Hot Takes, Cold Facts: What a Dual Fuel Thermostat Should Really Do

Samantha Hill, PhD, Center for Energy and Environment
Gabriel Ewig, Center for Energy and Environment

ABSTRACT

Dual fuel heat pump systems are a key decarbonization technology for homes with unfavorable economics for electric heat or those in extremely cold climates. However, the comfort, efficiency, and emissions outcomes of these systems often hinge on one critical component: the thermostat. Many of today's dual fuel thermostats are confusing to program, optimized for neither performance nor comfort, and default to costly or carbon-intensive operating modes. Concentrating on centrally ducted systems controlled by a single thermostat, this paper reviews ideal default thermostat settings and features like adaptive outdoor lockout temperatures, effective staging of heat pump versus auxiliary fuel, and simple-but-smart user interfaces that reduce error and decision fatigue. The paper draws from field experience in residential electrification programs, cold climate heat pumps, and centrally ducted dual fuel systems observed in the wild. We discuss how modest changes in control logic and default settings can yield outsized benefits for efficiency, peak demand, and occupant satisfaction. As the thermostat increasingly becomes the brain of the modern HVAC system, smarter dual fuel logic is not just a technical upgrade, it's a requirement for getting hybrid heating right. This paper invites program designers, implementers, and manufacturers to rethink what we ask of our thermostats and imagine a future where comfort and decarbonization aren't at odds with each other.

Introduction

Efficient whole home electrification remains challenging across northern climates due to extreme cold and widespread access to relatively low-cost natural gas (Wilson et al. 2024; Bastian and Cohn 2022). At the same time, significant decarbonization can be achieved in many retrofits by leveraging dual fuel technologies at lower upfront costs and lower operational costs compared to full electrification or continued gas-only heating (Smillie et al. 2024; Tudawe et al. 2022). For example, to electrify 100% of the heating load hours for weather matching the TMY1998-2022 NSRDB profile (NCEI 2026) in a typical Minneapolis home with a design load of approximately 44,000 Btu/hr (Jones et al. 2023), more than 3.5 tons of heating capacity would be required at the minimum temperature of -11°F, while about 70% of the annual heating load could be covered by 2.5 tons of capacity at 17°F, assuming a linear load with a balance point of 65°F. That smaller dual fuel air source heat pump (ASHP) would likely be cheaper to buy (CEE and Slipstream 2026), more appropriately sized for summer dehumidification (PNNL 2026; NEEP 2020), and less impactful to peak load on the electric grid than a 3.5-ton alternative, assuming similar efficiency tier ASHPs are under comparison. Further, the dual fuel system will offer more fuel flexibility and choice in an ever-evolving utility rate landscape (Otalora-Fadner 2023; Gruenwald 2021).

Dual fuel ASHPs come in many possible form factors, but this paper focuses on centrally ducted systems controlled by a single thermostat. More than half of all residential heating systems in climate zones 5 and above in the U.S. use centrally ducted natural gas furnaces (EIA 2023), many of which are paired with central air conditioners (ACs) that could be ASHPs instead. Dual fuel ASHP upgrades of traditional furnace and AC combinations are mostly untapped but important vector for building decarbonization (Malinowski et al. 2022) and coil-only ASHPs which can retrofit onto existing furnaces are available across a widening range of efficiencies and turndown ratios (Hill et al. 2024). Unfortunately, optimizing dual fuel ASHP benefits is not a one-size-fits-all endeavor. Climate, utility rates, and equipment design all influence a dual fuel system's potential performance while occupant and building owner priorities should ultimately be respected to balance comfort, costs, and sustainability to their preferences (Schoenbauer et al. 2024).

Recent field (Mendon et al. 2025; Schoenbauer, Genty, and Haynor 2024; Douglass and Rushton 2024; Hill et al. 2024) and modeling research (Larson 2025; Tudawe et al. 2022) examining dual fuel ASHPs shows that thermostat controls are critical for balancing the competing factors of energy savings, cost savings, comfort, and emissions reductions, but implementation in the field remains challenging. For example, some third-party thermostats can work with a furnace and AC combination or an ASHP but do not have controls able to distinguish between auxiliary heat and ASHP heating in a dual fuel configuration (Ewig and Hill 2026). These thermostats have been observed in real ASHP as AC replacement installs to operate furnace and ASHP combinations as if the ASHP were just another AC (Hill et al. 2024). Similarly, some ASHP manufacturers prevent their ASHP products from operating in heating mode if they are paired with third-party thermostats or air handlers, unless special modules are added (Daikin 2026).

Further, recommendations for the "optimal" dual fuel ASHP and control strategy can easily differ between two mirror image neighboring homes based on their homeowners' specific preferences (CEE and Slipstream 2025; ComEd 2024; Focus on Energy 2023). How, then, could any thermostat be expected to work in all dual fuel ASHP installs? The simple truth is that one single control strategy will not suit all dual fuel ASHP customers, and so dual fuel thermostats need to balance customizability with ease of set up to improve the outcomes of their average users. In this paper, we build on a growing body of work that's identified the challenges around dual fuel thermostats and leverage field testing experience to propose a set of thermostat features that programs should support or advocate for, that manufacturers should incorporate in their products, and that installers should understand and seek to improve dual fuel ASHP outcomes for more customers. The features recommended here are also entirely software based, requiring no costly hardware modifications.

Suggested Design Principles

When thermostats became ubiquitous, their objective was clear: toggle the space conditioning equipment on or off as needed to maintain room temperature near a specific setpoint. This goal remains, but more complex control algorithms have evolved to control variable output equipment, increase product differentiation, and cater to a growing number of energy efficiency programs (Felez and Felez 2026). Today's ideal dual fuel thermostat will provide features that can address those needs and more by prioritizing:

1. **Comfort.** Most thermostats prioritize comfort above all other factors and acceptably deliver it. However, not all customers know if or how they could improve comfort further, especially if they also want to balance comfort with other priorities like cost (Peffer et al. 2024).

2. **Affordable installation.** Thermostat hardware costs are typically on the order of $20 to $200, but installation can easily add several hundreds of dollars in costs when contractors are concerned about callbacks from unreliable controls or difficult-to-tune setups (Hill et al. 2024).
3. **Affordable operation.** Most dual fuel thermostats provide some control option, usually a switchover setting, to manage costs, but the determination of how settings should be configured for a given ASHP, home, and set of utility rates remains a burden for users or installers to figure out (Hansen-Connell et al. 2025).
4. **Resilient operation.** Utilities are increasingly modernizing their signaling infrastructure for HVAC systems with protocols like OpenADR or CTA-2045-A, but device-side intelligence to act on these signals in a dual fuel context is still under development and currently absent from existing standards (AHRI 2019).
5. **Transparency.** Traditional thermostats act like black boxes. They make decisions, usually without any customization of their underlying algorithms, and users are left to deal with the consequences (Peffer et al. 2024).

Simplifying Switchover

The single thermostat setting that most directly controls the overall balance between cost, comfort, and emission outcomes is called switchover. This setting is also sometimes referred to as the compressor lockout or the balance temperature, among other names (Midwest Collaborative 2026). Switchover defines the minimum outdoor air temperature where the ASHP is preferred to the backup heat source in a dual fuel system. Many utilities offer switchover selection guidance or training to their trade allies or customers, yet switchover optimization remains a major challenge in practice. A recent report on the ASHP market in Minnesota found that 61% of installers surveyed wish they had more controls guidance (Hansen-Connell et al. 2025). Important factors like utility rates, system efficiency, and grid emissions can change over time, making optimal switchover a literal moving target. Despite these complexities, significant opportunities remain for manufacturers to improve their thermostats and automatically calculate some of the important balance points that usually dictate switchover optimization.

The Relationship Between Switchover, Balance Points, and Homeowner Priorities

Table 1 summarizes the basic switchover setting strategies recommended depending on homeowner priorities, assuming comfort must be maintained even if the homeowner prioritizes cost or emissions. These control strategies are described in terms of balance points. A balance point represents the coldest outdoor air temperature where operating the ASHP still meets or exceeds the auxiliary heating system for a given performance criterion. At colder temperatures, switching to fossil fuel heat is necessary to meet or minimize the criterion.

For example, the **emissions balance point** occurs at the temperature where the high efficiency of the ASHP no longer compensates for the local electric grid's emission rate compared to the fossil fuel furnace's emission rate. Emission balance points are not widely promoted or implemented but research models estimate CO_2 savings of 8.5% - 40% can be achieved from dual fuel controls responding in real time to local marginal emission rates (Li et al. 2025, 2022; Tung et al. 2018). When electricity is generated primarily by clean sources like solar or wind, operating the ASHP as much as possible minimizes emissions. In this case, switchover should be limited only by the ASHP's capacity to heat the home, the capacity balance point.

Table 1. Recommended switchover strategy for optimizing operation for different priorities

Optimizing For:	Recommended Switchover Strategy:
Cost	Higher of either economic or capacity balance points
Comfort	Capacity balance point with droop-based staging
Emissions	Higher of either emissions or capacity balance points

The **capacity balance point** is the temperature where the ASHP's maximum output is equal to the home's heating load, which partly depends on unpredictable occupant behavior. Underestimation of the capacity balance point risks leaving occupants in the cold, but overestimation may also impact comfort. Recent surveys show that most homeowners in cold climates feel their new ASHPs provide equal or better comfort than the systems they displace, a sign that prioritizing ASHP runtime could improve comfort. (Hansen-Connell et al. 2025; Hill et al. 2024; Veilleux et al. 2022). More even and consistent temperatures are often cited by occupants to explain their improved comfort, which is likely related to the ASHP's capacity better matching the average home load compared to a furnace sized for the most extreme yet rare temperatures.

Droop-based staging controls are a simple yet useful strategy to maximize ASHP operation without risking comfort. They work by tracking the rate of change or difference between the temperature measured at the thermostat with the thermostat's setpoint. If the temperature drops too much or too quickly, the thermostat can call for a higher capacity heating stage (the furnace). Droop-based staging controls can be used instead of a switchover or in addition to switchover as a supplementary control layer. In any case where the capacity balance point is not certainly below the implemented switchover point, droop-based controls eliminate the risk of insufficient heat.

Finally, the **economic balance point** identifies the switchover temperature that minimizes operational costs. It occurs where the cost per unit of heat delivered is equal between the ASHP and furnace. The economic balance point can vary widely depending on utility rates, so droop-based staging controls are a complementary addition for managing costs alongside comfort.

How Dual Fuel Thermostats Could Automate Switchover Selection from Balance Points

Table 2. Data typically used to calculate dual fuel system balance points

Economic balance point	Capacity balance point	Emissions balance point
ASHP efficiency vs OAT	ASHP capacity vs OAT	ASHP efficiency vs OAT
Electricity costs	Home heating load vs OAT	Marginal electric emission rate
Fuel costs		Furnace emission rate
Furnace efficiency		

Many cold climate utility programs offer guidance for calculating balance points to determine appropriate switchover settings (CEE and Slipstream 2025; ComEd 2024; Focus on Energy 2023), but resources are uneven, balance points can change over time, and applying best practices requires a time investment many installers choose to skip (Hill et al. 2024). Table 2 summarizes the data typically used to calculate dual fuel balance points. This data is not trivial to synthesize but it is not so complex that an intelligent thermostat couldn't help to assemble it and approximate all relevant balance points algebraically, thereby reducing the burden on installers.

For example, an ASHP's **capacity balance point** could be estimated automatically using droop-based staging controls by any smart dual fuel thermostat with outdoor air temperature (OAT) data and a software update. The calculation simply requires noting the OAT at which the ASHP fails to reliably maintain the room temperature near setpoint on its own. In mathematical terms, this could be estimated as follows:

$$T_{capacity,n} = \begin{cases} T_{staging,0} - C & n = 0 \\ \frac{n * T_{capacity,n-1} + T_{staging,n}}{n+1} - C & n \geq 1 \end{cases} \quad (1)$$

where the capacity balance point temperature ($T_{capacity,n}$) is equal to OAT at the first droop-initiated staging event ($T_{staging,0}$) minus an adjustable constant (C). Then, once the number of droop-initiated staging events (n) equals or exceeds one, $T_{capacity,n}$ is equal to the running average minus C thereafter. The adjustable constant, C, roughly represents how much weight should be given to the existing balance point estimate or the possibility that it is lower. C could be implemented as a constant or it may shrink as the certainty grows. For best accuracy, the algorithm will exclude staging events unrelated to weather (like setback recovery). Even so, this strategy requires only simple control algorithms, no user inputs, and no large database. Only the values of n and $T_{capacity,n}$ need to be stored in memory between staging events. The ideal dual fuel thermostat will provide droop-based staging controls by default and automatically leverage that data to calculate the dual fuel capacity balance point to reduce the risk of comfort issues.

Calculating the **economic balance point** automatically is somewhat more complicated because data is required which thermostats do not measure. If the cost of electricity ($Cost_{kWh}$) is available in $/kWh and the cost of the fossil fuel ($Cost_{therm}$) in $/therm, the economic balance point ($T_{economic}$) can be estimated with the addition of just the furnace AFUE and the ASHP coefficient of performance (COP) at two different OATs (T_{COP1}, T_{COP2}). A COP derating factor (D) can be included to correct for differences between actual and rated performance. Assuming constant utility costs, constant furnace AFUE, and a reasonably linear COP trend with OAT[1], the economic balance point can be calculated as follows:

$$T_{economic} = T_{COP1} + \left(\frac{Cost_{kWh}}{29.3 * Cost_{therm}} * \frac{AFUE}{100} - COP_1 * D\right) * \left(\frac{T_{COP2} - T_{COP1}}{COP_2 * D - COP_1 * D}\right) \quad (2)$$

Furnace AFUE is an AHRI-certified equipment specification easily referenced onsite on the furnace nameplate. While ASHP COPs are not currently certified specifications, they are a required test at 47 and 17°F to calculate HSPF2 and are therefore known by the manufacturer (AHRI 2023). NEEP maintains a relevant database of these values for cold climate ASHPs (NEEP 2023) and derating factors are commonly referenced in state TRMs with ASHP measures (MN 2024; IL 2024).

The ideal dual fuel thermostat will calculate the economic balance point by simply asking the user for utility costs and equipment specifications. Additional features like time of use rate

[1] Economics are more sensitive to utility rates than ASHP efficiency (Tudawe et al. 2022) and while not strictly linear, field research comparing noncommunicating variable speed ASHPs with single stage ASHPs has shown similarly linear COP versus OAT trends across these product categories (Hill et al. 2024; Hill 2024).

structures, tabulated/nonlinear COP data, or periodic prompts that request updating the input data could be reasonably included through relatively straightforward algorithms. Utility programs could facilitate the ease of this calculation strategy by providing simple-to-find utility prices online or by application programming interface (API) so Wi-Fi connected thermostats could pull it directly with user-known inputs like zip code and utility name. Manufacturers of communicating ASHPs should program their equipment's performance curves directly into their thermostats and manufacturers of non-communicating/coil-only products should provide their COP data in their installation manuals or directly on their nameplate as is typical of furnaces.

Finally, while market research shows that emission reductions rank as less important to the average homeowner than costs or comfort (Hansen-Connell et al. 2025), **emission balance point** ($T_{emissions}$) calculations could and should be automated by dual fuel thermostats, too. If a thermostat has gathered enough information to calculate the economic balance point, it need only combine emission rate data to the assumptions and data previously identified:

$$T_{emissions} = T_{COP1} + \left(\frac{M_{electric} * AFUE}{M_{Fuel}} - COP_1 * D\right) * \left(\frac{T_{COP1} - T_{COP2}}{COP_1 * D - COP_2 * D}\right) \qquad (3)$$

A thermostat could reasonably estimate the fossil fuel emissions per unit of energy rate (M_{Fuel}) from look-up table based on fuel type and leverage existing API services like WattTime to get real-time electric emission per unit of energy rate ($M_{electric}$). The ideal dual fuel thermostat would leverage emission rate datasets and implement straightforward algorithms to simplify emissions reductions for customers motivated by their environmental footprint.

Armed with automatically calculated balance points from basic equipment and utility data, a thermostat would only need to know their owner's relative priorities to facilitate a suitable switchover selection. Table 1 matches the relevant balance point to reference to optimize for either cost, comfort, or emissions. Many people will prefer the ability to prioritize more than one of these factors. In that case, the ideal dual fuel thermostat could ask users to indicate their relative priorities between cost, comfort, and emissions. An easy-to-understand interface would be ideal and manufacturers can further differentiate their products by pairing it with easy-to-find additional information that would help a user know which settings to tweak if they find themselves not perfectly satisfied.

The Market Benefits from Supporting Smarter Software for Switchovers

In the worst cases, poor switchover selection can eliminate all expected heating season energy savings or lead to callbacks from uncomfortable customers. Thermostats have gotten increasingly "smart" over the last decade, but those smarts could improve dual fuel system operations so much more by facilitating the switchover selection process directly. Manufacturers should seriously consider improved thermostat controls as a significant **differentiation opportunity** with a high value proposition for their cold climate customers and influential market actors.

Installers want to install equipment that is straightforward to get right with low risks for callbacks. They don't want to spend time doing complicated calculations during their installations. Homeowners want the confidence that their HVAC system can control operating costs while maintaining comfort and they don't want to do complicated calculations, either. Utility programs want to facilitate efficient electrification projects for their customers and control bill impact outcomes. Dual fuel thermostats could facilitate all these priorities with relatively simple software updates and make economic and capacity balance point calculations a breeze.

Furthermore, thermostats with switchover settings that can update automatically from just a handful of inputs have potential for improving electric **grid resiliency** and sustainability. Smarter dual fuel thermostats could help more ASHPs be incorporated into time of use rate programs, load management programs, or emission reductions programs, none of which yet widely leverage the benefits effective fuel switching can provide. Taking load control programs as an example, most established strategies for residential HVAC curtailment risk occupant comfort by materially impacting the thermostat setpoint or the HVAC system's output capacity. Dual fuel systems can maintain setpoint but eliminate all compressor kW demand in winter by simply switching over to the auxiliary furnace. Unfortunately, the prominent demand response standard for residential variable capacity HVAC systems, AHRI 1380-2019, does not yet incorporate considerations for dual fuel controls (AHRI 2019). The ideal dual fuel thermostat will be ready to respond to standardized demand signals with temporary switchover modifications, enabling valuable fuel switching on demand.

Other Common Dual Fuel Thermostat Issues and How to Solve Them

Success Stalls at Setup

The importance of the initial thermostat configuration in the context of switchover selection cannot be overstated. However, several other improvements to the thermostat setup process could also impact outcomes. Common, 24-volt thermostats are capable of sophisticated control logic and customization, yet most greet their users with an interface that would feel at home in the previous century. Important settings get buried in multi-level or password-protected menus with cryptic abbreviations made worse by the nonstandard nomenclature employed across brands (PTCS 2023). The relationship between a setting and its impact on comfort, cost, or efficiency remains a mystery to everyday users and installers alike. This easily leads to situations where settings can be inadvertently modified or left in an unsuitable default setting, diminishing the system performance by a thousand cuts.

There is no technical barrier to a **guided setup wizard** that walks the installer or occupant through system configuration in **plain language** to avoid common setup pitfalls. The ideal dual fuel thermostat setup workflow should ask simple, plain-language questions to establish system type, fuel sources, location, utility rate structure, and occupant priorities to enable switchover calculations from the start. It should also explain each setting in terms of its impact on comfort, cost, or emissions before asking the user to confirm it. Especially for installer-level configurations, default settings should be kept to a minimum to ensure that the system controls faithfully reflect the specifics of the installation, rather than letting random defaults persist. The setup should also confirm the completed configuration with a summary that flags any settings which may be inconsistent with the installed equipment or climate.

A common missed opportunity during coil-only dual fuel ASHP installations is the **configuration of fan stages** (Hill 2024; Peffer et al. 2024). Communicating thermostats may do this automatically, but non-communicating systems always require manual configuration to get staging right. Especially for variable speed coil-only systems, fan speed modulation can significantly expand the operating space of the ASHP, improve cycle efficiency by 10% or more, and enhance comfort (Hill 2024). The ideal dual fuel thermostat will recognize that if the furnace has multiple stages, the ASHP should benefit from them in heating mode, too. It should also encourage installers to ensure the correct airflows are selected for both heating and cooling operation: if dehumidification is important, choosing a lower airflow for cooling mode can improve performance.

After an installer has completed a comprehensive setup wizard complete with staging controls setup, a **user setup wizard** could also benefit dual fuel ASHPs. This can be an opportunity for a homeowner to become familiar with their control options and weigh in on their prioritization of cost, comfort, and emissions, something that an installer can't necessarily define. Especially when ASHPs are installed as AC replacements, users may not be aware of the nuances between ASHP and furnace operation. Including a dedicated user set up wizard could provide basic information and myth-busting relevant to new ASHP adopters. The ideal dual fuel thermostat is uniquely positioned to be a decarbonization education tool as much as a comfort control device.

Emergency Heat Mode

Several common thermostat settings are known to suppress efficiency over time. One of the most insidious failure modes observed in the field is an accidental switch to **emergency heat mode**. Intended to provide an easy way to switch to auxiliary heat only in case of equipment failure, emergency heat mode locks out ASHP heating in direct favor of auxiliary heat. The mode may be engaged by occupants trying to accelerate recovery from a setback or after a perceived heat pump malfunction (Hill et al. 2024). If forgotten, a system in emergency heat mode runs on backup fuel indefinitely and the cost and emissions penalties may be significant. To avoid such mistakes, emergency heat mode should carry a persistent, prominent indicator when it is active, a plain-language explanation of what it means and what it costs, and a time-limited default that returns the system to normal operation unless manually prompted otherwise.

The ideal dual fuel thermostat will extend this sort of **trust-but-verify philosophy** regarding emergency heat use to any sudden or unexpected changes in auxiliary heat use. For example, droop-based staging controls maintain comfort by automatically switching to the backup furnace when the ASHP isn't keeping up. This can obscure equipment issues that would be obvious in a system without a redundant heating system, but equipment failures should not be invisible to either the thermostat or the user. Because the ideal dual fuel thermostat can determine the capacity switchover, it should also identify sudden changes and provide some indication of the unexpected operation. This transparency can help identify failures faster, potentially avoiding costly operating modes, repairs, or slowly compounding refrigerant leaks.

Setback Recovery

One of the longest-standing recommendations in residential energy efficiency programs is the scheduled setback. A setback reduces the heating setpoint by several degrees during sleeping or away hours to save energy. Decades of program data support the use of setbacks for traditional furnaces (DOE 2015). In ASHP systems, however, deep nightly setbacks are a less effective efficiency strategy because they can lead to inadvertent auxiliary heat use. When the setpoint steps up sharply in the morning, commonly by 4-6°F in an instant, the heat pump operating at its rated capacity in cold morning temperatures may not recover the space as quickly as the thermostat's logic demands. The thermostat may interpret this as an emergency or ASHP capacity failure and respond by calling for the highest capacity (but least efficient) heating stage, the auxiliary furnace. The irony is that occupants may set a deep overnight setback solely to follow longstanding efficiency wisdom and unintentionally trigger a daily fossil fuel penalty that the thermostat never discloses.

The solution to inefficient setback recovery is **intelligent recovery** where thermostat uses the setpoint schedule to anticipate recovery needs and chooses to ramp the setpoint gradually before the targeted setpoint time when the ASHP is the preferred heating source. This ensures that setpoint is hit according to schedule but that the system respects the switchover logic determined by the balance point calculations and owner priorities as much as possible. In the spirit of the transparency design principle, the ideal dual fuel thermostat will make its recovery strategy visible to the occupant. Messages like "Your home will begin warming at 5:45 am to reach 70°F by 7 am using the heat pump" should be used so the logic is understandable, trustworthy, and can be negated if the user so desires. Intelligent recovery is not a novel concept (Kim et al. 2024). Optimized start algorithms exist in commercial building controls and in some residential thermostats, but dual fuel thermostats should also apply these controls to their unique hybrid fuel source situation. Like other improvements, this fix requires no new hardware, only smarter software. If this solution does not get automated in dual fuel thermostats, then efficiency programs should consider updating how they communicate setback recommendations. Program guidance should account for characteristics unique to ASHPs and give customers the information they need to avoid uncomfortably deep setbacks in the pursuit of ineffectual savings.

Recommendations for Stakeholders

The features and strategies described in this paper are not aspirational. Most have been demonstrated to some extent or are achievable with modest software development. However, realizing the full potential of dual fuel ASHP systems will require coordination between multiple market actors. The following recommendations are organized by stakeholder group, recognizing that collaboration across all of them will be required to make significant impact.

Utility and Energy Efficiency Program Administrators

Utilities and residential program administrators occupy a unique position of influence and must initiate market coordination for the fastest results. They are the only stakeholders with both a clear business case and sufficient market influence to create conditions that make everyone else's action rational. Specifically, utility programs need to:

1. **Update Existing Incentive Programs.** At a minimum, all rebate-worthy thermostats should be dual fuel compatible, and all cold climate ASHP rebate programs should have dual fuel compatible controls embedded as an eligibility condition. These two program vectors already exist with enough volume and money moving through them that their alignment with dual fuel system requirements can provide other market actors with the concrete, near-term revenue motivation to prioritize dual fuel control features. These small, coordinating moves can align existing incentive streams without waiting for regulatory mandates, new program budgets, or mass market adoption.
2. **Coordinate and Align on a Dual Fuel Thermostat Specification.** Ideally, incentivized thermostats will offer features like those discussed in this paper and more, but an actionable specification must be defined in terms of outcomes rather than methods to

preserve design freedom[2]. Organizations like the Consortium for Energy Efficiency will be ideal partners with which to collaborate and align a market large enough to land on thermostat manufacturers' product roadmaps.

3. **Facilitate Access to Utility Rate Data.** The dual fuel economic balance point calculation requires utility rate inputs that are rarely in a format useful or accessible to thermostats or installers. Utilities should publish time-of-use and flat rate data in a standardized, machine-readable format. The required infrastructure investment could provide benefits beyond dual fuel system optimization, as evidenced by the success of paid services that aggregate rate data like Arcadia's Genability platform (Arcadia 2021).
4. **Modernize Dual Fuel Rate Programs.** A dual fuel ASHP can shed its entire electric heating load instantly and seamlessly by switching to its backup fuel. Utilities should expand on the nation-leading dual fuel rate programs demonstrated in Minnesota (CEE 2026) and leverage emerging thermostatic and/or system-based load shaving and fuel switching methods. This will expand product and demand response program compatibility and align with developments from FERC Order No. 2222.
5. **Update Setback Guidance for ASHP Systems.** Efficiency recommendations around temperature setbacks were originally developed for single-stage systems and can produce unintended penalties from ASHPs without intelligent recovery logic. Until intelligent setback recovery becomes standard in dual fuel thermostats, program guidance should explicitly address situations where setback recovery can diminish energy savings.
6. **Invest in Trade Ally Training.** Thermostat configuration is as consequential as equipment selection in a dual fuel system, but installer training rarely reflects this. Trade ally training programs should include dedicated modules on dual fuel thermostat setup, switchover selection, staging configuration, and demand response enrollment. Programs that offer enhanced incentives for quality installation will see better field performance outcomes than those that treat commissioning as an afterthought (Valoria et al. 2024).

Thermostat and Equipment Manufacturers

Once credible thermostat specification alignment exists, the first manufacturers to engage with it proactively will capture co-marketing relationships, contractor training channels, and the installer recommendation dynamic. Late entrants to the party may find dual fuel certifications become a bare minimum market entry requirement for the cold climate states where heat pump policy is moving the fastest. To keep up, manufacturers should:

1. **Invest in the Installer and User Interface Experience.** Implement a plain-language setup wizard that walks both installers and occupants through system configuration, explains the impact of each setting, and flags inconsistencies between settings and the installed equipment or climate. Default settings should be minimized in favor of prompted, confirmed configurations. A customized yet frictionless commissioning process can be the foundation for glowing reviews and repeat installer customers.
2. **Meet and Exceed Dual Fuel Thermostat Specifications.** Proactive engagement with specification development groups and implementing software improvements are marginal costs to gain a credible competitive advantage in a category where the products otherwise

[2] This paper has primarily described *how* thermostats can be better as a proof of concept and feasibility. Specification development must generalize these concepts into outcomes to foster innovation on the methods.

seem interchangeable to consumers. To stay ahead of the curve, focus on combining the features highlighted in this paper including:

  a. Automatic balance point calculation
  b. Droop-based staging as standard
  c. Intelligent setback recovery as default
  d. Demand response and grid signal readiness

Installers and Trade Allies

Installers are the last line of defense between an effective thermostat and a poorly configured one. The following recommendations are offered in the spirit of professional practice, not criticism:

1. **Treat Thermostat Configuration as a Callback Cure.** The time required to properly configure and test a dual fuel thermostat delivers real value. Callbacks caused by misconfigured thermostats cost more than the time proper setup would have taken.
2. **Never Leave a Job with Default Settings.** A dual fuel system with no switchover setting, a default switchover setting, or a switchover setting that was not discussed with the homeowner is a risk to an installer's reputation. Default settings can vary widely and have no guarantee to be a good fit for a specific install (Bucaneg 2025).
3. **Configure Fan Staging for the Heat Pump.** In non-communicating coil-only installations with multi-speed air handlers, confirm that the thermostat is configured to use leverage all appropriate fan stages during heat pump heating operation. This is a commonly missed step that can meaningfully suppress heat pump efficiency and comfort (Hill 2024). Airflow and pressure diagnostics should be used to assess the fan configuration in all ASHP modes.
4. **Conduct a Homeowner Handoff.** Before leaving a dual fuel ASHP installation, walk the homeowner through the basics of how their system works, what the thermostat is doing, and what they should watch for. Cover at minimum: what dual fuel means and why the system sometimes runs the furnace instead of the heat pump; how to read the operating mode display; what emergency heat mode is and why it should not be left on; and who to call if something seems off. A five-minute conversation at handoff can prevent months of inefficient or costly operation.

Policymakers and Standards-Making Bodies

Standards and policy set the floor for what the market delivers. In the dual fuel thermostat space, that floor is currently very low. The following recommendations identify specific standards and policy opportunities that could accelerate the improvements described in this paper across the entire market, not just among early adopters and engaged manufacturers.

1. **Include Dual Fuel Considerations in Existing Demand Response Standards.** AHRI 1380-2019 was not designed with dual fuel fuel-switching logic in mind, but protocols including OpenADR 2.0b and 3.0 have incorporated dual fuel support. Standards bodies should continue to develop addenda that address switchover-based demand response, heat pump runtime reporting, and carbon signal integration.

2. **Incorporate Dual Fuel Thermostat Performance into Heat Pump Incentive Frameworks.** Federal and state heat pump incentive programs should consider thermostat performance requirements that align with regional efficiency consortia as a condition of qualifying dual fuel installations. A heat pump paired with a poorly configured thermostat won't deliver the efficiency or emissions benefits that justify the incentive. Minimum thermostat standards tied to incentive eligibility are a cost-effective way to improve average field performance across a large and varied market.

Conclusions

The average thermostat has a lot of room for improvement for dual fuel ASHP applications. The good news is that the many improvements described in this paper are not technically difficult, financially prohibitive, or dependent on breakthroughs that have not yet occurred or may not be possible. They are, in most cases, software updates, training investments, and policy choices. The dream dual fuel thermostat is not waiting on a laboratory, it is waiting on the coordinated will of the stakeholders who together control whether it gets built, specified, installed, and used. No single stakeholder can perfect dual fuel thermostats alone. Manufacturers can build better products, but only if the market rewards their delivery and installers configure them correctly. Programs can set better specifications, but they are only useful if manufacturers produce compliant products and utilities make accessible the data and performance signals those products need. Installers can configure systems properly, but only if they have the training, tools, and time to do so. Policymakers can set the floor, but only for what the market has demonstrated is achievable.

Dual fuel ASHPs are one of the most practical and immediately deployable decarbonization tools available for homes in very cold climates and those where full electrification remains economically impractical. Unlike fully electric systems that can require large ASHPs, significant electrical infrastructure upgrades, and a tolerance for high upfront costs, dual fuel strategies can overcome ASHP limitations and offer more flexibility for cost-constrained homeowners. Dual fuel systems also offer more resiliency to volatile fuel rates and can improve occupant comfort. The technology is proven, the operational economics can always be favorable with the right switchover controls, and the installation base is growing.

Unfortunately, the current complexity involved in establishing an effective dual fuel control strategy has turned what should be a product strength into a challenge to be overcome. Dual fuel thermostats have a clear opportunity to accelerate decarbonization by ensuring that the ability choose between heating fuels based on costs, comfort, or emissions is a feature, not a bug. The thermostat is arguably the single best intervention point in the average dual fuel system. An ASHP paired with a poorly configured or poorly designed thermostat is, in the worst cases, little more than an expensive AC. The same ASHP paired with a thoughtfully designed thermostat can deliver on the full promise of dual fuel ASHPs: lower bills, lower emissions, reliable comfort, and meaningful grid flexibility. These can improve simultaneously and without asking users to become HVAC engineers.

The ideal dual fuel thermostat calculates balance points automatically, stages intelligently, recovers setbacks efficiently, responds to grid signals dynamically, and communicates transparently with its occupant. The blueprint described in this paper is not a vision for a distant future product. It is a description of what is achievable today, largely through software, on hardware that is already manufactured and installed. Guided setup wizards, droop staging defaults, demand response via switchover control, and user-centered interfaces are all within reach of current thermostat platforms. Manufacturers, utilities, installers, and policymakers can all take actions today to improve dual fuel thermostats, bridge the controls gap, and make dual fuel ASHP installs easier, more efficient, and more flexible than ever before. The opportunity is clear, we just need to collaborate.

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