The Control Premium: Behavioral Barriers to Electrification and Demand Response in the Midwest

Phylicia Lee Brown, Ph.D., Slipstream

ABSTRACT

Efficiency programs are transforming nationwide, shifting efforts towards adoption of high-efficiency electric technologies and grid-interactive programs. However, market adoption remains constrained by both financial costs and less-understood behavioral barriers. This paper posits that the perceived psychological cost of accepting performance risk and ceding control acts as a significant barrier, often overriding a clear financial return.

Using interview and survey insights from field studies and market assessments I conducted in recent years, I introduce the **Control Premium** as a conceptual framework for understanding these behavioral barriers. The Control Premium manifests as a demand for certainty and predictability across all segments. Residential customers minimize risk by opting for hybrid systems (heat pumps with fossil fuel backup, hybrid vehicles) and condition their interest in Demand Response on receiving clear estimates of event frequencies. C&I customers require a detailed proposal on DR event structure, as operational disruptions jeopardize production. Crucially, the premium pits control against grid resilience, as customers report reluctance to allow utility access to battery storage, reserving the asset for personal backup during outages. The premium is not equitably distributed: for historically marginalized and low-income customers, it compounds upon structural barriers that must be resolved before behavioral barriers even become the operative constraint.

Rebates are insufficient to advance affordability and grid resiliency. I explore how programs can increase adoption, including by normalizing hybrid pathways and including control-enhancing tools (like real-time data) that address customers' reticence to cede control.

Introduction

The United States is in the midst of a fundamental energy transition. Efficiency programs nationally are shifting toward high-efficiency electric technologies and grid-interactive programs—including demand response (DR), dynamic rates, and grid-edge storage—as essential tools for decarbonization and grid reliability (Nadel and Fadali 2022). Yet market adoption of these technologies and programs remains far below modeled potential (Bastian and Cohn 2022; Wekhof and Houde 2023; Drehobl, Ross, and Ayala 2020). Financial barriers such as upfront cost, long payback periods, and rebate complexity are real and extensively documented. They are not, however, the whole story.

What is far less understood and largely undertheorized in the energy efficiency literature are the behavioral barriers to adoption: the psychological costs associated with ceding control, accepting performance risk, and surrendering asset autonomy to an external actor. A growing body of scholarship establishes that behavioral barriers, not just prices, are critical drivers of energy consumption, and that effective policy must account for behavioral factors (Allcott and Mullainathan 2010; Frederiks, Stenner, and Hobman 2015). Critically, behavioral interventions

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are often *lower cost* than equivalent financial interventions, making their systematic neglect by program designers doubly consequential (Allcott and Mullainathan 2010).

This paper introduces the **Control Premium** as a conceptual framework for understanding these behavioral barriers. The Control Premium is defined as the perceived psychological cost of accepting performance risk and ceding autonomy over one's home, business, or assets to an external actor—whether a utility, technology system, or market operator. The Control Premium functions as a hidden tax on program participation and efficient technology adoption, one that frequently overrides otherwise favorable financial returns, and that manifests distinctively across residential, commercial and industrial (C&I), and market actor segments.

The United States Midwest—Michigan, Minnesota, and Wisconsin in particular—offers an instructive vantage point for examining the Control Premium. These states share a set of structural conditions that amplify behavioral barriers: electric rates that are high relative to natural gas, creating unfavorable switching economics; legacy industrial and auto industry cultures oriented toward operational self-sufficiency; strong utility monopolies with histories of mixed performance and limited customer trust; and stark regional variation between urban utility corridors and rural propane-dependent communities that produces divergent risk calculations even among customers with similar financial profiles. These conditions do not merely illustrate how behavioral barriers *can* function; they reveal how behavioral barriers function *differently* across customer segments, geographies, and institutional contexts, differentiations that have direct implications for program design.

The equity dimensions of the Control Premium deserve particular attention. A substantial body of research documents the disproportionate energy burdens faced by historically disadvantaged communities such as LMI households, communities of color, manufactured home residents, and rural customers dependent on delivered fuels (Drehobl, Ross, and Ayala 2020; Carley and Konisky 2020). For these populations, the Control Premium does not operate in isolation: it compounds upon structural barriers—high upfront costs, health and safety preconditions, administrative complexity, and a well-founded history of distrust toward utilities and government programs—that must be resolved before behavioral barriers even become the operative constraint (Hernández 2016; Clapper et al. 2024). Program designers who address only the financial barrier without attending to the deeper behavioral and structural conditions will systematically fail to reach the communities most in need.

This paper draws on primary qualitative and survey data collected across Michigan, Minnesota, and Wisconsin between 2023 and 2026, including in-depth interviews with residential customers, C&I customers, market actors (HVAC contractors, electricians, building owners), and a community-scale pilot evaluation with income-qualified manufactured home residents. It presents the Control Premium as a durable, generalizable behavioral phenomenon, traces its manifestations across customer and technology contexts, examines its equity dimensions, and offers a set of program design recommendations for reducing it.

Conceptual Framework: The Control Premium

The Control Premium is defined as the perceived psychological cost of (a) ceding operational control, (b) accepting performance risk, and (c) surrendering asset sovereignty to an external and often distrusted actor. The premium is not irrational: it reflects rational responses to real uncertainty, persistent information asymmetry, and for many customers, history of broken promises between utilities and the communities they serve. Critically, the Control Premium is distinct from pure financial barriers and their effects: it is present even when financial incentives are sufficient and available, and it is this defining characteristic—behavioral resistance that persists in the face of favorable economics—that makes it both analytically important and practically challenging for program designers.

Theoretical Foundations

This paper is guided by the sociotechnical framework, which holds that technological adoption is shaped not by technical performance alone but by the social, political, regulatory, and cultural conditions in which technologies are embedded (Geels 2002; Geels et al. 2017). In this framework, behavioral barriers are structural phenomena and reflections of systemic conditions, rather than individual failures of rationality. Following Geels et al. (2017), I operationalize behavioral barriers as encompassing the cultural and social dimensions of energy technologies, including psychological resistance, institutional distrust, and consumers' interpretive frameworks for what controllable and reliable energy service should look like.

The Control Premium builds on this structural foundation by grounding its behavioral mechanisms in the decision science literature. Prospect Theory (Kahneman and Tversky 1979) established that people evaluate outcomes relative to a reference point, and that losses loom larger than equivalent gains—a cognitive asymmetry with direct implications for energy program participation. A customer weighing a DR enrollment decision is not performing a neutral cost-benefit calculation: they are comparing a certain, immediate loss (relinquishing thermostat control) against an uncertain, probabilistic gain (bill savings over future event seasons). Loss aversion tilts this calculation away from participation, independent of whether the expected financial return is positive.

Thaler and Sunstein's (2009) Nudge framework extends Kahneman and Tversky's (1979) insights by demonstrating that choices are powerfully shaped by the *choice architecture* in which they are made—defaults, framing, salience, and social context—in ways that deviate systematically from standard economic predictions. The framework identifies three cognitive tendencies particularly relevant to the Control Premium: *loss aversion* (already discussed); *status quo bias*, the tendency to remain with one's current situation even when alternatives are objectively superior; and the *endowment effect*, by which ownership increases the perceived value of an asset. The endowment effect is especially potent in energy contexts: customers who own a gas furnace, a backup generator, or a home battery perceive these assets as having value beyond their market worth, thus resisting any program that would transfer control of those assets to an external actor, even temporarily.

Consumer behavioral research in the energy domain confirms that these cognitive dynamics operate markedly in contexts of unfamiliarity, high stakes, and low information. Frederiks, Stenner, and Hobman (2015) synthesize the behavioral economics literature as it applies to household energy decisions, demonstrating that loss aversion, present bias, inertia, and social norms jointly shape energy behaviors in ways that standard economic interventions routinely fail to address. Their core call for research to focus on “not only *what* predicts consumers' behavior, but *when, where, how, why, and for whom* these effects occur”, is the animating principle of this paper (Frederiks, Stenner, and Hobman 2015, 1391).

Research on technology adoption adds additional theoretical scaffolding. Davis's (1989) Technology Acceptance Model (TAM) demonstrates that perceived ease of use is as predictive of adoption as perceived usefulness. In other words, technologies experienced as difficult to control or manage face resistance independent of their objective performance. In energy terms, 'ease of use' maps directly onto 'ease of maintaining control': a technology that requires the user to cede autonomy, even partially, incurs a behavioral adoption penalty that goes undetected by purely financial evaluation frameworks. Wolske, Stern, and Dietz (2017) provide the empirical inverse: in their study of residential solar adoption, *perceived behavioral control*—the degree to which customers feel confident in their ability to manage a technology—is a key predictor of adoption interest. Higher perceived control predicts higher interest while reduced perceived control is, in contrast, a systematic adoption suppressor.

Rogers' (2003) diffusion of innovations framework adds a market-structural dimension: technology adoption follows a predictable S-curve in which early adopters (i.e., those with high risk tolerance, strong information access, and low psychological barriers) are concentrated at the left tail of the distribution. The finding across our primary data that current heat pump adopters are disproportionately 'climate activists and tech-curious homeowners' is not incidental; it reflects the structural reality that programs optimized for early adopters—those with naturally low Control Premiums—systematically leave the late majority underserved. The late majority, by definition, exhibits higher premiums and requires qualitatively different program design.

The Three Axes of the Control Premium

I conceptualize the Control Premium as operating along three interlocking axes, each validated by distinct theoretical and empirical literatures:

Operational Control — *Resistance to programs or technologies that limit or transfer control over core operational functions*: thermostat settings, production schedules, battery discharge, or vehicle charging windows. This axis is anchored in loss aversion and status quo bias (Kahneman and Tversky 1979; Thaler and Sunstein 2009): customers treat their current operational arrangements as the reference point against which any program change is evaluated, and the certain, immediate relinquishment of control is weighted more heavily than the uncertain, future financial benefit of participation. This asymmetry is independent of whether the financial return is favorable; it is the structure of the trade-off, not its magnitude, that drives resistance.

Performance Risk — *Fear that a technology or program will fail to deliver on its promised performance, producing comfort loss, productivity disruption, or financial harm*. This axis is validated by Davis's (1989) TAM—perceived ease of use as an adoption predictor—and by the trust-acceptance model of Siegrist (2000), which demonstrates that low institutional trust amplifies perceived risk and discounts perceived benefits. Wolske, Stern, and Dietz (2017) provide the empirical inverse: higher perceived behavioral control over a technology reliably predicts higher adoption interest, supporting the argument that programs which increase transparency, predictability, and opt-out clarity will measurably reduce performance risk anxiety.

Asset Sovereignty — *Reluctance to allow external actors to access or draw upon personally owned or publicly subsidized assets* (e.g., home batteries, EVs, or flexible thermal loads) for grid benefit**.** The asset sovereignty axis is most directly anchored in the endowment effect: physical ownership creates perceived value and perceived rights that customers are highly reluctant to dilute. It also draws on the literature on identity and self-determination, in which control over one's home and assets are bound up with notions of domestic security, independence, and dignity—values with particular salience in the upper Midwest auto-industry cultural context.

Behavioral Heterogeneity and the Distribution of the Control Premium

While the Control Premium provides a generalizable framework for understanding how demand for certainty and predictability acts as a barrier to electrification and grid participation, the magnitude and form of the premium varies substantially across and within customer segments—a heterogeneity with direct implications for program design.

Research on dynamic pricing has documented this heterogeneity in quantitative terms: Faruqui and George (2005) found that responsiveness to critical peak pricing varied substantially across residential, small C&I, and large C&I customers, as well as by rate type, climate zone, season, air conditioning ownership, and other characteristics. Such diverse heterogeneity is also evident within residential customers; with Poblete-Cazenave and Rao (2023) finding higher propensities for ASHP adoption amongst urban households in warmer climates with younger heads of households in larger and better insulated homes.

Risk preferences also play a documented role in energy technology adoption decisions. Qiu, Colson, and Grebitus (2014) find that individual risk aversion is distinct from loss aversion, and independently predicts residential energy technology purchase decisions, with more risk-averse households less likely to adopt efficient technologies even when expected financial returns are favorable. Schleich et al. (2019) extend this finding, demonstrating in a large-scale European study that time discounting, risk aversion, loss aversion, and present bias each independently predict household adoption of energy-efficient technologies, and that their effects are additive. Together, these studies suggest that the Control Premium is not a single uniform barrier but a composite of interacting cognitive tendencies whose relative weight varies by customer, context, and technology. The primary data in this paper provides the qualitative architecture for understanding how that heterogeneity manifests in practice. What Poblete-Cazenave and Rao (2023), Qiu et al. (2014), and Schleich et al. (2019) document quantitatively, the results below surface qualitatively and with sufficient specificity to suggest where premium-reducing interventions are most likely to find purchase.

Most critically, the premium is amplified among historically marginalized populations. Customers who have experienced repeated harm, neglect, or discriminatory treatment by utilities and government institutions develop what the risk perception literature characterizes as a *trust deficit*: when institutional trust is low, perceived risk is amplified and perceived benefits are discounted, regardless of the objective risk-benefit ratio (Siegrist 2000). For communities subject to infrastructure disinvestment, discriminatory mortgage lending, and redlined service territories, this trust deficit is not a cognitive bias to be corrected; it is a rational inheritance of documented institutional harm (Clapper et al. 2024).

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Methodology

This paper employs a mixed-methods research design, combining large-scale quantitative survey data with qualitative in-depth interviews (IDIs) drawn from a robust evidence base collected across Michigan, Minnesota, and Wisconsin between 2023 and 2026. The primary empirical foundation is Volume V of the 2025 Michigan Energy Waste Reduction, Demand Response, and Efficient Electrification Statewide Potential Study, commissioned by the Michigan Public Service Commission (MPSC) and conducted by Slipstream (Koliner, Brown, and Sharer 2025). To strengthen the generalizability of the Control Premium framework, I integrate findings from three additional primary data sources: the 2026 Minnesota CARD Homeowner and HVAC Journey Mapping Study (Brown, Lick, and Segura 2026a), the 2026 Minnesota CARD Electrician IDI Results (Brown, Lick, and Segura 2026b), and the 2025 Large Midwest Utility Manufactured Home Pilot Evaluation (Stendel et al., 2025). I further include behavioral and attitudinal findings from a 2025 Wisconsin Cold Climate Dual-Fuel RTU study to ground the framework in a commercial and industrial context (Slipstream 2025). Detailed data sources and sample specifications are presented in **Table 1**.

As the primary researcher for the qualitative components of these studies (with the exception of the 2025 Wisconsin Dual-Fuel RTU Cold Climate Dual-Fuel RTU study), I designed and conducted the in-depth interviews (IDIs) and led the thematic coding and analysis. The research utilized semi-structured interview protocols to capture the qualitative texture and lived experiences of research participants. All interviews were audio-recorded, transcribed, and processed using qualitative analysis software. This paper's analytical approach utilized inductive coding to surface emergent manifestations of the Control Premium, followed by a deductive application of the behavioral economics framework. While the qualitative sample size (n=32 for the core Michigan study) is modest, the multi-state integration provides the necessary geographic and demographic breadth to validate the Control Premium as a durable behavioral phenomenon. Large-scale survey data (N=648 in Michigan) served as a quantitative triangulation point for identified behavioral patterns.

Reflecting the paper's social science grounding, it is important to note my positionality as a mixed-methods senior researcher with a doctorate in environmental sociology. My equity-centered perspective intentionally prioritizes the voices of low-income and historically marginalized customers, as well as those with high levels of utility distrust, whose experiences of infrastructure precarity often amplify the Control Premium.

Table 1. Summary of Primary Data Sources and Sample Specifications

Data Source	State	Segment	Sample Size (N)	Data Collection Method
Energy Waste Reduction, Demand Response, and Efficient Electrification Statewide Potential Study, Volume V: Primary Data Collection	MI	Residential	330 (Survey); 6 (IDI)	Mixed-methods
	MI	C&I	318 (Survey); 6 (IDI)	Mixed-methods

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Data Source	State	Segment	Sample Size (N)	Data Collection Method
	MI	Market Actors	20 (IDI)	Qualitative
Minnesota CARD Homeowner and HVAC Journey Mapping Study	MN	Residential	11 (IDI)	Qualitative
	MN	HVAC Contractors	3 (IDI)	Qualitative
Minnesota CARD Electrician Interview Study	MN	Electricians	4 (IDI)	Qualitative
Manufactured Home Pilot Evaluation Report	MN	IQ/LMI Residents	22 (IDI)	Qualitative
Wisconsin Cold Climate Dual-Fuel RTU: Final Report	WI/Midwest	C&I / Building Owners	5 (IDI)	Qualitative
	WI/Midwest	HVAC Contractors	2 (IDI)	Qualitative
	WI/Midwest	Design Teams & Mfr Reps	6 (IDI)	Qualitative

Results: The Control Premium Across Segments

Across the full qualitative dataset, the Control Premium emerged as a durable and consequential behavioral phenomenon. Its defining characteristic—persistence even in the presence of a favorable financial return—was evident across studies. Multiple customers explicitly declined savings, rebates, or bill credits rather than cede operational control, allow utility access to their assets, or accept performance uncertainty. The results are organized by the three axes along which the premium operates: operational control, performance risk, and asset sovereignty.

Axis 1: Operational Control — Residential and C&I Customers

The most pervasive expression of the Control Premium across the interview sample was resistance to programs that would limit or transfer control over core operational functions: thermostat settings, battery discharge, production schedules, or vehicle charging windows. Customers consistently described their existing operational arrangements not as conveniences but as constitutive of what adequate energy service should feel like; a framing that rendered even temporary, compensated control cession objectionable.

Demand response enrollment was the clearest flashpoint. Among residential customers, interest in DR was almost uniformly conditional rather than categorical, and the decisive conditions were consistently about control structure rather than compensation level. The survey data frames the scale of the problem: 48% of Michigan residential respondents had never heard of demand response programs, and of the 28% who were aware but not enrolled, the most consistent non-financial barrier was uncertainty about what participation would actually require of them. The qualitative data demonstrates this: customers who could not predict how often events would occur, how long they would last, or whether they could override a setpoint treated that uncertainty as a disqualifying feature.

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"An important motivator would be getting clear estimates of how often this would occur." — Residential Customer, Upper Peninsula, Non-low-income

The absence of event frequency information functions as a significant veto for risk-averse customers. It is not that customers were unwilling to participate in principle, it is that uncertainty about loss of control is itself experienced as a loss, activating the prospect-theoretic asymmetry between certain, immediate relinquishment and uncertain future benefit (Kahneman and Tversky 1979). A C&I customer exemplifies how providing information that gives customers visibility into what is happening in real time can function as a control-restoring mechanism and reduce barriers to DR adoption.

"I'm preparing to present that case again because I think the DR program is very attractive. Especially because it includes a real time meter of our energy use, which I would find extremely helpful."— C&I Customer, Large Manufacturer, Kalamazoo

Among residential customers who had direct DR experience, the data reveals what the "gold standard" program looks like from a customer's perspective. The single residential customer with zero concerns about his DR enrollment, was participating in a contactor-based program that cycled his AC without perceptible impact. His description is analytically important because it defines the implicit benchmark against which all other programs are measured—a program that cedes no perceptible control:

"It happens in the background. It doesn't happen often or long enough to cause any substantial penalty for our comfort. Sort of free money from my perspective." — Residential Customer, HVAC Industry Veteran, Upper Peninsula, Non-low-income

This participant's profile is not a typical customer; it is a destination. His comfort with utility DR access was built on three conditions that are rarely met in standard program design: technical understanding of how the system operates, zero experienced discomfort across all events, and a long, positive relationship with his utility. This HVAC industry veteran's 'free money' framing is analytically significant: the program he describes is one that imposes no perceptible change to his operational baseline. It is, in effect, a zero-status-quo-cost program that, more than the compensation level, is what makes it acceptable (Thaler and Sunstein 2009). Where those conditions do not hold, the following residential customer's experience is more representative: a summer cooling DR participant whose primary critique was that large temperature swings caused the AC to run all night in recovery mode, negating efficiency and worsening comfort:

"Instead of large temperature swings throughout the day, keep it at a consistent but comfortable temperature for longer periods. Greater flexibility and clarity on how to manually change temps when needed during peak periods." — Residential Customer, Greater Detroit, Low-income

This participant does not reject DR categorically. He demands control, predictability, and consistency—conditions that map directly onto what the TAM literature calls perceived ease of

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use (Davis 1989) and exemplifies the behavioral freeze that occurs when any dimension of a program feels uncontrollable or uncertain, even when the actual probability of disruption is low.

For C&I customers, the operational control axis shifted from discomfort into liability. Only 8% of Michigan C&I survey respondents participated in DR, despite higher awareness rates than residential customers, a gap that the qualitative data explains clearly. For businesses across varied industries from tourism to manufacturing and production operations, DR event risk is not experienced as inconvenience; it is experienced as a direct threat to customer commitments, production timelines, and contractual obligations. The data also reveals the inverse: a sole proprietor running an arts and retail business that only operates at night represented what the data synthesis terms a "Control Premium inversion." Because DR events typically occur during daytime hours when his business is closed, the program poses no operational risk whatsoever. Faruqui and George's (2005) documented heterogeneity in DR responsiveness maps directly onto the contrast found between different C&I business types. This divergence points to an underexplored targeting opportunity: a segment of C&I customers for whom the operational control barrier is structurally near-zero, and for whom DR enrollment is a natural fit that standard outreach does not systematically identify.

Axis 2: Performance Risk — Residential and C&I Customers, and Market Actors

The performance risk axis—fear that a technology or program will fail to deliver on its promised performance, producing comfort loss, productivity disruption, or financial harm—was grounded across the interview sample not in abstract anxiety but in direct experience, secondhand accounts, and structurally produced skepticism about institutional reliability. It manifested across two related but distinct registers: equipment performance risk, or fear that a technology will fail to deliver on its physical promises and program performance risk, or fear that a utility or program administrator will fail to honor the terms of participation. While the residential data surfaces primarily equipment performance risk, the C&I data reveals that prior negative program experience produces an equally powerful, and organizationally entrenched, form of the premium.

Among Michigan and Minnesota residential customers, heat pump performance in cold climates was the dominant performance risk preoccupation. The Michigan survey context frames the scale: 53% of residential respondents reported being *unfamiliar* or *very unfamiliar* with heat pumps. This awareness deficit is itself a prerequisite condition: customers cannot navigate control trade-offs for technologies they do not understand. However, the IDI data reveals that familiarity is not sufficient; customers who had heard of heat pumps often carried secondhand accounts of underperformance during extreme cold events that functioned as powerful adoption suppressors. These accounts were typically rooted in earlier-generation equipment, but their currency in local social networks has outlasted the technology.

In the Wisconsin Dual-Fuel RTU C&I study, the City exhibited a structurally analogous pattern: articulating a formal carbon neutrality goal by 2030 while simultaneously expressing concern about added troubleshooting complexity from a dual-fuel RTU. The goal is acknowledged and endorsed, but the control anxiety overrides it at the decision point. This is the Control Premium in its clearest theoretical form: behavioral resistance that persists in the presence of explicit, stated preference for the desired outcome.

The hybrid pathway emerged across residential segments as the key performance risk mitigation strategy: retaining gas backup alongside heat pump installation. Critically, the backup was not expected to be used frequently; its value was almost entirely psychological and functions

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as a performance insurance whose presence made the primary system acceptable. A HVAC distributor interviewed confirmed that this preference is not idiosyncratic but market-wide:

"It will largely be a dual fuel market in Michigan, especially northern Michigan, where heat pumps are paired with gas furnaces."— HVAC Distributor, Michigan

The residential pattern of relying on secondhand accounts rather than expert guidance is not incidental: the Minnesota homeowner journey mapping data reveals a structural trust asymmetry that explains it. Homeowners reported high trust in contractor technical expertise but low trust in contractor system recommendations, suspecting financial motives. This asymmetry leaves customers navigating the performance risk question largely through informal peer networks—networks that circulate older, worst-case equipment narratives with far greater fidelity than accurate current-generation performance data. The sociotechnical adoption literature would predict exactly this outcome: where expert guidance is distrusted, information flows through social channels that systematically amplify risk perception and produce conservative adoption decisions (Rogers 2003; Wolske, Stern, and Dietz 2017).

Program performance risk operates through the same underlying mechanism—trust-mediated information processing—but is compounded in the C&I context by organizational memory. Among C&I customers in the Michigan data, prior negative DR program experience functioned as institutional scar tissue: a CFO's prior negative DR experience—the precise nature of which was not disclosed but whose effect on organizational decision-making was unambiguous—had effectively vetoed re-enrollment for the organization, despite the facility manager's genuine interest. The program had failed to deliver on its performance promise once; that failure had been institutionalized into the organization's decision-making structure in a way that standard re-engagement approaches are unlikely to reach.

"*I will say that our CFO might maybe had a previous experience with the demand response type program, and it sounds like it was maybe negative. So I'll be kind of fighting upstream on that perspective and maybe have to do a better job of explaining the risk mitigation or risk of that program."* — C&I Customer, Large Manufacturer, Kalamazoo

This dynamic points to a C&I program performance risk pattern that is qualitatively different from the residential context: where residential customers rely on informal peer networks to filter technology performance information, C&I customers encode prior program failures into organizational memory that resists correction through information alone.

Axis 3: Asset Sovereignty — Residential Customers and Market Actors

The asset sovereignty axis—reluctance to allow external actors to access or draw upon personally owned or subsidized assets for grid benefit—was also consistently evident across the interview sample. Its primary expression was categorical resistance to utility access to home battery storage, even when customers understood the grid benefit and were offered compensation.

The structural paradox the data reveals is significant: the same grid instability that motivates battery adoption in Michigan—specifically, frequent outages that are driving growing demand for whole-home backup solutions—is precisely what makes customers unwilling to allow utilities to discharge that battery. In other words, the utility's own reliability failures

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amplify the very asset sovereignty barrier that grid-interactive battery programs seek to overcome.

Customers who owned or expressed interest in owning storage described the asset in terms that went well beyond its market value: as emergency reserve, as a bulwark against utility failure, as a form of household preparedness whose purpose is explicitly defined against grid dependence. For instance, residential customers with strong interest in solar and battery installation expressed great interest in selling excess power back to the grid but not enrolling in programs that gave their utilities control over when their battery discharged. These positions were held despite entirely different financial circumstances and for partially different reasons, but the behavioral outcome was identical, and the language was strikingly similar across customers interviewed.

> *"I would be interested in selling my access power back to them, not letting them control it."* — Residential Customer, Greater Detroit, Non-Low-Income

The data also surfaces one important exception: Residential customer willingness to allow utility access to battery storage is contingent on the program being "completely transparent" and low-impact, and only in the context of a long, positive utility relationship. This acceptance is the destination the data points toward, not the baseline it reveals.

The broader market actor data confirms that the asset sovereignty problem is structural, not incidental. Storage installers across the Michigan market actor interviews reported that battery interest is driven overwhelmingly by energy independence and backup power motivations, not grid participation. Customers are purchasing the asset that would theoretically make grid-interactive programs most valuable specifically to opt out of utility control. This dynamic creates a direct conflict between the policy objective (aggregating distributed storage for grid flexibility) and the customer motivation (purchasing storage as insurance against the grid's failures). Program designs that ignore this conflict will fail to convert battery ownership into grid participation at scale.

Equity Dimensions of the Control Premium

The Control Premium is not equitably distributed. While it operates as a barrier across all income levels and customer segments, its magnitude, character, and consequences vary substantially by income, and those variations are not random. They are the behavioral inheritance of structural conditions: uneven infrastructure investment, administrative systems built around the financial and logistical capacities of middle-income customers, and a history of broken institutional promises that has left the communities with the most to gain from the energy transition with the least reason to trust the programs designed to serve them. This section highlights three interconnected equity dimensions of the Control Premium as they emerge from the primary data: upfront cost as a prerequisite condition that renders the behavioral question moot for many LMI customers; infrastructure precarity as a rational amplifier of the premium for low-income customers; and the compounding of administrative, trust-based, and structural barriers.

First, the *Cost Prerequisite*. A defining and underappreciated equity dimension of the Control Premium is that the ability to negotiate the premium at all presupposes financial capacity. The premium is, in a meaningful sense, a middle-class problem: it describes the psychological friction that arises when a customer who could afford to adopt a technology chooses not to, or conditions their participation, because the terms of control are unacceptable. For low-income customers, this calculus rarely comes into view. The decision is foreclosed earlier, by cost, and the control question never becomes the operative constraint.

The policy implication is precise: programs that address only behavioral barriers—making control conditions more transparent, offering opt-out guarantees, improving event frequency communication—will systematically fail to reach the customers most burdened by energy costs, because those customers cannot access the programs' behavioral benefits without first clearing a financial threshold that post-purchase rebate structures do not address. For LMI customers, deep upfront subsidy is not a complement to behavioral program design, it is a prerequisite to it.

Second, *Infrastructure Precarity.* For customers living in areas with unreliable grid infrastructure (e.g., disproportionately low-income urban customers and rural customers dependent on delivered fuels), the Control Premium is not merely higher than for customers with stable service; it is grounded in a qualitatively different set of stakes. Ceding control of home temperature to a utility that already fails regularly is a categorically more consequential decision than ceding it to a utility with a reliable service record. The premium, for these customers, is not a cognitive bias to be corrected but a rational calibration to documented institutional performance. The Clapper et al. (2024) analysis of redlining's legacy effects on residential energy efficiency and thermal resilience provides the structural grounding for this pattern: communities shaped by decades of racially motivated disinvestment exhibit measurable deficits in housing quality and energy infrastructure performance that translate directly into higher rational risk for any program requiring trust in utility delivery.

Market actor findings from the Michigan data corroborate the scale of the precondition problem: more than 50% of homes in Detroit carry health and safety barriers (e.g., mold, roof issues, etc) that must be resolved before energy efficiency work can proceed, and that program silos prevent the integrated solutions required. The Detroit Home Repair Fund was identified as a promising model for holistic, pre-condition-resolving program delivery. The implication for the Control Premium framework is that behavioral barriers cannot be addressed in isolation from the structural conditions that determine whether customers can safely and reliably participate in programs at all.

Third, *Administrative and Structural Inequity Burdens* function as a compounding layer of the Control Premium for LMI customers. Complex rebate applications, income verification requirements, and limited cognitive bandwidth under conditions of energy insecurity (Hernández 2016) each amplify the perceived cost of program participation; not as a financial barrier, but as a transactional one. When the administrative overhead of enrollment is itself experienced as a loss of time, dignity, and agency, it operates as a Control Premium at the program entry point, before the question of ceding operational control ever arises. For instance, the MH pilot's pre-qualification design of removing income verification as a gatekeeping requirement produced an immediately measurable equity outcome: approximately one quarter of post-evaluation interview customers reported that an income verification step would have prevented their participation entirely. When program entry requires navigating uncertain, multi-step procedures under conditions of low institutional trust and limited administrative capacity, rational customers decline.

Compounding these administrative barriers is the reality that marginalized populations are disproportionately concentrated in precarious, minimum-wage employment that offers little or no flexibility for missed workdays. For these households, time is not a neutral resource:

attending a contractor audit or a home visit represents a real income loss that higher-wage customers do not face. This is a dimension of program burden that standard program design rarely accounts for. The manufactured home pilot data surfaces this tension clearly: while customers expressed genuine gratitude for receiving free home retrofits, many identified the requirement of taking multiple days off work for contractor visits as a significant hardship. This finding aligns with Drehobl, Ross, and Ayala’s (2020) documentation of the ways program structures that presuppose schedule flexibility and administrative capacity reproduce inequitable outcomes even when financial barriers are removed, and with Chase et al.’s (2024) observation that equitable program delivery requires meeting communities’ logistical realities—not just their financial ones.

Discussion and Conclusion

Behavioral barriers to electrification adoption are real, consequential, and systematically under addressed. In my analysis of a multi-state, mixed-methods evidence base, I introduce the Control Premium as a conceptual framework. I demonstrate how it manifests through three interlocking axes—operational control, performance risk, and asset sovereignty—all of which are expressions of the same underlying preference for certainty and self-determination. Critically, I also highlight the inequitable distribution of the Control Premium, with its consequences disproportionately burdening those whose experience of utility failure have been most damaging. The heterogeneity documented in this paper—across geography, income, operational profile, and institutional history—is precisely what the quantitative behavioral literature would predict (Qiu et al. 2014; Schleich et al. 2019; Poblete-Cazenave and Rao 2023), and it is what makes segment-blind program design systematically inadequate.

Overall, findings gathered from the Control Premium and its three axes can be translated into actionable program and policy recommendations that include:

1. **Normalize hybrid pathways**: Design programs that explicitly accommodate and incentivize dual-fuel heat pump systems rather than requiring full commitment. Hybridization is the path for the mass market. Reject the 'all-or-nothing' program design assumption.
2. **Make programs invisible (or legible)**: Programs that operate transparently in the background, with no perceptible control loss, are the gold standard. Where true invisibility is impossible, invest in real-time information tools (dashboards, meters, event notifications) that give customers the experience of control even while participating.
3. **Provide clear event frequency guarantees**: The absence of this information is a veto for risk-averse customers. Programs should commit to maximum event frequencies, minimum notice periods, and opt-out mechanisms at specific temperatures.
4. **Segment and target by operational profile**: The C&I data reveals that the Control Premium is near-zero for businesses with off-peak operating hours. Target these businesses for DR enrollment as a near-term strategy. Simultaneously, recognize that high-premium segments (manufacturers with tight deadlines) require fundamentally different program designs such as real-time data access, not load shedding. Additionally, institutional scar tissue from prior program failures requires dedicated re-engagement, not just improved program design.

5. **Invest in trust before programs**: For customers with utility distrust, program enrollment will remain an uphill battle without prior trust-building. Community partnership models, trusted messengers, and proactive service quality improvements consistent with community-based delivery models are prerequisites, not supplements, to program success.
6. **Equity-centered program design**: Low-income customers face the cost barrier before the control barrier. Programs must address cost first (deep upfront subsidy, not post-purchase rebate). Income-qualified (IQ) Programs must also ground their efforts with clear understandings of structural inequities that stymie program participation and eligibility. Reduce administrative burdens by employing pre-qualification pathways and greater investment into health and safety measures above and beyond energy efficient measures.

To that end, the Control Premium contributes to the lean but growing efforts integrating socio-psychological and behavioral perspectives within electrification adoption scholarship. This paper does not just introduce a conceptual vocabulary for how we can understand the Control Premium through its three interlocking axes, but also provides tangible guidance that the field can use to design, evaluate, and target energy programs more precisely.

A particularly generative direction for future scholarship is the heterogeneity of the premium across customer segments. The quantitative behavioral literature documents that risk aversion, loss aversion, time discounting, and present bias each independently predict energy technology adoption, and that their effects are additive and variable across segments (Qiu et al. 2014; Schleich et al. 2019; Poblete-Cazenave and Rao 2023). The qualitative evidence in this paper gives that heterogeneity a human face; revealing why a rural Upper Peninsula homeowner, a Kalamazoo manufacturer, and an income-qualified manufactured home resident face structurally different premiums requiring structurally different responses. What remains is to close the gap between these two bodies of evidence: segment-level quantification of the Control Premium, tested against the qualitative typology introduced here, would substantially advance both the precision of program targeting and the theoretical development of the framework.

Future research should endeavor to explore the regional generalizability of the framework and extend it to other regions and utility contexts within and outside of the Midwest. Additionally, more research focused on measuring and operationalizing the Control Premium outside of its theoretical framework such as quantifying the dollar value of the Control Premium ("willingness to accept" studies) and testing premium-reducing program designs through randomized evaluations will be critical as we work toward equitable decarbonization.

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