Splitting The Split Incentive: Novel Program Design to Increase Multifamily Demand Response

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ABSTRACT

Multifamily Smart Home Rewards (SHR), a federally funded grant project, explored the deployment of smart home technologies within existing multifamily (MF) rental properties. The project focused on enhancing demand response (DR) capabilities while addressing the longstanding "split incentive" barrier between tenants and property owners. During 2024–2025, the team installed smart thermostats and electric water heater controls connected through a cellular-backed wireless network, enabling two-way communication and remote access. An industry-leading opt-out enrollment process also emerged to accommodate tenant turnover and support sustained participation. In addition, the project introduced a novel dual-incentive model that rewarded both tenants and property owners based on demand response performance, further strengthening engagement and long-term program success. This system enabled the utility to manage electric loads dynamically, improving grid flexibility and reducing peak demand.

The smart devices have been installed in eight multifamily properties (2,000 + units), with a focus on affordable housing. The project includes field validation, data collection, and third-party assessment to evaluate energy savings, grid responsiveness, and non-energy benefits such as improved tenant comfort and property management efficiency. With this new program model, the utility has been able to increase DR enrollment from an average of 2% to 90% per property.

Partners include a non-profit research team (for research and metrics), water heater controller and smart thermostat vendors, and the utility's experienced MF and DR teams. The project will inform future utility programs, energy codes, and national adoption strategies. A comprehensive technology transfer plan will ensure scalability and knowledge sharing across utilities, policymakers, and the building industry.

Introduction

Austin Energy[1] (AE) has a comprehensive portfolio of incentives and programs for energy efficiency (EE), energy modeling, green building ratings, energy code development and support, and Demand Response (DR). Relevant DR initiatives include: 1) 2001-2012: installation of 70k radio-controlled thermostats (100 MW of DR), but costly maintenance and lack of 2-way data have led to program sunset. 2) 2002-present: over 17k "Cycle Saver" electric-resistance water heater timers installed in multifamily properties—remain operational but impacted by limited battery life, timekeeping drift, etc. 3) 2008-present: AE led the adoption of local energy code amendments for single family (SF) and multifamily (MF) properties requiring water heater timers at properties with electric water heating. 4) 2014-present, over 20,000 smart thermostats enrolled for temperature setback incentives – successful for SF, but adoption in MF is low due to

[1] Austin Energy is the community-owned municipal electric utility for the City of Austin.

Wi-Fi access limitations, the split incentive between tenants and owners, tenant turnover, and other factors. This new program development, Smart Home Rewards, aims to tackle these issues.

Grant funding from the Department of Energy has been used to field test two-way communicating thermostats and water heater controls through a purpose-built network in large (100+ unit) MF properties in real and dynamic conditions, and an incentive structure designed to overcome the split incentive between owners and tenants. AE's partner in this project, New Buildings Institute (NBI), provides independent third-party assessment of the technology. Finally, this project will support technology transfer; AE will launch a self-standing program reflecting lessons learned to serve as a case study, and share lessons learned to other utilities, green building systems, energy code entities, and stakeholders.

The hope is that Smart Home Rewards demonstrates the benefits of grid-interactive equipment controls networks and technologies that interact with HVAC, electric water heaters, and other electric loads at existing MF properties. Leveraging the new system to design and deploy a dual incentive that, based on ongoing load reductions, rewards both the tenant and property owner, thereby helping to overcome the "split-incentive" dilemma. The technology shows strong potential for grid flexibility nationwide.

The validation objectives for SHR focus on field-testing grid-interactive controls to demonstrate a win-win-win model that benefits tenants, property owners, and the utility. Project activities center on adding load flexibility, leveraging AMI data, and achieving energy savings. For property owners, the initiative introduces enhanced control capabilities, new revenue potential, and marketing advantages through smart home features. The field test incorporates smart thermostats, electric water heater controls, and a purpose-built network utilizing existing or expanded Wi-Fi. Work targets hard-to-reach multifamily residents, including low-income[2] customers. The project seeks to verify both energy efficiency and demand response impacts for water heater and HVAC controls, as well as evaluate whether a dual-incentive model can meaningfully address the split-incentive challenge.

Each component of the technology solution has been used for many years in commercial and single family (SF) buildings. Wireless, mesh-network, thermostats are applied in the commercial building sector, along with one-way communicating equipment control switches. The enhancement this project brings is the combination; two-way communicating smart controls, with a program design that encourages the property management staff and tenants to maintain and participate in DR. AE has installed over 17,000 load control switches on electric water heaters and has required it in the City energy code since 2008. AE has been utilizing load control thermostats for residential HVAC systems for almost 20 years. The DR thermostats have evolved from radio-controlled duty-cycling, to smart two-way communicating thermostats. With approximately 100,000 thermostats participating in Austin's DR program over the last two decades, AE has comprehensive experience managing customer experience. The added benefits of smart controls are that residents will have the ability to remotely control their devices, enhancing convenience, control, and potentially decreasing energy usage and bills. Smart Home Rewards combines and coordinates the operations of the thermostats and water heater controls while giving the property the ability to monitor and maintain equipment. Program and Incentive Design Smart Home Rewards program consists of three key components:

[2]Low-income households (0-80% of area median income) in the Austin area spent an avg. 5-8% of their income on energy costs (electricity, gas, etc).

- Dual Tenant and Owner Incentives
    - Tenants receive an initial $50 incentive after their first season of participation and $25 each year thereafter
    - Properties receive a $5/device incentive each year. Thermostats are installed by the utility at no cost to the owner. HVAC tune-ups and weatherization measures were included as part of the grant as well.
    - Tenants must reside in the unit for 2 of the 4 summer months to receive the incentive.
    - No tenant penalties for event override of a DR event.
    - Tenants may opt-out at any time, forfeiting the bill credit incentive.
    - Incentives are only issued to tenants with communicating thermostats (based on Demand Response Management System (DRMS) reporting)
- Opt-out DR Enrollment Model
    - To ensure high participation, Austin Energy identified property owners willing to support an 'opt out' enrollment model where tenants are by default participating in DR events and enrolled to receive bill credits.
    - Tenants can override events without penalty or opt out of the program at any time.
    - Only one of the major thermostat manufacturers could support an opt-out enrollment model where the thermostat is registered to participate without requiring the tenant to submit an application. Registration of the device in the DRMS is managed during installation when serial numbers of pre-registered devices are linked to specific tenant units.
    - Austin Energy created a new semi-automated enrollment approach that first identifies eligible devices (based on actual communication and performance), links them to eligible tenants (based on occupancy), and issues either a first time or recurring incentive.
    - The current incentive design of $50 initial and $25 recurring matches Austin Energy's single family thermostat incentive. Alternate incentive models were considered to account for differences in HVAC tonnage and enrollment duration between single-family and multifamily customers. The same incentive was deemed most practical to implement and also avoids concerns of perceived unfairness in issuing different incentive levels for SF customers.
- Dedicated Property-Wide Communication
    - Due to the turnover associated with multifamily properties and lack of consistent tenant-or property-wide Wi-Fi, a dedicated communication network was identified as a key component.
    - Partnered with properties that had electric water heaters compatible with cellular-backed communication controllers or that operated existing property-wide Wi-Fi.

Description of Technologies

A purpose-built wireless network of smart thermostats and water heater load controls backed by cloud-based analytics to deliver a flexible demand management was installed at MF properties. These technologies, coupled with a novel DR incentive that pays both the tenant and property are designed to overcome the split incentive while also providing non-energy benefits (NEB).

- **Smart thermostats.** DR pre-registered smart thermostats were installed at four MF properties. Tenants were informed of their participation in the DR program and given the option to unenroll and/or opt-out of DR events. Connectivity of the thermostats was achieved by community Wi-Fi available to the tenants or through a cellular network enabled water heater controller.
- **Vendor 1 water heater controller.** This controller establishes two-way communication via cellular network. It allowed monitoring of power usage, water temperature, and the scheduling of curtailment/DR events using a cloud-based platform. Additionally, smart thermostats interfaced with the cellular network in locations lacking community Wi-Fi, ensuring continuous connectivity and maintaining their eligibility for DR dispatch.
- **Vendor 2 water heater controller.** Similar to Vendor 1, these controllers allow for the scheduling and deployment of DR events through a cloud-based platform. The Vendor 2 controllers were installed at MF properties where no other smart devices were installed.
- **Data loggers.** A sub-population (~5%) of the apartment units at three of the five MF properties had data loggers installed. The data logger received inputs from current transducers (CTs), which measure the power draw of individual circuits in the electrical panel. The data logger was connected to three circuits in each applicable apartment unit to measure the power usage for the HVAC condenser, air handler, and water heater.
- **Utility Meter Data.** Tenant energy use data can be accessed by the AE team though the AE App. This meter data management software allowed for tracking and gathering of tenant and property-aggregated energy use in 15-minute intervals.

Description of participating properties

Smart Home Rewards focuses on five participating properties identified as A, B, C, D, E. Properties A, B, and D are income qualified multi-family (MF) communities, which means they are either a not-for-profit provider of low-income housing, or can demonstrate that at least 30% of distinct units are occupied by tenants that use housing vouchers as a form of payment or receive the customer assistance program bill credit. Properties A, B, and D, received smart thermostats, Vendor 1 water heater controllers with cellular network connectivity, and data loggers.

Property C, not an income qualified property, only had smart thermostats installed, and utilizes community wi-fi.

For clarity, we will be referring to property E as one property, but it is composed of four student housing properties. These properties are all owned by the same owner, and they all have Vendor 2 water heater controllers installed. Property E received no other smart devices.

DR Event Design

The Smart Homes Rewards program includes DR events, one where the thermostats are called on to curtail, and the other one where the water heaters are. The thermostats enrolled in the Smart Home Rewards Pilot program were called on to curtail during the same times as the participants in the already established Power Partner Thermostat (PPT) Program. It was agreed that the DR events would follow the same format as the PPT program: a maximum of 25 events in the summer, no more than three consecutive DR events, and at least one winter DR test event. During the DR season, members of the DR team and Energy Management Operations (EMO) hold a daily huddle at noon to discuss the probability of calling an event on that day. This discussion considers weather forecasts and energy demand forecasts, as well as looking at the previous seasons' Four Coincident Peak (4CP)[3] days. The outcome of the huddles can be to call a DR event that afternoon or not. Then, the exact time and duration is determined based on the forecasts.

Typically, the DR events last two hours and begin at 3:30 or 4:00 PM. The Smart Homes Rewards thermostats were pre-registered, so the DR events used the default parameters installed by the thermostat vendor. These parameters include a setback of 2– 4 °F, not to exceed 85 °F, and a 30-minute pre-cooling period of -2°F. The pre-cooling feature is a standard default feature from the vendor and is triggered 30 minutes before the two-hour window of anticipated high energy demand, based on available forecasts. Winter DR events are mainly used as a resource for emergency dispatch and/or DR testing. The parameters for winter DR events are 4 °F setbacks, a duration of 2 to 4 hours, and a minimum thermostat temperature of 40 °F.

The water heater curtailment events were initially scheduled to mirror the existing Cycle Saver water-heater timer program, which operates from 3:00 pm and 7:00 pm from June through September and from 1:00 am 5:00 AM year-round, excluding weekends and holidays. This schedule remained in place through the summer of 2024.

At the start of the shoulder season, as more data on residents' water-usage patterns became available, the team consulted with the EMO group to identify time periods that would provide the greatest value for adjusting the curtailment schedule. The AE team also held monthly meetings with water heater controller vendors to review monthly data reports and discuss observed participant behavior. These discussions helped guide further refinements to the curtailment schedules. With the experience gained in 2024, the 2025 summer curtailment times were set to the same general windows, with minor adjustments made as new data was collected throughout the DR season.

To establish a baseline, one weekday each week was designated as a "no curtailment day" during which no DR events were scheduled. This allowed the team to observe typical water heater electricity usage without intervention. The no-curtailment day varied from week to week.

Measurement and Verification Plan

As previously stated, the sources of data include: 1) tenant devices (e.g. hot water heater controls and smart thermostats); 2) data loggers installed in a sub-population of tenant units; and 3) existing utility meters and data/billing systems. Data from tenant devices and network equipment are provided by the technology vendor(s) selected by that property for installation. Data from the data loggers and utility systems is provided by Austin Energy. Data was analyzed by New Building Institute (NBI) and the AE project team,

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[3] 4CP is the Electric Reliability Council of Texas (ERCOT) demand charge program that determines transmission and distribution costs for each transmission and distribution utility like Austin Energy.

to provide better insight on the impacts and benefits of the proposed technology solution to the electric grid, building owners, and tenants. With the implementation of these technologies, SHR intended to establish a baseline in 15-minute kW intervals and substantiate the DR curtailment (kW) with the data logger information and the meter data.

Data Collection Techniques

Meter data. This data is accessed with the web-based AE App tool. The tool allows for the download of kWh data for all units in a multifamily property and on a per unit basis as well as an aggregation of all meters for a property. Additionally, a range of time can be preselected for which data is downloaded. All the data available through the AE App comes from AE's Meter Data Management System (MDMS). The meter data is downloaded in CSV file format.

Data logger. At the time of installation, the loggers are programmed using a hot spot wi-fi network, such that they "remember" this network at the time of data collection. At the time of data collection, which was done approximately every four months, an AE representative must physically be close to the logger with the same hot spot to establish a connection, but usually it is not necessary to enter the units. Once the connection has been established, the logger records can be accessed through an internet browser using the logger's IP address or through the data logger website. Then, a time range must be selected for the data to be downloaded. Finally, a CSV file is downloaded with the kWh and kW data for each of the circuits in 15-minute intervals.

Water heater controllers. To establish a baseline, the AE team and Vendor 1 implemented a rotating non-event day protocol, designating one weekday per week during which no DR dispatches occurred. The designated non-event day shifted each week, for example, Monday in week 1 and Tuesday in week 2; while DR events were executed on all remaining weekdays. Energy-use data collected on these non-event days served as the reference load profile; Vendor 1 computed the baseline by averaging kWh consumption across the designated intervals. Vendor 1 provided the AE team with monthly measurement files that included 15-minute interval kWh usage for each controller, along with the corresponding calculated baseline. DR events were not scheduled on weekends to maintain consistency and avoid confounding baseline development. Vendor 2 transferred similar reports, except that no baseline was established.

Assumptions and Constraints

Maintaining continuous data collection from the data loggers has been a persistent challenge throughout the project, largely due to frequent tenant turnover at participating properties. When a tenant vacated a unit containing a data logger, the project team was often not notified by property management, resulting in delays of up to a month before the issue was identified. In addition, properties occasionally disconnected power to long-vacant units, which inadvertently deactivated the data loggers and interrupted data capture.

Results

This project resulted in a variety of both quantitative and qualitative results. Overall, the pilot was effective at shifting load, but the magnitude of the load shifted as compared to the level of project management overhead creates difficulty for scaling.

Qualitative Results

The pilot offered valuable insights into some challenges of this program design, including:

1. Difficulty engaging with property owners to enroll in the program
2. Technology challenges, including network dead zones and thermostat complexity
3. Tenant and building staff turnover
4. Difficult data management due to multiple vendors and reporting formats
5. Relatively high overhead costs for the amount of load shed realized

Overall, the program seems to have had little impact on customers' comfort. Although participants were pre-enrolled, they could still override individual thermostat events or opt out of the program entirely. In practice, very few chose to do so: only 71 of 927 thermostat were opted out, and none of the 2,001 water heater controllers were opted out.

One area of particular concern for DR programs is the increased demand associated with the pre-cooling period and spikes in load as systems ramp back up after the curtailment period – particularly if this rebound coincides with 4CP interval. This is relevant for electric resistance water heaters. We found that there is some impact but not enough to pose a problem. Vendor 1 offers a programmable rebound parameter limit, which was successfully deployed. This rebound parameter is defined as the maximum power level (in kW or percent of nameplate) to allow devices to ramp back up after the curtailment period ends. This helps prevent a sudden surge in demand immediately following an event. For this deployment, the rebound duration period was set to 60 minutes after the end of the curtailment period, during which the water heaters operated in a reduced-power mode.

Quantitative Results

Overall, the program realized load shed through thermostat and water heater curtailment events. The preliminary project results below are separated into a summary for thermostat-only events called in the summer, water heater-only events called year-round, and combined events where both the thermostat and water heater were called. As these are preliminary results and the grant is ongoing, additional work is needed in data aggregation related to event times and duration.

Thermostat-only event results

Thermostat-only demand response (DR) events were called from June through September, for two consecutive summers. The impact of DR events was verified via two data sources: 1) property-level aggregated meter data, and 2) a small sampling of apartments with data loggers (e-gauge equipment).

To determine the impact of thermostat-only events, we compared the demand of hours when only a thermostat event was being called to equivalent non-event hours. Equivalent non-event hours are defined as hours meeting two requirements: (1) no DR event was called, and (2) cooling degree hours (CDH) were within the range of CDH observed during DR events[4].

[4] "Cooling Degree Hours" are similar in concept to cooling degree days, which is a measure of the magnitude and duration that outside dry bulb air temperature is higher than a specific "base temperature" which we define as 65F.

Across all DR-season months (June through September), the aggregated meter data indicate that during thermostat event hours, the average hourly demand per property (roughly 200 apartment units) was 2.2 kW less than equivalent hours on baseline days in the 2024 season (3.2% reduction). In 2025, the average load was 0.16 kW less (0.21% reduction). Note that these results are based on aggregated meter data and not isolated to the HVAC load alone.

The table below summarizes the total impact of thermostat events by year, assuming all events achieved the average demand reduction described above. Note that these results do not account for increased load associated with either (1) precooling or (2) bounce-back demand after events. See the Qualitative Results for more discussion about this.

Table 1. Impact of summer thermostat curtailment events by year, using property-wide meter data averages

	2024	2025
Average kW reduction per hour, per property	2.2 kW	0.16 kW
Average event duration	2 hours	2 hours
Number of summer curtailment events	20	27
Number of properties	2	4
Total kW reduction	176 kW	34.6 kW

We also analyzed the thermostat-only results for units with dataloggers, following the general methodology described above. The dataloggers provide data disaggregated by end use, so the results below reflect the change in measured demand of the HVAC equipment only. Individual logger averages are scaled to the property level by multiplying by the average property size of 200 units.

Table 2. Impact of summer thermostat curtailment events by year, using datalogger averages

	2024	2025
Average kW reduction per hour, per property	2.1 kW	0.12 kW
Average event duration	2 hours	2 hours
Number of summer curtailment events	20	27
Number of properties	2	4
Total kW reduction	164 kW	26 kW

Water heater-only event results

Water heater demand response events were called year-round, with distinct logic for winter and summer seasons. Three data sources were available to analyze water heater demand response event impact: 1) property-level aggregated meter data, 2) water-heater end-use results from water heater Vendor 1, and 3) a small sampling of apartments with data loggers (e-gauge equipment).

To determine the impact of water heater-only events, we compared the demand of water heating event hours vs. equivalent non-event hours. For water heaters, equivalent non-event hours (also referred to as baseline hours/days) are defined as any hour that falls within the water heating event window on a day without an event[5].

All results shared in this section are focused on actual event hour changes and do not account for increased load associated with preheating the tank or bounce back demand after events. See the Qualitative Results for more discussion about this.

Across all properties in the study, meter data indicated that the average property demand during water heater event hours was 6.8% lower than the same hours on baseline (non-event) days in the summer and 11.8% lower in the winter. This equates to an average property-level hourly demand reduction of 4.2 kW in the summer and 6.0 kW in the winter. Note that this is based on aggregated meter data and not isolated to the water heating end use.

The table below summarizes the total program impact of water heater events if all events achieved the average demand reduction shown above.

Table 3. Impact of water heater curtailment events by season, using property-wide meter data averages[6]

	Summer 2024	Winter 2024-2025	Summer 2025	Winter 2025-2026
Average kW reduction per hour, per property	4.2 kW	6.0 kW	4.2 kW	6.0 kW
Number of event hours	456	504	442	382
Number of properties	2	2	3	3
Total MW reduction	3.8 MW	6.0 MW	5.6 MW	6.9 MW
Program total MW reduction	22.3 MW			

To obtain a more precise look at the water heating results, we can use data disaggregated to the water heating end-use gathered from Vendor 1's tracking. The data show that across all months, the water heater events were successful. With the exception of one month (October 2024), events successfully shifted water heater demand across both summer and winter seasons.

The table below summarizes seasonal total property-wide demand reduction due to water heater curtailment events. Data are based on scaling the Vendor 1 water heater results to the property level. Note that this represents only the water heating portion of property demand.

Table 4. Average impact of water heater curtailment events by season, using Vendor 1 data

Season	Average water heater demand (kW), entire property	Average change in water heater demand (kW) per event hour, entire property	Average percent change in water heater demand per event hour
Summer	Non-event: 19.0	-10.5	-55%

[5] For example, if events are called from 12AM–4AM in the month of December, then the hours of 12AM–4AM on days without events are the equivalent non-event hours.
[6] Summer 2024 includes July 24 – September 30; Winter 2024-2025 includes October 1, 2024– May 31, 2025; Summer 2025 includes June 1 – September 30; Fall 2025 includes October 2025-March 30, 2026.

	Event: 8.4		
Winter	Non-event: 29.7 Event: 7.0	-22.7	-76%

The table below summarizes the total impact of water heating curtailment events by year, assuming all events achieved the average demand reductions described above.

Table 5. Total impact of water heater curtailment events by season, using Vendor 1 data

	Summer 2024	Winter 2024–2025	Summer 2025	Winter 2025–2026
Average kW reduction per hour, per property	10.5 kW	22.7 kW	10.5 kW	22.7 kW
Number of event hours	456	504	442	382
Number of properties	2	2	3	3
Total MW reduction	9.6 MW	22.9 MW	13.9 MW	26 MW
Program total MW reduction	72.4 MW			

To validate the results provided by Vendor 1, we also examined the water heater demand for units with dataloggers. Datalogger results also showed lower water heater demand during event hours for all months except October 2024, which aligns with the Vendor 1 results. The reduction is less pronounced, and the demand per water heater is lower in magnitude than the Vendor 1 data across the board. The higher non-event hour (i.e., baseline) average in the Vendor 1 data causes the load shed to be much higher than the datalogger results. Additional research is required to understand the discrepancy between the data logger results and the Vendor 1 results.

The table below summarizes seasonal total property-wide demand reduction due to water heater curtailment events. Data are based on scaling water heater datalogger readings to the property level.

Table 6. Average impact of water heater curtailment events by season, using datalogger outputs

Season	Average water heater demand (kW), entire property	Average change in water heater demand (kW) per event hour, entire property	Average percent change in water heater demand per event hour
Summer	Non-event: 3.4 Event: 2.4	-1.0	-29%
Winter	Non-event: 6.2 Event: 3.4	-3.4	-55%

Combined thermostat and water heating event results

During summer months, there were a small number of hours (39 hours in 2024, and 42 in 2025) where both water heating and thermostat curtailment occurred simultaneously. The results below summarize these events.

The impact of these events was verified via two data sources: 1) property-level aggregated meter data, and 2) a small sampling of apartments with data loggers (e-gauge equipment). For the baseline hours (i.e., equivalent non-event hours), we filtered for hours that meet the equivalent hour criteria for both the thermostat and water heater events: (1) the hours fall within the CDH range, and (2) are water heater event hours on non-event days.

Table 7. Average kW reduction per hour, per property of combined water heater and thermostat curtailment events

Data Source	2024	2025
Meter data	2.6 kW	14.7 kW
e-gauge data	4.2 kW	4.3 kW

These results align with the findings above that suggest water heater events can contribute significantly to demand reductions.

Conclusion

Overall, the program successfully shifted load in both the summer and winter seasons, using thermostat and water heating events. The project team found that the approach of engaging all units of multiple large multifamily buildings results in a scaling of impact that is difficult to achieve at the single customer level. However, the program faced challenges related to site recruitment, technology connectivity, staff turnover at the sites, and tenant occupancy changes. The thermostat events were also slightly less effective during the 2025 summer season as compared to 2024, and the team is still investigating the reasons for this. Current theories include:

- Maintenance staff turnover and lack of customer education: some thermostats might have been switched out for non-enrolled devices because tenants thought something was wrong with the thermostat during events. This led to uninformed maintenance staff switching it out.
- Lack of awareness at Verizon: Connectivity problems also may have been higher in 2025. Verizon’s deprioritizing of units in 2025 that were previously prioritized in 2024 could have contributed to connectivity problems. Similar programs located in other geographical regions have not experienced the same connectivity problems, so this requires further exploration.

All data shown in this paper are preliminary, and the final project report (expected in fall 2027) will contain an additional year of data as well as verified results for 2024-2025.