively.
Some customers continued to use lower-efficiency window air conditioners and space heaters after heat pump installation.	Heat pump installation should be accompanied by tenant education.
IAQ metrics appear to improve from pre- to post-period.	ComEd should ensure that non-energy health impacts of improved IAQ from switching to electric cooking are accounted for in cost-effectiveness calculations of beneficial electrification.
Additional space heating in the mechanical room was not beneficial to DHW system efficiency. Some additional space heating, however, is required to protect the mechanical room and connected spaces from uncomfortably low temperatures and/or freezing.	**The mechanical room space heating setpoint of 70°F is too high**, especially during the summer. A setpoint of 60°F would maintain sufficient comfort levels in the laundry room and allow the HPWHs to operate at high COPs, while avoiding unnecessary space heat energy use.

Table 2 outlines the conclusions and recommendations associated with the DHW system.

Table 2: DHW recommendations

Conclusion	Recommendation
Hot water needs were adequately met, and the HPWH system used 9% less energy than the pre-retrofit DHW system. Energy savings were lower than expected, likely due to faults in the recirculation pump and circulation pump controls. Costs of DHW heating increased by over 250%.	To optimize this system's performance in the near term, the recirculation pump will be shut off. Going forward, the unbalanced return circulation system will be improved, and controls of the circulation pump will be adjusted. Subsequent conclusions and recommendations address future installation and program considerations.
Recirculation losses are often very high in older buildings. There were multiple issues scoped at the beginning of this project. Some adjustments were made, and it was decided that further renovations were not practical at the time.	In future projects, it is very important to understand the existing distribution system. Critically, if there is a component of an ideal renovation that cannot be completed at the time, protocols should be put in place to ensure that the stop-gap system is operating as intended.
The Dickens building had very high hot water consumption. This resulted in more electric resistance heating and lower system efficiency.	Programs should screen candidate buildings for high hot water consumption (total gal/person/day x 40% > 17.6). This information should be accounted for in building recruitment and system design.
Recently, improvements in system design practices and integrated system technologies have occurred.	Future applications should pursue a pure swing tank design, a "return to center" design without a swing tank, or integrated "systems on a skid." The predicted need for electric resistance heating should be minimized. HPWHs are not technology that can have one solution for all applications and regions.
Central HPWH systems will have worse operating cost outcomes than individual HPWH systems (i.e. in-unit) which can eliminate a fixed charge for each dwelling unit and do not suffer from recirculation losses.	Focus on electrifying buildings with in-unit water heaters due to the economic and performance advantages within current rate structures and the northern Illinois climate.

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