MULTIFAMILY ZNE CASE STUDY

Atascadero Family Apts | Atascadero, CA

PROJECT PROFILE

- Built under 2013 CA Code to be ZNE
- Number of buildings: 2
- 60,842 square feet
- 60 units: 22 two bedroom, 24 three bedroom, and 14 four bedroom
- Located in: Atascadero, CA
- Climate Zone: 4
- Monitoring: electrical end uses in each unit, DHW: flow, temperature, electrical

Owner: Corporation for Better Housing; Contractor: BLH Construction; Energy Consultant: Redwood Energy

Project Goals and Achievements

In 2014, Atascadero Family Apartments won highly competitive funding from the USDA Rural Development Division with commitments to all-electric design, 105% solar PV offset with a strategy to store 5% of the site energy "off-grid," LEED Platinum, and Dept. of Energy Zero Energy Ready Homes (ZERH). While this was the developer's 5th all electric project, this design strategy for storage was new and overall, a departure from their standard designs, which are typically not high performing, all-electric buildings and assume a central gas boiler not individual systems.

The most challenging change to the design was replacing the central gas boiler. The first design option proposed an Aermec central heat pump combined system (heating, cooling and DHW). But upon observation of the 2014/15 installation and operational challenges at another CBH demonstration site, the team pursued a second strategy implemented on other 2014-era USDA RD-funded sites of the same Owner: a rooftop 60-gallon heat pump water heater (HPWH) for every apartment, paired with a 4x8 solar thermal panel and 65-gallon storage tank for "off-grid" generation and storage. However, when pricing came back from these other sites, it proved to be too expensive at $10,000 per system. The third design was funded and built for $4000/tank using HPWHs for each apartment and included "off-grid" storage strategy utilizing a larger tank volume (80 gal vs. 50 gal), increased storage temperature (140F vs. 120F), thermal mixing valves and Insteon on/off timer controls traditionally used with resistance water heaters. Ultimately, for 22 of the HPWHs, the EPIC-funded research team relied on the integrated Rheem controls to set the temperature, timing and operation modes (e.g. Heat Pump Only vs. Resistance Hybrid) to evaluate thermal storage.

ANNUAL KWH CONSUMPTION

389,453	322,800
Gross kWh	PV Production

83% ZNE

EFFICIENCY MEASURES

- Envelope upgrades: R-21 + R-5 Rigid, R-49 Attic, U=.30, SHGC=.28
- Individual Rheem heat pump water heaters: 50 gal for 2-bedroom units, 80 gal for 3 and 4bedroom units
- Ducted Maytag iQ high efficiency split heat pumps (HSPF 10, SEER 19)

Research Team: Association for Energy Affordability, Franklin Energy, Redwood Energy and Stone Energy Associates. For more information about EPIC grant, please visit www.aea.us.org/research. Final Report: Getting to All-Electric Multifamily ZNE Construction Publication Number: CEC-500-202X-XXX.

MULTIFAMILY ZNE CASE STUDY

Atascadero Family Apts | Atascadero, CA

Performance

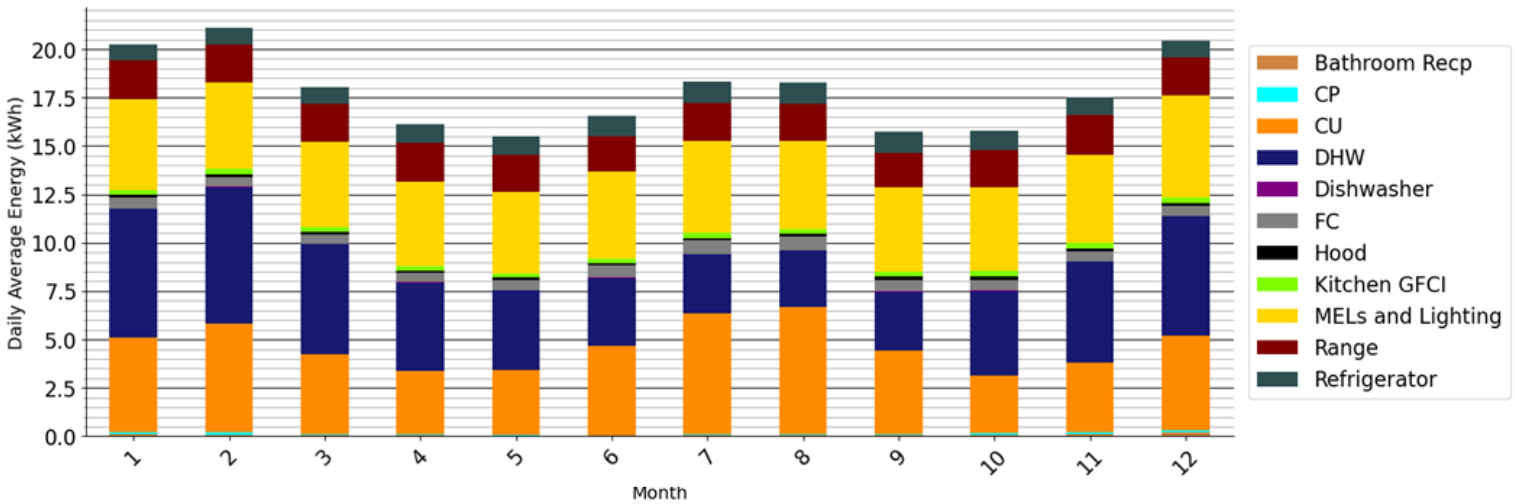
Over the course of 6 months, the Research team evaluated different HPWH configurations to maximize thermal storage. Several installation changes were made throughout the project in response to monitoring, which revealed operational issues that would have otherwise gone unnoticed. The occupancy/motion sensor controlling the DHW recirculation pumps was triggered more often than anticipated (for example, by sensing motion reflected in a mirror), roughly doubling the energy usage of the HPWHs. A push button demand control was later installed in its place, reducing the energy use. The HVAC heat pumps had an uncontrolled crankcase heater, which amounted to on average 3 kWh/apartment/day. The project missed its ZNE target by 17%, but performance is expected to improve with the final set point and schedule for the DHW system and temperature controls installed on the crankcase heaters.

Considerations and Recommendations

While a one size fits all approach for thermal storage is not reasonable populations with highly variable demand, for this project 140F in heat pump-only mode provided benefit on average to 22 apartments (side bar). In the absence of algorithm-based load shifting, complex shifting schemas may not be beneficial without understanding impacts of proprietary operational logic, dependingon the goal of the load shifting. Knowing that MELs and cooking comprise a large portions of end use, particularly in grid peak hours, identifying strategies to reduce these uses and/or shift other end uses becomes more critical to reduce costs and emissions during grid peak. Consider crankcase heater energy use or control mechanism when specifying heat pumps for space heating. They can be controlled,uncontrolled or nonexistent, and not all specification sheets will convey their functionality or energy consumption. Push button demand controls for DHW are recommended over motion sensor controls due to motion sensor controls beingtriggered more often than anticipated.

A set point of 140° F was successful for all hours Energy Saver or HP only mode compared to 125° F. Resulted in:

1. Greater hot water storage to accommodate large coincident hot water demands.
2. Smoothed out variable demand
3. Mitigation of very low delivery temperatures.
4. Lower COPs but still not significant enough to offset the gains from reducing the frequency of resistance energy.



Average daily energy use of the HVAC compressor unit (CU) and DHW were roughly equal for 2-, 3- and 4-bedroom units. The third highest energy use in each apartment was miscellaneous electrical loads (MELs) and lighting, the fourth was cooking.

Research Team: Association for Energy Affordability, Franklin Energy, Redwood Energy and Stone Energy Associates. For more information about EPIC grant, please visit www.aea.us.org/research. Final Report: Getting to All-Electric Multifamily ZNE Construction Publication Number: CEC-500-202X-XXX.