Behavioral Economics and the Human Dimension of Prepaid Utility Service: Advancing Affordability and Persistent Conservation in the Modern Built Environment

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ABSTRACT

At the intersection of behavioral economics and utility program design, this paper examines the psychological underpinnings and evolution of prepaid electric service. As global energy systems transition toward decarbonization and the need for grid maintenance and resilience investments accelerates, the affordability of residential electricity has become an urgent policy concern. Traditional postpaid billing creates a significant temporal and cognitive gap between energy consumption and its cost, often leading to financial difficulty and inefficient usage. Prepay architecture is designed to compress this gap by combining pay-as-you-go settlement with frequent, salient feedback, low-friction payment options, and—where applicable—account-level alerts and arrearage management.

Synthesizing empirical evidence from established U.S. and international programs, this paper finds that prepay implementations have been associated with persistent residential energy savings of approximately 4% to 17%. The paper interprets these outcomes through five behavioral lenses—customer agency, cognitive bandwidth, loss aversion, price salience, and operant conditioning—noting that these mechanisms are hypotheses rather than causal channels in the cited evaluations. A detailed case study of Orlando Utilities Commission (OUC)'s prepay implementation explores real-world program implementation and the challenges and benefits it presents to both the utility and ratepayers.

Finally, the research highlights how modern prepay designs are evolving into human-centered platforms. By integrating non-disconnect models, disaggregation, and gamification, utilities can reduce systemic debt while improving customer satisfaction. The paper concludes that prepaid service represents a scalable, equitable solution for the modern built environment, enabling utilities to be proactive partners in financial management and energy conservation.

Introduction

The transition toward a decarbonized, efficient, and intelligent power grid is a human challenge as much as a technical one. While advanced infrastructure provides the physical platform for high-performance buildings and responsive energy delivery, fully realizing the resulting economic and environmental benefits depends on individual decision-making and household behavior (Manning and Nassab 2024). At the same time, U.S. electricity demand is projected to grow steadily, departing from the flat demand of prior decades, driven by population growth, end-use electrification, extreme weather, and new large loads such as data centers.

These supply- and demand-side pressures have translated into an electricity affordability crisis in which residential electricity prices have risen faster than general inflation and faster than household earnings, increasing the share of household income devoted to energy and the prevalence of energy-related debt. From September 2024 to September 2025, average U.S.

residential electricity rates rose 7.4%, from 16.8 to 18.0 cents per kilowatt-hour (Tufts University 2025). Increases continued into 2026, with the Bureau of Labor Statistics reporting a 6.3% year-over-year increase for the 12 months ending January 2026, well above the 2.4% general inflation rate (BLS 2026). Median weekly earnings rose only 4.2% over a comparable period (Borenstein 2026), and average monthly residential electricity bills reached roughly $156 by late 2025—a 29% increase from $121 in 2021 (NEADA 2026). Approximately one in 20 U.S. households now carry utility debt that has been or is about to be sent to collections (TCF 2025).

In this environment, utilities seek mechanisms to align consumer incentives with grid needs and improve household-level affordability without eroding consumer protections. Prepaid electric service is one such mechanism whose effects result from combining payment timing, real-time feedback, alert cadence, and lower-friction payment options. Recent empirical work supports this bundled framing: in Indonesia's nationwide rollout, prepaid customers exhibit roughly twice the short-run price elasticity of postpaid customers and lower estimated welfare losses from a tariff increase, and the gap in elasticity widens over time as customers form new habits (Imelda, Abatayo, and Resosudarmo 2024).

This paper treats prepay as an integrated platform and interprets observed energy and financial outcomes to develop forward-looking design implications for utilities, recognizing that the persistence and equity of these outcomes depend on intentional program design and consumer-protection guardrails.

Pay-As-You-Go Architecture for the Utility–Customer Interface

Prepay is familiar to most consumers from other sectors—mobile data plans, transit fares, gift cards, and digital subscriptions, among many others. In residential electricity in the U.S., prepay programs have enrolled more than two million customers across at least 100 different utilities, including investor-owned, cooperative, and municipal entities (Ozog 2013). As of 2025, Exceleron's platforms alone supported prepay service across 75 utilities in 24 states, with the largest individual programs serving more than 100,000 customers (Exceleron 2025a). Despite this growth, the majority of U.S. residential customers continue to be billed under a postpaid model, receiving a monthly statement for usage from the previous 30 to 45 days. This traditional model creates a substantial cognitive and temporal gap between behavior and cost (EPRI 2010).

Prepay architecture compresses this lag by inviting customers to fund their utility account upfront. Usage costs are then deducted daily or in nearly real time as energy is consumed. Most modern prepay platforms forecast the remaining balance in terms of days of service, allowing consumers to plan their consumption with greater precision. In practice, these integrated signals (pay-as-you-go settlement plus salient feedback, alerts, and lower-friction payment options) may drive the documented behavioral and affordability outcomes described below.

A second design feature that distinguishes prepay from conventional postpaid billing is the cash-flow profile of the payment itself. The traditional monthly cycle typically requires a large, lump-sum monthly payment. Prepay instead supports high-frequency, low-dollar transactions—for example, $20 every few days—that more closely match the cash-flow realities of many hourly-wage households and those without significant savings (Ozog 2013). Marketing research on payment frequency finds that more frequent, smaller payments are associated with higher perceived subjective wealth and shape discretionary spending decisions (De La Rosa and Tully 2022). The transaction-cost burden of more frequent payments is mitigated by auto-replenishment options, multiple payment channels (web, kiosk, retail cash networks, debit/credit), and automated alerts, which substantially reduce the per-transaction effort required to maintain a positive balance (Exceleron 2025a).

Prepay does not align equally well with every household. Survey and qualitative research on hard-to-reach (HTR) energy consumers documents substantial heterogeneity in payment preferences, digital literacy, and exposure to service-interruption risk among low-income households (Rotmann et al. 2020). Some households benefit from frequent payments and tight balance management, while others—particularly those with unreliable internet access, medical equipment dependencies, or highly seasonal income—may face risks from any payment model that allows for rapid service interruption. The DOE Low-Income Energy Affordability Data tool documents that 42% of U.S. households (roughly 51 million) are classified as low-income and face an average energy burden of 6%, triple the 2% burden faced by non-low-income households (DOE 2025); within that population, payment constraints and vulnerability to disconnection vary substantially by region, climate, housing tenure, and household composition.

These differences reinforce the importance of voluntary enrollment, transparent terms, and program safeguards discussed in the boundary conditions section below.

Operational feature comparison

Table 1 outlines the key operational differences between traditional postpaid utility service and modern AMI-enabled prepay.

Feature	Postpaid mechanism	Prepaid mechanism
Billing cadence	Monthly statement, 30–45 days in arrears	Daily or near-real-time deduction; monthly reconciliation for taxes/fees
Customer feedback	One monthly bill; periodic Home Energy Reports in some utilities	Continuous balance, days-of-service forecast, push/text/voice alerts
Payment channels	Bank draft, mailed check, monthly online pay	Web, mobile app, IVR, retail cash networks, kiosks; auto-replenish
Security deposit	Often required (typically 2/12$^{\text{ths}}$ of one year's service)	Frequently waived; applied to opening balance if held
Treatment of arrears	Past-due balances accrue; disconnect typically follows a series of notices	Portion of each payment applied to arrears (commonly 25–40%); incentive matching possible
Behavior at $0 balance	Disconnect after multi-step notification process governed by state rules	Two models: (1) brief grace period followed by remote disconnect/low-cost reconnect; (2) non-disconnect model in which customers are automatically rolled back to postpaid service

Table 1. Payment model key feature comparison *(Exceleron 2025a)*

Evidence from Program Evaluations

Empirical work on prepaid electricity spans investor-owned, municipal, and cooperative utilities in the United States, large-scale mandatory and quasi-mandatory rollouts in Indonesia and South Africa, and a range of program designs. Because methods, samples, and program features differ substantially across these studies, they offer a body of evidence with a consistent qualitative pattern—reductions in consumption, improved arrearage management, and high participant satisfaction—but should not be interpreted as directly comparable point estimates. Selection effects also matter: most U.S. prepay programs are voluntary, and self-selected populations may differ systematically from non-participants on price sensitivity, income, housing tenure, and digital engagement. The savings estimates summarized below should therefore be read as effects on the populations who chose to enroll, not as causal estimates of what would happen if prepay were universal.

Customer demographics and enrollment trend

Voluntary prepay attracts a more heterogeneous customer base than the legacy framing of prepay as a collections tool implies. A 2016 E Source national survey of U.S. residential electricity customers found that interest in voluntary prepay was highest among younger consumers (18–54) and renters, with roughly 30% expressing interest, and lower (approximately 9%) among older homeowners (E Source 2016). The 2016 survey is one of the few national-scale instruments specifically focused on prepay; readers should treat the percentages as expressions of stated interest in an internet-based survey rather than as enrollment outcomes and should note that population-level interest will not always generalize to specific utility service territories with different demographics or rate structures. Within prepay programs, segment analyses at the Salt River Project (SRP) indicate that the top four customer segments—including budget-conscious households, renters, younger digitally engaged customers, and those seeking to avoid deposits—comprise roughly 90% of enrollees (Exceleron 2025a).

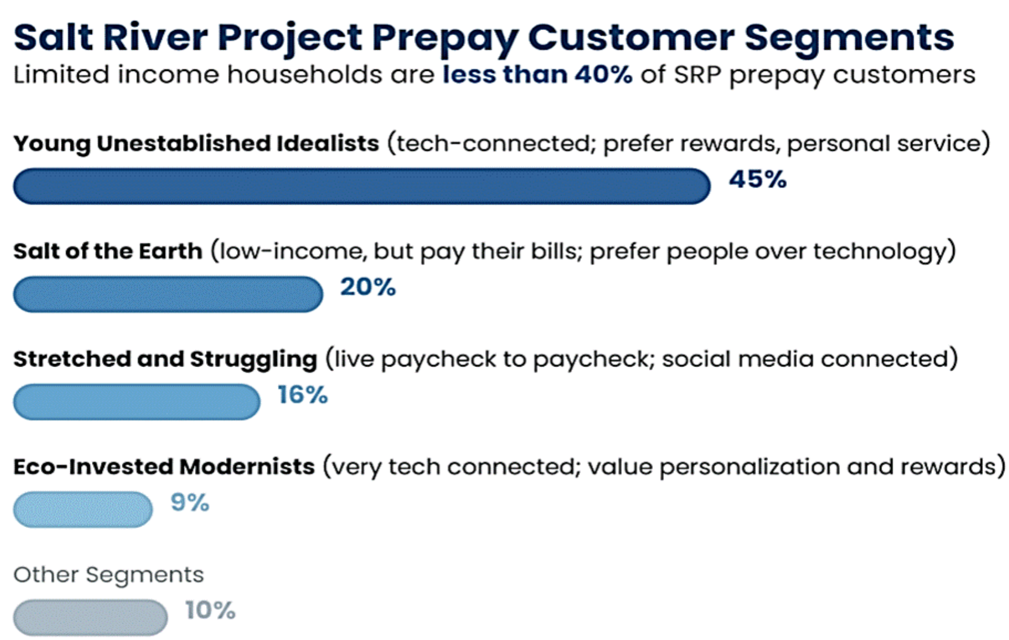

Figure 1. Prepay program participant demographic survey results. *Source:* Salt River Project

SRP's M-Power prepay program, in operation since the 1990s, has grown to approximately 160,000 enrolled households—roughly 15% of SRP's residential customer base (SRP 2025). This level of voluntary penetration over decades is consistent with the survey-based finding that prepay's appeal may be broader than its origins suggest.

Energy conservation and usage reduction

Reported reductions in residential electricity consumption following a switch from postpaid to prepay cover a range of approximately 4% to 17% (Imelda, Abatayo, and Resosudarmo 2024; Jack and Smith 2020; Ozog 2013; Qiu, Xing, and Wang 2017). The endpoints of that range correspond to studies that differ substantially in research design and program context. The lower end is anchored by observational U.S. work on voluntary programs (e.g., Oklahoma Electric Cooperative: ~11% on a matched-control basis; Ozog 2013) and by a 2018 DNV evaluation across six Tennessee Valley Authority Local Power Companies that found ~9% consumption reduction and ~10% demand reduction (DNV 2018, summarized in Exceleron 2025a). The upper end is anchored by Imelda, Abatayo, and Resosudarmo's (2024) analysis of Indonesia's nationwide AMI-enabled prepay rollout, where prepaid customers reduced consumption by approximately 17% in response to a tariff increase versus 4% for postpaid customers. South African evidence from Jack and Smith (2020) finds that mandatory prepay was associated with roughly 13% lower household consumption in Cape Town. Table 2 summarizes representative studies along with their program context.

Program / setting	Reported reduction	Study design	Enrollment regime	Source
Salt River Project M-Power (Arizona)	~12% consumption (program-level)	Utility program report; matched comparison	Voluntary, long-running	SRP 2025 Customer Programs Report (in Exceleron 2025a); EPRI 2010
Oklahoma Electric Cooperative	~11% consumption	Matched control	Voluntary	Ozog 2013
6 TVA Local Power Companies	~9% consumption; ~10% non-coincident peak demand	Multi-utility evaluation; matched control	Voluntary	DNV 2018 (summarized in Exceleron 2025a)
Indonesia (PLN nationwide)	~17% response to tariff increase (vs. 4% postpaid)	Billing-data DID using tariff shock and meter rollout	Mandatory rollout	Imelda, Abatayo, and Resosudarmo 2024

Phoenix metro (large utility)	~12% consumption	Matching + difference-in-differences	Voluntary	Qiu, Xing, and Wang 2017
Cape Town, South Africa	~13% consumption	Billing-data analysis	Mandatory rollout for new connections	Jack and Smith 2020
BGE prepay pilot (Maryland)	~2.4–4.1% net change in usage (full-pilot participants); larger among full-year participants	Pilot evaluation (APPRISE); ran Aug 2019–Oct 2020 during COVID; existing EmPOWER MD efficiency saturation	Voluntary; during COVID disconnect moratoria	APPRISE evaluation (summarized in Exceleron 2025a)

Table 2. Representative prepay evaluations, by program context. *Sources: EPRI 2010; Imelda, Abatayo, and Resosudarmo 2024; Jack and Smith 2020; Ozog 2013; Qiu, Xing, and Wang 2017; Exceleron 2025a.*

Several studies of long-running programs report that observed reductions persist over time. In Indonesia, Imelda et al. estimate that the price elasticity of prepaid users grows in absolute value from roughly −0.14 in the first year of enrollment to roughly −0.47 after seven years (Imelda, Abatayo, and Resosudarmo 2024). SRP reports that 15% of customers on M-Power are responsible for an outsized share of the utility's residential energy savings (25%) and peak load reduction (58%) relative to their share of customers (SRP 2025 Customer Programs Report, summarized in Exceleron 2025a). Persistence patterns are program- and context-specific and have not been established for every implementation.

Comparison with Home Energy Reports

Prepay's reported savings are larger than those typically observed in randomized evaluations of Home Energy Reports (HERs), which generally find treatment effects in the 1.5% to 3% range (Allcott and Rogers 2014; Gerster et al. 2025). There are several plausible reasons for this discrepancy. HERs programs are typically opt-out and applied to a large, randomized sample, whereas most U.S. prepay programs are opt-in and may attract more price-sensitive households; selection effects almost certainly bias upward any cross-program comparison in favor of prepay. HERs are also much lower-intensity behavioral interventions—periodic mailers or emails containing social comparisons—whereas prepay is a continuous behavioral and financial interface backed by AMI and a payment relationship. Finally, Allcott and Rogers (2014) document non-trivial habituation and backsliding patterns even within HERs trials, and downstream evaluations have flagged partner-selection effects in utilities that adopt these programs. In short, prepay and HERs sit at different points on the intensity and infrastructure spectrum; the larger reported effects for prepay could reflect, in part, the greater intensity and bundled nature of the intervention.

Customer satisfaction and reported experience

Customer satisfaction data are consistently positive across utility-reported and third-party sources. A 2024 E Source national survey of prepay customers found 91% reported high satisfaction with prepay billing, citing transparency and control as the primary drivers (E Source 2024, summarized in Exceleron 2025a). Utility-specific evaluations report similar magnitudes: a Department of Energy–supported review of Oklahoma Electric Cooperative reported that 95% of prepay customers were "satisfied" or "very satisfied" (Ozog 2013); SRP reports that prepay customers consistently rank 4–5 points higher in satisfaction than postpaid customers (Qiu, Xing, and Wang 2017); and BGE's prepay pilot reported 96% of enrolled participants describing a positive effect on overall satisfaction with the utility (APPRISE, summarized in Exceleron 2025a). These results should be interpreted considering survey self-selection (satisfied customers are more likely to remain enrolled and to respond to surveys), but they demonstrate consistency across geographies and methodologies.

Affordability and arrearage management

Prepay's direct affordability effect is most clearly demonstrated in arrearage management. As a customer adds funds to their prepay balance, a defined portion is directed toward past-due amounts and the remainder funds ongoing service. Common splits are 25% to arrears / 75% to current usage in alternative-design programs (Exceleron 2025a) and 35% / 65% in legacy designs such as SRP M-Power.

Utilities that have implemented prepay alongside arrearage management report meaningful reductions in aged accounts receivable: across Exceleron's client base, the share of accounts more than 90 days past due has typically fallen by approximately 80% (Exceleron 2025a; E Source 2016). In an illustrative scenario, a 50,000-customer program with an average $850 arrearage at enrollment, a 75/25 split, and a 25% utility match can retire approximately $34M in arrears within a year while costing the utility roughly $8.5M in matching credits—more cost-effective than equivalent collections activity in postpaid (Exceleron 2025a).

Behavioral Mechanisms: Interpretive Frameworks for Reported Outcomes

The behavioral economics literature offers several frameworks that are consistent with the patterns observed in prepay evaluations. These mechanisms are interpretive lenses; for example, the share of observed savings attributable to loss aversion is examined distinctly from price salience. Cleanly separating these channels would require experimental designs that are not present in the existing literature.

It is also useful at the outset to distinguish prepay from time-varying pricing instruments such as time-of-use (TOU) and critical-peak pricing (CPP). Harding and Sexton (2017) review a large body of evidence on residential response to time-varying prices and conclude that responses are typically modest in the absence of automation and decision support, and that the salience of price signals during the act of consumption is critical to whether households respond. Prepay is not a dynamic pricing instrument in the price-design sense, but it raises the salience of the existing rate for every day of consumption and bundles that signal with a depleting account balance and frequent contact from the utility. Where TOU mainly varies the price level over time, prepay mainly varies the visibility of price information and the cash-flow consequences of consumption decisions.

Customer agency and payment flexibility

Prepay gives customers explicit choice over when and how much to pay toward upcoming usage. Survey and interview research with prepay participants in multiple contexts identifies flexibility—defined as the ability to choose payment timing and size—as one of the strongest predictors of satisfaction (Aribisala and Mohammed 2021). De La Rosa and Tully (2022) provide causal evidence from a different context that smaller, more frequent payments are associated with higher perceptions of subjective wealth and changed discretionary spending, which may explain why participant satisfaction tends to exceed that of postpaid customers in the same utilities.

Cognitive bandwidth and functional affordability

Mullainathan and Shafir (2013) argue that scarcity—of time or money—imposes a cognitive "bandwidth tax" that crowds out long-horizon planning in favor of immediate, high-stakes decisions. Under postpaid billing, a household facing scarcity may be unable to integrate a large month-end bill into its planning horizon and may instead respond after the bill arrives or after a disconnection notice. Prepay reframes the same energy cost as a series of smaller transactions that fit within a more limited planning horizon and convert a single large liability into a sequence of manageable purchases—a property termed functional affordability.

A household with cyclical income (e.g., a monthly paycheck) may experience days of severe constraint near the end of a pay period during which even a small amount is difficult to fund. Whether prepay or postpaid is more supportive in these moments depends in large part on the specific protections in place, including weather and medical-equipment protections, the availability of emergency assistance, and the design of the program's behavior at zero balance (discussed below).

Loss aversion and the framing of consumption

Under postpaid billing, the experience of consuming electricity is framed largely as a sequence of small gains (light, cooling, comfort) followed by an acute loss when the monthly bill arrives. Under prepay, the customer first funds an account; from that point forward, each unit of consumption is experienced as a deduction from the funded balance—a loss—rather than as an abstract and growing future obligation. Because people are typically more sensitive to losses than to equivalent gains (Tversky and Kahneman 1991), this reframing is consistent with the behavioral asymmetry observed in prepay populations. Qiu, Xing, and Wang (2017) discuss this account in the context of their 12% estimated reduction at SRP. Loss aversion in prepay is best understood as a reframing of how consumption is presented, not as a claim that postpaid customers do not respond to the bill they receive.

Price salience and demand elasticity

Price salience, in this context, refers to the degree to which the cost of electricity is prominent in a consumer's mind at the moment of consumption. Postpaid customers are rarely confronted with price during the act of consuming electricity; they encounter it once per billing cycle, typically as a single aggregate figure. Smart meter data show, however, that even the receipt of a monthly bill measurably reduces consumption in the following days, particularly during peak hours (Gilbert and Graff Zivin 2014). The salience effect, therefore, is not zero under postpaid billing, but it is intermittent. Prepay raises the frequency of those salience moments from approximately once per month to daily, through balance displays, alerts, and the immediate visibility of unit-level costs.

Imelda, Abatayo, and Resosudarmo (2024) provide the clearest evidence on the elasticity implications of this difference. In Indonesia's tariff change, prepaid customers responded with roughly twice the short-run price elasticity of postpaid customers, and their estimated long-run elasticity grew over the subsequent years of enrollment. While comparably designed feedback under postpaid billing could close part of that gap, the available evidence is most consistent with bundled prepay architecture producing larger elasticities than postpaid in real-world deployments.

Habit formation and operant conditioning

Persistent behavior change generally requires repeated reinforcement rather than single interventions. Within prepay, each instance of behavioral adjustment (e.g., changing a thermostat setpoint) is reinforced by a visible reduction in the rate of balance depletion and an extension of the days-of-service forecast. Repeated experience of this contingency over weeks or months is consistent with habit formation and is one explanation for why long-running programs report stable or increasing rather than decreasing impacts (Imelda, Abatayo, and Resosudarmo 2024). Daily feedback loops are not unique to prepay, as shortening the billing cycle or providing daily in-home displays under postpaid could in principle generate similar reinforcement, but they emerge naturally as a feature of the prepay interface.

Boundary conditions: over-purchasing and sunk-cost concerns

An important conceptual concern is whether prepay could induce ex-ante over-purchasing (households topping up beyond expected usage as a buffer against running out of credit) and ex-post over-consumption due to sunk-cost reasoning (a ratepayer may justify greater use because they have already paid for it). The available empirical record does not support a meaningful version of this concern in residential prepay. First, prepay credits do not expire and roll over indefinitely, so funded balances do not create a "use it or lose it" incentive; this differs from prepaid mobile data plans that expire monthly.

Second, observed consumption is lower among prepay customers than among comparable postpaid customers in the evaluations gathered here, which is the opposite of what a dominant sunk-cost mechanism would predict (Imelda, Abatayo, and Resosudarmo 2024; Ozog 2013; Qiu, Xing, and Wang 2017). Third, prepay customers tend to make small, frequent payments rather than large infrequent ones (Exceleron 2025a), which limits the size of any prepayment that could function as a sunk cost. In the context of the psychological mechanisms described above, loss aversion may dominate sunk-cost effects. This is an area where further targeted research would be useful, particularly for higher-income, less-constrained households with different behavioral patterns.

Summary of behavioral mechanisms

Table 3 summarizes the behavioral lenses discussed above and their relationship to prepay program features.

Behavioral mechanism	Mechanism description	Corresponding prepay design feature
Customer agency	Flexibility over payment timing/size raises subjective wealth and satisfaction (De La Rosa and Tully 2022; Aribisala and Mohammed 2021).	Pay what you want, when you want; multichannel payment options; no required deposit.
Cognitive bandwidth	Scarcity narrows planning horizons (Mullainathan and Shafir 2013).	Small, frequent transactions; days-of-service forecast; balance-based alerts.
Loss aversion	Losses loom larger than equivalent gains (Tversky and Kahneman 1991).	Funded balance reframes consumption as an ongoing loss.
Price salience	Salience of monetary cost during consumption shapes elasticity (Gilbert and Graff Zivin 2014; Harding and Sexton 2017).	Real-time balance display, push/SMS alerts, optional disaggregation, unit cost feedback.
Operant conditioning	Repeated immediate reinforcement supports habit formation (Imelda, Abatayo, and Resosudarmo 2024).	Daily feedback loop linking behavior to balance depletion and days of service.

Table 3. Behavioral mechanisms and corresponding prepay program features.

Synergistic Benefits and Literature Limitations

The literature reviewed above supports three consistent findings: (1) prepaid programs are frequently associated with persistent reductions in electricity consumption; (2) participants often report high satisfaction, likely related to financially supportive program designs and (3) arrearage repayment can improve when a portion of incremental payments is allocated to past-due balances. These effects are unlikely to be attributable to payment frequency alone. Reported outcomes are also contingent on the strength of the feedback loop and interplay of program design choices: the salience and cadence of alerts, the ease of making small payments, and the presence of customer safeguards that reduce the frequency and duration of avoidable service interruptions.

Research also highlights program guardrails which uphold consumer protections and mitigate potential perverse incentives. Key measures to consider include differences between voluntary and default enrollment, interactions with state and local customer protection regulations, and the risk of harmful outcomes when program design relies heavily on disconnection rather than engagement.

The empirical literature on prepay relies heavily on utilities' reported data, working papers, and a small number of peer-reviewed studies; some figures cited—particularly enrollment counts and arrearage outcomes—come from program operators rather than from independent evaluations, and should be read as such. Investments in additional independent, experimental evaluations of voluntary prepay—particularly with random assignment to disentangle selection from treatment effects—would substantially strengthen the evidence base.

Case Study: Orlando Utilities Commission (OUC)

Orlando Utilities Commission's prepay program, PowerPass, offers a firsthand view of prepay's evolution and resurgence as an energy savings and affordability tool for all customers, rather than a narrowly scoped program for debt reduction alone. PowerPass began as a voluntary arrearage management tool enabled by OUC's early AMI deployment in 2012, and it remains true that many customers enroll for financial reasons – call center employees offer payment plans and prepay among a suite of options to customers with arrears, for example. Other customers see prepay as a way to avoid initial deposits for starting service. However, prepay enrollees are not only low-income; younger customers, college students and those living in apartments make up a substantial portion of program demographics.

From a customer segmentation analysis, prepay participants are more likely to be 'Hopefuls' (characterized as financially struggling), but 'Savers' (financially focused on the long-term) and 'Greenish' (younger, environmentally-focused and typically recently out of school) participate in disproportionate numbers as well. OUC's customers tend to be more transient, which in conjunction with the debt-management focus of the marketing program to date may explain why many customers who initially enter the program may not stay long term (about 900 people leave the program each month, though it continues to grow by ~1,000 new enrollees for a net increase of 100 new customers monthly). Despite this turnover, total program enrollment has ticked up to 21,000 participants to date and continues to increase monthly.

PowerPass program implementers note that the program offers multiple benefits to enrollees, including greater salience of energy use and frequent engagement, as well as greater control over spending and payment structure. In evaluating the benefits of the program for ratepayers, OUC cites debt reduction, energy savings, and customer satisfaction improvements, as well as the utility's holistic commitment to offering customers choice in how they use and pay for energy. In addition to nearly $3 million in debt reduction, PowerPass has enabled participants to achieve a 5-7% energy savings rate.

Florida has strict requirements for energy efficiency programs, including that they pass the Ratepayer Impact Measure (RIM) test. OUC includes prepay within its own internal 1% energy savings goal, but the Florida Commission does not recognize behavioral programs and therefore OUC does not include it formally in its DSM portfolio. However, OUC notes in Commission filings that prepay is a customer-centered offering that delivers energy savings. Though the program is offered purely as a payment option, with no personalized messaging on energy savings, OUC's data show that the program delivers about 600kWh of savings per customer per year.

OUC's PowerPass program is not without its challenges. As enrollment in the program grew, back-end operations, which include significant manual work, became increasingly strained and required an additional full-time employee. However, OUC did not stop promoting PowerPass completely. Though the utility has not conducted a recent paid campaign specifically for PowerPass, they have actively promoted prepay as part of other efforts, including the Hot Weather Campaign and in customer newsletters. During the COVID-19 pandemic and the subsequent rebound period, OUC offered customers who fell into arrears the opportunity to enroll in PowerPass and waived the set-up fee. Despite reinstituting the set-up fee after COVID-19, the response and general PowerPass promotion has attracted approximately 100 "net" new participants each month, possibly influenced by rising energy prices that add to the financial burden on ratepayers in Florida and nationwide. Notably, customers enrolled in PowerPass report high satisfaction with their experience, with a satisfaction score of 8.75 on a scale of 10.

Designing a Modern Prepay Program: Forward-Looking Implications

The synthesis above supports three observations about the effects of prepay: persistent reductions in electricity consumption among voluntary enrollees; generally positive participant satisfaction; and improvements in aged arrearages where a portion of incremental payments is directed toward past-due balances. The remainder of this paper translates those findings into forward-looking program design implications, each of which should be interpreted as design hypotheses grounded in the reviewed evidence and should be adapted to local regulatory requirements, consumer protections and technology readiness.

Non-disconnect and incentive-based models

The most consequential design choice in modern prepay is whether the program disconnects customers at or soon after zero balance or rolls them back to postpaid service. Emerging non-disconnect designs use incentives, alerts, and behavioral nudges to incentivize regular account funding without using remote disconnection as the enforcement mechanism. Behavioral and field research supports this approach, even suggesting that in ongoing trust-mediated relationships, positive incentives tend to be more durable than sanctions (Fehr and Rockenbach 2003). Arrearage forgiveness could be another complementary feature that enhances prepay's capacity to be a supportive affordability tool: for every dollar a customer pays into the account, the utility can match a portion or forgive a defined share of the past-due balance. This produces a positive reinforcement cycle that rewards engagement and systematically reduces system-wide bad debt without relying on disconnect-driven compliance.

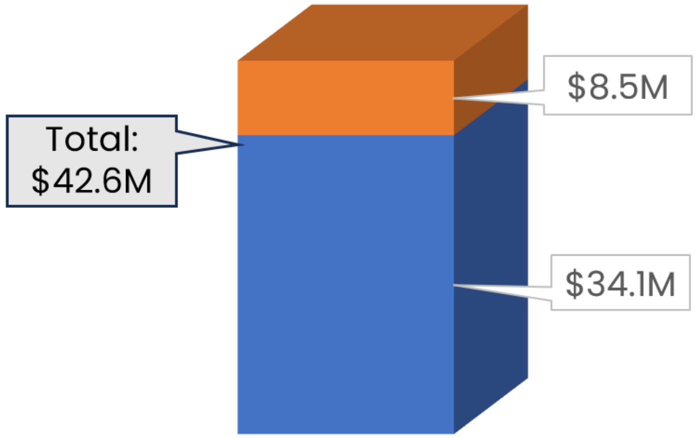

Figure 2. Arrearage reduction for 50Kcustomers in a 25% utility matching program. *Source:* Exceleron 2025.

Behavioral demand response and disaggregation

Modern prepay is closely complementary to behavioral demand response (BDR). Because prepay customers already monitor their accounts and usage closely, the marginal cognitive cost of responding to a peak-event notification is lower than for the average postpaid customer. Combining the two is conceptually straightforward and is being implemented in near-term Exceleron deployments: DR participation translates directly into additional free usage on the prepay account, and customers can apply the reward to their balance in real time rather than waiting for a quarterly check or bill credit (Exceleron 2025a). Economic modeling of one such design at a Pacific Northwest utility—a configuration with 30 annual DR events, 0.3 kW per-event load reduction, and a $1/kWh customer incentive layered on a 9% prepay-driven baseline conservation effect—produces benefit-cost ratios of approximately 1.32 at 20,000 enrolled customers and 1.85 at 180,000 enrolled customers. The latter's scale is comparable to SRP M-Power (Exceleron 2025b).

Appliance-level disaggregation, which infers per-appliance consumption from smart-meter interval data, is a natural complement. Gerster et al. (2025) show in a randomized setting that disaggregated feedback updates households' knowledge about which appliances drive their bills and shifts behavior more than aggregate feedback alone. Because prepay customers already engage frequently with consumption data, disaggregation-based recommendations (e.g., "shifting your dryer use by two hours saves $3.00 today") have lower friction in the prepay context and can be tied directly to balance preservation.

Gamification and engagement

Game-design elements—point systems, levels, social comparisons, time-bounded challenges—offer one mechanism to maintain engagement once the initial novelty of prepay has faded. In a controlled household energy conservation game study, competition-based gamification was associated with an 8% increase in conservation relative to a standard energy dashboard (Fijnheer et al. 2021). In the prepay context, gamified peak-event challenges could position households to compete to reduce their balance burn rate during an established window, with the top performers receiving instant account credits, as a natural extension of the frequent points of engagement inherent to prepay.

Marketing, messaging, and trusted intermediaries

Engagement with energy-burdened and hard-to-reach customer populations requires careful marketing. Research on these populations highlights a high baseline distrust of utility offerings, which may be rooted in prior negative experiences with billing or disconnection (Rotmann et al. 2020). Successful programs use trusted local messengers—community-based organizations, faith institutions, and local retailers—and frame prepay as a tool for transparency and control rather than as a debt-management or last-resort offering. SRP's marketing of M-Power as a way to negate surprises from end-of-month energy bills is one illustrative example (EPRI 2010); customer acquisition and retention in other contexts depend on utilities adopting a similarly intentional approach to their messaging strategy.

Conclusion

Prepaid electric service is neither a silver bullet nor a regressive collections tool. It is a behaviorally rich payment architecture whose effects on consumption, satisfaction, and arrearage management are consistently positive across a heterogeneous body of evidence whose magnitudes vary with program design, enrollment regime, regulatory context, and population. The behavioral mechanisms most often cited to explain its outcomes—agency, cognitive bandwidth, loss aversion, salience, and operant conditioning—are best understood as interpretive frameworks. Taken together, the strongest empirical finding is that prepay-enrolled customers exhibit substantially higher short- and long-run elasticity than postpaid customers facing the same prices (Imelda, Abatayo, and Resosudarmo 2024).

For utilities and regulators, the most useful question is therefore not whether prepay saves energy, but, "How should a prepay program be designed to enhance energy savings for a given population, given local consumer protections, the available evidence base, and the utility's operational goals?" Modern non-disconnect designs, arrearage forgiveness, behavioral demand response integration, disaggregation, and intentional marketing all shape whether the architecture delivers to its potential. Investing in higher-quality independent evaluations—particularly randomized or quasi-experimental designs that can isolate the contribution of individual program features—would strengthen the evidence base and inform regulatory deliberations as more utilities consider expanded offerings. Prepay is one tool among many for navigating the affordability crisis and the transformation of the energy system into something entirely new; its value depends on how thoughtfully it is implemented, but it has the potential to afford residential utility customers greater agency in an otherwise unpredictable energy landscape.

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AI-assisted Tools:

AI-assisted tools used: Google Gemini, ChatGPT.
Used for: Paper revisions, literature research, and conforming to style guidelines.
Extent: Editing existing draft, reference list, and re-formatting.
Human review: The authors reviewed and verified all content changes and citations.