Community Office for Resource Efficiency

312 W. Hyman Avenue Aspen, Colorado

Local architect and homeowners bring Aspen Modern designated home into the future with all-electric power, including a state-of-the-art heat pump

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Executive Summary

Set against the backdrop of Aspen Mountain and nestled in the heart of downtown historic Aspen, the home at 312 West Hyman has undergone a dramatic and intentional transformation, one that honors its mid-20th-century aesthetic while boldly embracing a cleaner, more efficient future. Originally built between 1954 and 1956 by Genevieve Birlauf Leininger, the chalet had remained mostly unchanged for decades, with aging infrastructure, natural gas reliance, and poor thermal performance. Under the stewardship of new owners and architect Jeffrey Woodruff, AIA, Principal of Cloud Hill Design, the home is now a beacon of sustainable renovation within the City of Aspen's *Aspen Modern* program.

With sustainability as a guiding ethic and grant support from the Community Office for Resource Efficiency (CORE), the home is now 100% electric, buoyed with solar panels and battery storage. CORE's support of a portion of a state-of-the-art heat pump was the difference between this project coming to fruition or having the home renovated to a less environmentally beneficial standard.

The transformation of an inefficient home with gas-powered heat and hot water into one that produces on-site energy and eliminates substantial amounts of building emissions in Aspen is integral to CORE's mission and the climate goals for municipalities and counties throughout the region. Accomplishing this goal while also preserving the historic nature of the home and its status as a cultural asset by maintaining the street façade also served the City of Aspen's preservation goals.

For the homeowners, now raising two-year-old twins, the results are tangible. The home is quiet, thermally stable, filled with natural light, and, most importantly, free of fossil fuels and indoor pollutants.

"The 1950s weren't about energy efficiency; the construction was about cost." *-Jeffrey Woodruff, AIA, Principal, Cloud Hill Design*

Purpose Statement

This case study offers insight into a project that offers replicable strategies and solutions for renovating a historically designated *Aspen Modern* home to be 100% electric, where the conversion from gas was possible through the installation of a SpacePak system, which was perfect for retrofitting the heating and cooling systems. The 100% electric-powered home is further supported with solar infrastructure and on-site battery storage.

Recognizing that building constraints, such as the inability to alter the home's façade and general footprint, are opportunities and that seeking solutions beyond popular market products provided the foundation for a roadmap to implement significant change in this building's emissions, indoor air quality, and livability.

Meaningful lessons from this project illustrate that even with the rigorous standards around historically designated properties, changes can be made inside and outside the property if they are strategically placed and conceived.

Those who may benefit from this case study include the following:

- Architects and designers
- Historic preservation professionals
- Community planners
- Energy sector professionals
- Fire department professionals
- Code enforcement professionals
- Those wanting to update and modernize their home

The Opportunity

Project Overview

Project

Conversion of a historically designated *Aspen Modern* chalet from all gas heating and water heating into a 100% electric-powered home with heating and cooling

supported by a new heat pump, including new solar infrastructure and storage, interior renovation, and the removal of the tuck-in garage to a detached location on the property.

1970s photo of 312 W. Hyman. Aspen Historical Society

Partners

- Aspen Fire Protection District
- Cady & Associates
- Cloud Hill Design
- Community Office for Resource Efficiency (CORE)
- CT Lighting
- City of Aspen Electric
- City of Aspen Historic Preservation Committee

Project Costs:

Tesla Batteries: $65,272

Solar Panels: $31,481

Heat Pumps: $ 66,284

Total Project Cost: $96,753

CORE Contribution: $15,000 towards heat pump and hot water heat pump

Building Specifics

Location: 312 W. Hyman Avenue, Aspen, Colorado (Pitkin County)

Building Type: Residential home designated as an *Aspen Modern* building. Aspen Modern is a program of the City of Aspen's Historic Preservation program

Square Footage: 1,536 square feet

Year Built: 1956

Utility Provider: City of Aspen Electric

Heating and Cooling System:

- Old System – Sealed combustion gas
- New Systems – SpacePak small duct high velocity central heating and cooling system

Domestic Hot Water System: Electric hot water heater

Electric Features: Induction stove

Solar Infrastructure: 12 Solar Panels- 415W each totaling 4.98KW

Electric Service Size: 600 amps

Problem to be Solved

This project sought to solve a simple but critical problem: how to modernize a 1950s home, designed in an era of low energy costs and minimal insulation, for 21st-century energy, health, sustainability, and comfort standards, all without compromising its architectural heritage as an *Aspen Modern* designated chalet.

"Inspiration for the chalet was drawn from the Birlauf's history and contemporary precedent." *– Jeffrey Woodruff, AIA, Principal, Cloud Hill Design*

Originally constructed with concrete masonry unit (CMU) walls, dimensional lumber, and single-pane windows, the home's envelope was extremely leaky. A blower door test revealed an ACH (air changes per hour) of 1.05, signaling massive heat loss. Heating was still supplied by a sealed combustion natural gas boiler with outdated piping, and the boiler room, one of the home's most scenic spots, was dangerously overheated due to poor insulation.

The ACH data was imperative as it contributed to finding the correct size heat pump so it would run efficiently and not waste energy that wasn't needed in the home.

In addition, the home had challenging constraints, mainly non-parallel walls, which provided creative thinking in choosing a site location for the heat pump and the homeowners' desire for in-floor heating downstairs and duct heating upstairs.

For health and cleaner indoor air, a goal of the project was to eliminate the tuck-in garage in favor of a new detached garage at the back of the property.

These inefficiencies and site challenges, coupled with the owners' goals of improving indoor air quality and electrifying the entire home, shaped the project from the outset and provided not only benefits to the owners' but contributed to reducing building emissions in Aspen and providing a model for how efficiency upgrades can be made in a designated *Aspen Modern Home*.

Process for Solving the Problem

1. Set Foundational Goals

   There were two foundational goals that guided this project. One was the complete removal of natural gas service entirely. That meant no gas for heating, hot water, cooking, or fireplaces. The team aimed for a 100% electric solution. The other was honoring the legacy of the original owner, Genevieve Birlauf Leininger, and maintaining the charm, quiet, and historical nature of the chalet while also modernizing it with increased natural light and a significant decrease in indoor pollution.

"Removing gas from the house was an early decision. Our clients now have two-year-old twins, and their kids should have the healthiest indoor and outdoor air quality." *– Jeffrey Woodruff, AIA, Principal, Cloud Hill Design*

All decisions then stemmed from these two basic tenets for the project, which provided structure to all other problem-solving. Projects that provide non-negotiable goals can pave the way for creative thinking because the pillars that must be part of the solution are immovable.

2. Collect data to provide a baseline and identify opportunities

Although the team understood that gas-powered heat and hot water were inefficient and polluting, it was important to fully understand the extent of the problem and quantify it. Energy analyst Charles Cady of Cady & Associates performed an energy assessment, which included infrared photographs and blower door tests. The blower door test revealed an ACH (air changes per hour) of 1.05 (meaning 105% of the air in the chalet was lost to the outside every hour). The loss was due to air loss at several points in the home:

- Exterior doors
- Attic gable vents
- Concrete masonry unit
- Windows and window trim
- Outlets and sill plates
- Outdated and insufficient insulation
- Slab

Other baseline conditions that contributed to energy loss or unlivable modern conditions were uninsulated gas pipes and a sealed combustion gas boiler, which can lead to gas leaks, backdrafting (pulling gas into the home's ventilation system), and performance issues if not properly maintained.

Eliminating the tuck-in garage provided an opportunity to improve indoor air quality. Attached garages can leak pollutants like carbon monoxide, volatile organic compounds, and other chemicals into the home, impacting human health.

Identifying areas of the *Aspen Modern* chalet that could be reconfigured without impacting the street façade was integral to bringing in more natural light and enhancing the health and environment of the home.

3. Align values with organizational support, industry standards, and community goals

At this point in the urgent climate crisis, the building sector provides one of the greatest opportunities to make tangible and measurable changes to our collective emissions in the Roaring Fork Valley, state, and nation. This project aligned with CORE's mission and grant program goals, benefiting the community by eliminating emissions and reducing reliance on limited natural resources, while setting an example for Aspen homeowners and demonstrating what's possible even in historically designated buildings.

Without the budget for the complete heat pump infrastructure for heating and cooling, as well as hot water, the project would have come to a standstill as conceived. The $15,000 grant from CORE allowed the project to achieve 100% electric power.

The design team also aligned their project plan with best practices in their field. Their preservation plan drew from the *Secretary of the Interior's Standards and Guidelines for Architecture and Engineering*, holding themselves to rigorous criteria. Contributing to the community's efforts to lower emissions in a city with robust climate action plans was critical in gaining buy-in from neighbors, government, and nonprofits like CORE.

"All-electric homes aren't just a climate solution — they're a practical path toward a cleaner, healthier, and more resilient community." *– Tim Johns, Senior Energy Concierge, CORE*

4. Creative and rigorous thinking

Once funding was in place to achieve maximum emissions reduction, the constraints of the project invited innovative approaches. The building's non-orthogonal design, owner preferences, and development limitations required thinking outside the box.

The non-parallel walls presented a significant challenge for heat pump placement. When concerns arose about installation and warranty due to a change in ownership with one of the leading heat pump manufacturers, the team conducted a thorough analysis of multiple solutions. They ultimately moved from a traditional approach to SpacePak, a small duct with high velocity central heating and cooling system designed for flexible installation in older homes. This compact yet powerful system offered several energy-saving features, including more efficient humidity removal than conventional air systems. It also provided in-floor heating and worked within the existing constraints of the home's plenum. While not the obvious first choice, the SpacePak elegantly solved multiple problems simultaneously.

"We wanted in-floor for thermal comfort, but upstairs ducted. We got both solutions in SpacePak." *– Jeffrey Woodruff, AIA, Principal, Cloud Hill Design*

Honoring the past through the modernization process was imperative to the owners' aesthetic vision, requiring creative space visualization and authentic design changes. The team identified an opportunity in the boiler room, which

ironically offered the best views of Aspen and Shadow Mountains. Converting this utility space into a bedroom allowed for purposeful reallocation without major exterior alterations. Additionally, removing a drop ceiling revealed a higher wood-paneled ceiling, creating more volume while providing space for new, improved insulation.

Results of Process

Ultimately, the home's systems were brought fully into the modern era with graceful, sustainable solutions while its soul was carefully preserved. The biggest win is that the final renovation honored the legacy of the Birlaufs by maintaining the charm, quiet, and aesthetic qualities of the *Aspen Modern* chalet. At the same time, the project achieved the goal of 100% electric power with in-house energy production and storage via solar panels and batteries. The project also brought healthier indoor air, an abundance of views, and natural light that were absent before the project.

Thoughtful architectural decisions reimagined underused spaces:

- The boiler room, once occupying prime real estate with mountain views, was removed, freeing up the original bay for a bedroom and closet with new views of Shadow and Aspen Mountains.
- Vaulted ceilings replaced drop ceilings upstairs, using steel collar ties to open volume and bring natural light deep into the interior.
- The garage is now a detached building off the alley, eliminating a major source of indoor air pollution.

"Some of the best views from this chalet were from the garage and boiler room. Now the bedrooms enjoy Shadow and Ajax Mountain views."

– Jeffrey Woodruff, AIA, Principal, Cloud Hill Design

The team coupled a small duct (R-6 wrapped aluminum tubing) with high-velocity air movement upstairs. Utilizing the outmoded boiler flue as a chase to get to the upper level allowed the reuse of existing infrastructure without triggering any design variances.

On the main floor, in-floor radiant heating and cooling were achieved by maximizing the capabilities of the SpacePak unit. It includes an air-to-water heat pump for heating and cooling on an elevated rack outside the chalet and a buffer tank for hydronic storage. Supplemental heating and cooling are delivered on both levels through wall-mounted hydronic fan coils.

A newly installed energy recovery ventilator reduces the energy cost and requires minimal operation, given the updates to the thermal envelope. The quiet operation of the heating and cooling system, coupled with in-floor heating and cooling on the main level, provides for year-round thermal comfort.

Collaborative approvals from the Aspen Fire Protection District and the City of Aspen's Chief Building Officer have made this project a case study for

reconciling historic preservation with high-performance energy design and safety. The work with the outside agencies helped the project meet energy storage requirements for the solar system with the inclusion of an EV blanket and heat detection.

The design team demolished the existing slab, which gave the mechanical team an opportunity to switch to an appropriately sized heating and cooling system that is water-based rather than air exchange, which offers more comfort and health safety.

To further enhance the indoor environment, photometric studies from CT Lighting perfected the ambient and task lighting in the living spaces. In addition, the deep chalet eaves protect from the summer sun but welcome the winter light and warmth deep into the living spaces.

Historic touches from the original Birlauf family remain preserved, including a valise of travel ephemera, the family crest tile, and handwritten documents telling the story of the home's European roots. These items are held by the current owner as a tribute to the chalet's lineage.

Lessons learned were impactful and will continue to inform this team in future projects and hopefully will influence the Aspen community and particularly inspire future projects in the *Aspen Modern* context.

Lessons Learned

1. **Start with Foundational Goals**
   - Understand primary and non-negotiable goals
   - Data informs solutions
2. **Design Systems to Match Site-Specific and All-Electric Programmatic Constraints**
   - Non-orthogonal structures and tight mechanical spaces require flexible mechanical solutions

- SpacePak was chosen specifically for its ability to meet these challenges with compact ducting, in-floor compatibility, its small size, and hybrid delivery options

3. Analyze and Compare Before Committing

- A rigorous evaluation of systems (traditional vs. modern, air-to-air vs. water-based) led to better-informed decisions
- Collaboration with the MEP team and installer was critical in moving to the most viable long-term solution

4. Prioritize Indoor Air Quality and Health

- Eliminating combustion-based systems (i.e., no gas, removing attached garage) improves indoor air quality and reduces health risks
- The use of an energy recovery ventilator further enhanced air quality and efficiency

5. Use Historic Constraints as Design Opportunities

- The team repurposed existing architectural features, such as using an old boiler room, as an opportunity to stay within historic guidelines without sacrificing performance
- By preserving exterior façades and celebrating original elements, like opening ceiling volumes and old vents, the project team honored the home's history while modernizing its function
- Thinking of design constraints as opportunities stretched the team’s ability to ideate solutions

6. Integrate Safety and Energy Storage Early

- Planning for on-site energy production and storage required coordination with fire and building officials
- Following NFPA 855 standards (e.g., heat detection, EV blanket, and garage layout) ensures long-term safety and compliance

7. Don’t Be Afraid to Replace Legacy Infrastructure

- Removing the 1956 slab addressed both radon mitigation and thermal system performance
- This decision also allowed for better mechanical routing and in-floor radiant system integration

8. Comfort and Quiet Matter

- Quiet, high-efficiency heating and cooling systems, like radiant floors and fan coils, deliver more than energy savings; they dramatically improve day-to-day comfort

Concluding Statements

The renovation of 312 West Hyman in Aspen, Colorado, aimed to resolve critical issues tied to outdated, inefficient 1950s construction. The original home featured CMU walls, baseboard heating, and an aging sealed combustion gas boiler system that was both energy-intensive and insufficient for modern comfort or air quality standards. The owners wanted a healthier, fully electric home for their young children, with improved thermal performance, better indoor air quality, and a layout that better utilized the home's incredible views. Removing gas, updating the envelope, and reprogramming the structure while respecting its historic integrity were early and guiding decisions.

Key lessons emerged from the project that could benefit similar renovations. Flexibility in mechanical design was crucial: the non-orthogonal layout and limited space resulted in a switch from a traditional heat pump system to SpacePak, which supported in-floor heating downstairs and ducted air upstairs within existing constraints. Reusing the old boiler flue as a duct chase, demolishing the slab for radiant comfort and radon mitigation, and working closely with city and fire officials all contributed to a successful outcome that balanced code compliance (NFPA 855), design quality, and performance.

The results have been transformative for the homeowners, offering year-round comfort, drastically improved indoor air, and reduced operational costs. The project can spark meaningful conversations about sustainable upgrades in historically protected properties. By eliminating gas entirely, integrating solar and battery storage, and adhering to NFPA 855 standards, this project sets a compelling precedent for historic homes seeking modern performance without sacrificing character or safety. The project offers meaningful reductions in greenhouse gas emissions in Aspen and the greater community.

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Sources

Resources and Formats

- Aspen Historical Society
- Aspen Modern
- Secretary of the Interior's Standards and Guidelines for Architecture and Engineering
- SpacePak

CORE

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AspenCORE.org
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