Empowering Low-Income Customers to Shop Energy Smart at Scale

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ABSTRACT

There is great potential to deliver benefits to low-income households, the energy system and society at large—by implementing digital, market-based programs that incentivize super-efficient[1] product purchases and nudge consumers towards them. We will review recent work on barriers and solutions to low-income energy efficiency in California and New York; consider the role that plug loads play in energy burdens; and present estimates of the benefits that targeting low-income customers with higher incentives on super-efficient products could deliver, including reductions in energy bills, avoided energy costs and avoided subsidy payments funded by ratepayers. We will also talk about recent innovations to empower low-income households, such as instant online point-of-sale incentives, which address up-front purchase price barriers and are being implemented in partnership with utilities and retailers. By expanding the universe of plug load & appliance categories addressed, adopting market-based and behavioral strategies and using data to target marketing and incentives for greatest impact, utility-branded online marketplaces can scale participation and improve the cost-effectiveness of residential programs to reduce energy burdens.

Introduction

Despite the economic recovery in the U.S. over the period following the financial crisis, and the considerable sums of ratepayer and taxpayer funds that are flowing into bill subsidies and direct installation of weatherization and energy efficiency measures targeting the low-income segment, many Americans still struggle to pay their energy bills. According to the Energy Information Administration's Residential Energy Consumption Survey (RECS), a staggering 31% of U.S. households reported facing a challenge in paying energy bills or sustaining adequate heating and cooling in their home in 2015[2] (EIA, 2017). This national survey is consistent with the triennial 2016 Low-Income Needs Assessment (LINA) survey conducted in California (Evergreen Economics, 2016a), which found that 28% of low-income customers "often" or "constantly" struggle to pay their energy bills.

ACEEE's 2017 State Energy Efficiency Scorecard tallied low-income spending on energy efficiency programs in 2016, which amounted to over $1 billion across the 35 states for which data were available (Berg et. al., 2017). In 2017, California ratepayers funded $372 million in energy efficiency measures and energy education at no cost to low-income customers, as well as $1.24 billion in electricity and gas rate discounts (roughly $270 per participating household annually) (CPUC, 2017). More needs to be done to understand why low-income customers who receive discounts were found to have a similar degree of energy burden (i.e.,

[1] By "super-efficient", we are referring throughout this paper to energy-using consumer products that are within the top 90th percentile of all models currently offered for sale, in terms of their efficiency.

[2] This is despite the fact that average U.S. residential electricity rates remain below $0.13/kWh cents per today, only about $0.015/kWh higher than a decade ago (eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_3).

home energy costs as a percentage of household income) as their income-eligible counterparts not receiving them (Evergreen Economics, 2016a).

The NY Clean Energy Advisory Council's Low- and Moderate-Income (LMI) Working Group found that despite spending $700 million in public funds on delivering clean energy and bill payment assistance initiatives that support the LMI market segment each year, over 256,000 residential customers had been disconnected in the past 12 months, and over 1 million were over 60 days behind in making payments, with $711 million owed to utilities (CEAC, 2017).

In both of these states, far more is being spent each year on bill subsidies than on productive investments into efficiency measures. Although there are circumstances when bill subsidies are needed to avoid hardship, subsidies fail to tackle the root causes of energy burden and may contribute to energy waste. This balance needs to change.

Both RECS and LINA also documented suppressed demand for energy services and widespread energy conservation practices. In the California study, four out of five respondents said they have to conserve energy at home, because they can't afford to pay higher utility bills, and over 40% were in the "elevated" to "high" energy savings practices groups (Evergreen Economics, 2016b).

Against this backdrop of existing programs, remaining energy burdens and pervasive conservation behaviors, great untapped potential lies with influencing new product purchases, which are increasingly online.

Status Quo for Plug Loads

The typical home has more than 50 devices that plug into a wall outlet for power, and these plug loads account for two-thirds of residential electricity consumption (NRDC, 2015). Existing direct install low-income programs have delivered great benefits, but have limitations (particularly with respect to plug loads), including:

- Limited plug load category coverage. The majority of utility low-income electricity programs include lighting, air sealing, insulation, water efficiency, water heating, HVAC repairs & replacements, and appliance upgrades & repairs; and the most common gas measures were insulation, air sealing, HVAC replacement & repairs, and water heater upgrades (Drehobl & Castro-Alvarez. 2017). Appliance upgrades rarely go beyond refrigerators, washing machines and microwaves; whereas electronics and miscellaneous plug loads are virtually absent (Drehobl & Castro-Alvarez. 2017).
- High cost per kWh saved and limited economies of scale. In an overview of the largest electric ratepayer-funded energy efficiency programs specifically targeting low-income households across 51 metro areas (Drehobl & Castro-Alvarez, 2017), ACEEE found that program savings were achieved at an average cost above $1/kWh, with $1,525 spent per program participant to save 1,371 kWh on average. And prospects for achieving economies of scale with existing direct install approaches are not good; ACEEE reported that utilities that spend more money on their low-income customer base also tend to achieve higher savings for these customers; in fact, they found a strong, linear correlation between spend and savings (Gilleo, Nowak & Drehobl, 2017).
- Failure to address barriers that prevent low-income households from making efficient product purchases themselves. Since many resource-consuming devices are not included in existing direct-install or rebate programs – and even super-efficient devices can be

found in many product categories without incremental cost – it is important to give low-income households the tools they need to make smart purchasing decisions on their own, considering both up-front purchase price and operating costs.

In addition, there are several regulatory barriers that prevent utility and private investment into low-income plug load energy efficiency:

- Excluding the avoided cost of bill subsidies from residential program cost-effectiveness tests used for primary program screening;
- Bill relief not tied to consumption, such as a flat tariff reduction each month;
- Go-back restrictions under low-income programs[3] that leave households without access to suitable energy efficiency programs for long periods;
- The up-front purchase price barrier is not addressed by residential rebates, so rebate programs tend to be underutilized by LMI customers;
- Lack of clarity surrounding market transformation and behavioral programs (e.g., utility earnings or incentive frameworks), which prevents such promising strategies from being applied to benefit the LMI segment.

Recognizing the limitations of existing policy frameworks and contributions of traditional low-income bill subsidy and direct install efficiency programs, policymakers, regulators and utilities are looking for innovative solutions to expand low-income energy savings.

Empowered Low-Income Customers. The Promise of Online Choice Engines.

Senate Bill 350, California's Clean Energy and Pollution Reduction Act of 2015, highlighted the importance of including low-income households and disadvantaged communities in climate and clean energy planning and programs. Plug-load efficiency was singled out as a primary strategy in California's Existing Buildings Energy Efficiency Action Plan (prepared pursuant to SB 350). In the latest Action Plan update, the California Energy Commission (CEC) highlighted several new initiatives on plug loads (CEC, 2016), including work on appliance standards and market transformation (MT); online utility marketplaces were highlighted as a promising MT approach. Below, we will discuss how this might support new approaches to plug load efficiency to benefit the LMI segment.

Also pursuant to SB 350, the CEC published a Low-Income Barriers Study that called out the importance of ensuring "…that low-income persons have product selection options and information necessary to avoid driving up their plug-load energy use" (CEC, 2017). Striving to empower low-income customers to buy efficient products is a radical conceptual leap from existing low-income rate discount and energy savings assistance programs, with great potential to benefit all ratepayers.

New York appears to be moving in a similar, more market-based direction under the "Reinventing the Energy Vision" (REV) framework. The NY Public Service Commission (NYPSC) has approved earnings-based utility incentives related to reductions in residential

[3] In Decision D.17-12-009, the CPUC eliminated the Go-Back Rule, which prevented IOUs from getting credit for providing efficiency measures to the same home more than once.

terminations and bad debt expense. And in a May 2016 Order, the Commission expressed the expectation that a greater portion of the burden for ensuring affordability for low income customers will shift from direct financial assistance to innovative, market-based approaches (NYPSC, 2016).

So what would a market-based program to empower low-income households to shop energy-smart look like? One model would be to leverage the increasing number of utility-branded online marketplaces, such as those mandated by the California Public Utilities Commission[4].

These marketplaces, done right, are sophisticated "choice engines" that rely on analytics to turn product market data and personal information into tools that allow consumers to shop according to their ambition to purchase efficient products for their homes that will save them money on their energy bills[5] – without them having to learn about kWh, therms and efficiency metrics. Behavioral economist and Nobel laureate Richard Thaler and his colleague laid out the power of choice engines (Thaler & Tucker, 2013): "The rise of choice engines will do more than create super shoppers. It will make markets more efficient, create new businesses, and improve the way governments serve their citizens. Big stuff."

Results from the PG&E Marketplace

The PG&E Marketplace is one example of a choice engine[6]. During the 2015-2017 trial period, the PG&E Marketplace engaged 10% of the utility's customers (roughly 0.5M unique visitors), influenced hundreds of thousands of product purchases and achieved estimated gross first year electricity savings of 15,304-41,901 MWh (or lifetime savings of 158,683-434,619 MWh) and gross first year natural gas savings of 593,000-1,630,000 therms (lifetime savings of 8,221,000-22,576,000 therms); 77% of the electricity savings and 88% of natural gas savings were attributed to the Marketplace alone, without incentives, backing out savings attributed to mid-stream and upstream incentive programs (Malinick, 2018). The categories that contributed the most to gross lifetime electric savings attributed to the Marketplace were electric water heaters, pool pumps and clothes washers; the top gas savings categories were gas water heaters, smart thermostats and clothes washers.

These savings were achieved at a cost of between $0.05 – $0.13 per gross first year (or $0.004 – $0.012 per gross lifetime) kWh saved (Malinick, 2018), which suggests that a consumer choice engine that makes efficiency visible in the marketplace and actionable for consumers can scale and achieve highly cost-effective savings[7].

Relevance to the LMI Segment

Significant savings were also associated with product categories not currently addressed by low-income direct install programs, but which are commonly purchased by low-income

[4] In Resolution E-4820, the CPUC mandated all IOUs to launch online energy management technology marketplaces. Enervee currently operates marketplaces for utilities serving 15% of all residential electric customers (and 5.7 million gas-only) customers in the USA, and over 27 million residential customers in Europe.
[5] Two-thirds of consumers across seven countries in North America and Europe think it's important to purchase efficient products for their homes (Champniss, 2018).
[6] For an introduction to the PG&E Marketplace, see Binley et al. (2016).
[7] This compares favorably to PG&E's claimed savings from its aggregate 2017 plug load and appliance portfolio (Arquit Niederberger, 2018b).

persons themselves, whether they are renters or owners. Savings for televisions, for example, were estimated at between 2,894 and 7,928 gross lifetime MWh (Malinick, 2018), which would cut PG&E customer bills by as much as $1,036,427 at the prevailing average low-income tariff (or by $1,815,036 at the average residential rate)[8].

TVs are a good example of the value of an online choice engine to address current policy challenges, while empowering low-income households to invest in efficiency themselves:

- TV efficiency is not correlated with retail price (Arquit Niederberger, 2016). Therefore, low-income households can be directed to more efficient models at a given price point, and there is no need to provide them with a financial incentive to shop energy smart.
- The Enervee Score makes efficiency visible to consumers. In 2016, the most recent year for which data are available, 71% of all TV models shipped in the USA were ENERGY STAR qualified, so the added differentiation provided by the zero to 100 Enervee Score makes the market more transparent and allows consumers to choose the most efficient models (Arquit Niederberger & Champniss, 2017).
- Electronics and miscellaneous plug loads are the main driver of residential load growth in California (NRDC, 2015), and account for roughly 7% of total residential energy consumption nationwide (EIA, 2015), so this is a big opportunity. If we were able to nudge 1/3 of all 35 million TV purchases in a single year to the most efficient models (with Enervee Scores of 90+), lifetime savings would reach into the thousands of GWh.

Large savings were also achieved through encouraging smart thermostat purchases with and without rebates: gross lifetime savings of up to 255 MWh and 33,400 therms for rebated purchases and up to 19,415 lifetime MWh and 2,538,871 lifetime therm savings without rebates (Malinick, 2018). Many more site visitors are influenced by the Marketplace than take advantage of utility incentives (Malinick, 2018).

Platform analytics also show that the most-viewed products on the Marketplace are generally more efficient, and often less expensive, than the average of rebated products (Arquit Niederberger, 2018a). Figure 1 shows a more recent analysis of clicks to retail.

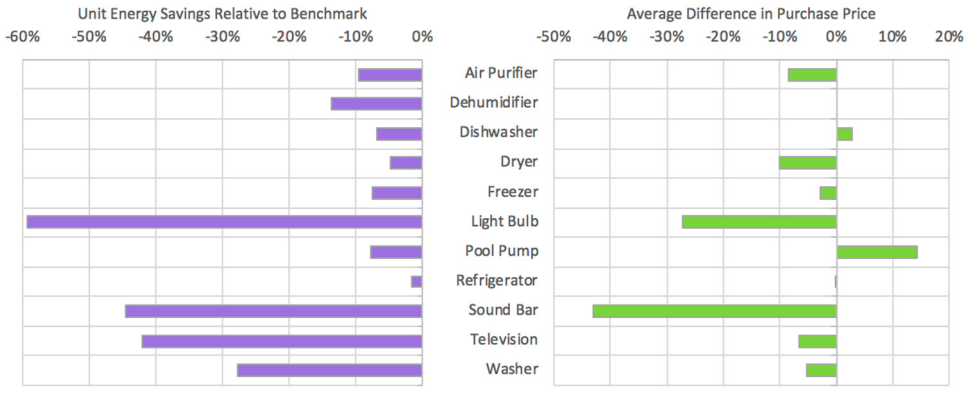

Figure 1. Comparison of 2017 marketplace clicks to product at online retailer to average of 30 most similar products. *Source*: Enervee.

[8] The current average low-income tariff (California Alternate Rates for Energy) is $0.13/kWh and the average residential rate is $0.23/kWh (PG&E, 2018).

Application to Low Socio-Economic Status Shoppers

We have reason to believe that appliance and lighting choice engines will be as valuable to low- and moderate-income customers as they are to the general population.

Low-income consumers may fixate or focus on communications referencing financial sums and figures (Mani et al., 2013), with the reference of money and savings alerting or priming their awareness of belonging to a financially constrained consumer group (Champniss et al. 2016). Consequently, it may be expected that low-income respondents will use the energy savings figures presented to move their preferences toward more efficient models. We tested this hypothesis in a randomized control trial and found that providing low-income consumers with the Enervee Score for products (the relative energy efficiency on a scale of 0–100), or with energy bill savings information, both lead to more efficient product preferences (Arquit Niederberger & Champniss, 2017). And, given that no interaction effect was observed, these two factors appear to work independently of each other, with the energy score serving as an easy-to-process heuristic and eliciting a hot/impulsive decision style, whereas the energy savings information prompts a more reflective/cool decision style, due to the added cognitive request[9].

The market-based online retail approach capitalizes on the trend towards online shopping and purchases. For the increasingly connected low-income segment (not only millennials), mobile is the device of choice for internet access, so mobile-first is a requirement to effectively serve this demographic.

Elements of an innovative online retail approach might include offering high incentives only on super-efficient product purchases (to stimulate product innovation and maximize the reduction in energy burden), instant online incentives to address the up-front purchase price barrier and solutions for contractors. Instant incentives offered on super-efficient products with incremental costs can be adjusted in real time to test participation under different cost-sharing arrangements, such as requiring a fixed co-pay per appliance purchased, or indexing the amount of the co-pay to the anticipated bill savings and income levels. This type of flexibility supports continual program optimization and can eliminate the need for artificial income qualification boundaries and encourage private investment. The online approach also facilitates partnerships to make energy-saving product purchases affordable[10].

Based on an indicative program design including LED light bulbs and incentivizing only the most efficient products currently available (refer to Appendix) – and leveraging the existing online utility marketplaces – investing $1 million in such a program in California could cut energy bills of low-income customers by $1.46 million (Table 1).

Table 1. Impact of indicative $1 million online retail program targeting CARE customers

	Lifetime Electricity Savings (MWh)	Energy Bill Savings (CARE Rate)	Avoided Energy Cost	Avoided CARE Subsidies	Delivery Cost (per lifetime kWh)
With LED	10,670	$1,457,560	$1,280,340	$1,004,213	$0.094
Without LED	5,548	$757,975	$665,815	$522,221	$0.180

[9] Interestingly, the personalized bill savings information was salient for low-socio-economic status respondents, but had no effect for the general population, except in an emergency replacement buying context, which tends to elicit reflective decision making (Champniss & Arquit Niederberger, 2017).

[10] The Nest Power Project is a smart thermostat program geared specifically to low-income households.

In addition, all ratepayers would benefit from avoiding the need to fund $1 million in CARE bill subsidies and over $1.2 million in energy costs. The energy savings are significant – as a result of targeting super-efficient products – and can be achieved at a cost of 9.4 cents per kWh. These estimates are based on the following assumptions and inputs:

- Budget: $750,000 for instant incentives at online and/or in-store point-of-sale; $250,000 for installation, marketing and incentive processing.
- Incentives would target super-efficient products with Enervee Scores at 90 or above, justifying a net-to-gross ratio of 1. This approach of targeting CARE customers and only the most efficient products is considered to be a best practice, in line with CPUC guidance on incentives to customers in Section 2.2.1 of Decision 18-05-041 Addressing Energy Efficiency Business Plans.
- Avoided cost of energy: $0.20/kWh for HVAC, $0.12/kWh for all other measures.
- Avoided cost of bill subsidies: $0.09/kWh saved (difference between a residential rate of $0.23/kWh and a CARE rate of $0.14/kWh).

Such a program would include market transformation, behavior change and incentive elements – and therefore requires the right framework for experimentation, based on solid theoretical underpinnings, a compelling logic and the ability to track performance metrics that allow for continual learning and adjustment.

There are several straightforward ways to encourage utilities to better target any financial incentives in the residential sector to those most in need. One is to include the avoided cost of bill subsidies in residential sector program cost-effectiveness screening tests (e.g., TRC) and/or earnings mechanisms. Another is to assign a net-to-gross-ratio of 1 to any measures that target financial incentives to super-efficient products to benefit income-qualified households.

Conclusions – Leveraging Utility Online Marketplaces

Low-income programs delivered via online marketplaces are poised to offer great value to low-income households & disadvantaged communities, ratepayers and society as a whole, because they:

- Provide ongoing energy efficiency support for all low-income customers. This is important, because in any given year, many more households are provided rate discounts than receive energy efficiency measures[11];
- Nudge private investment by low-income households into more efficient products—even without incentives. By making efficiency visible and providing personalized energy bill savings and total cost of ownership information, the added market transparency and lowering of search costs drives more efficient choices;
- Cover dozens of plug load & appliance categories not included in existing efficiency programs, which nonetheless contribute significantly to energy burden. TVs, for example,

[11] The ratio in California in 2016 was 24X, with 4.5 million enrolled in the CARE discount program and 187,877 homes treated under the Energy Savings Assistance Program (CPUC, 2017).

are ubiquitous, and among the 600+ models currently on the market, consumption ranges by 4-fold, with efficiency not correlated with price[12];

- Offer greater choice and convenience to low-income customers, property managers and building owners. Online marketplaces capitalize on high internet access (mobile, computer)[13] and the trend towards an increasing share of online purchases of products & services[14], to inject energy into the shopping journey. They are an "always on" resource and can modernize programs to scale participation. Online point-of-sale incentives, for example, directly address the purchase price barrier, without interrupting the shopping journey;
- Deliver targeted and cost-effective incentives at scale. The data engine behind the public-facing marketplaces helps diagnose barriers and informs program design. With daily updated retail price and relative efficiency information, it's possible to dynamically match incentive levels to incremental costs and to focus incentives on the most efficient products, rather than commonly used benchmarks.
- Create a seamless digital experience to implement a range of legislative mandates.

Retail is increasingly moving online, even for major domestic appliances, and virtually every modern shopping journey includes online elements. By expanding the universe of plug load & appliance categories addressed, adopting market-based and behavioral strategies and using data to target marketing and incentives for greatest impact, utility-branded online marketplaces that provide customers with energy aware choice engines can scale participation and improve low-income program cost-effectiveness. An online retail approach is not a substitute for more conventional program designs, but an essential innovation, if ambitious climate and energy efficiency goals are to be achieved cost-effectively.

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[12] Even within a specific size class, we've documented a 4-fold range in consumption (Arquit Niederberger, 2016).
[13] 2016 Low-Income Needs Assessment included a telephone survey, which found that more than 80% of California low-income customers surveyed have wifi service at their homes, including 84% of those at or below the Federal Poverty Level (Evergreen Economics, 2016b).
[14] NPD Group 2017. Major Home Appliances See Online Channel Growth.

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Appendix

Measures Included in Indicative $1 Million Low-Income Program – With LED Scenario

	Product Category	Efficiency Threshold (Enervee Score)	Incentive per Unit	Number of Incentives	Lifetime Specific Electricity Savings[15] (kWh/unit)
Kitchen	Refrigerators	97	$600	320	6314
	Freezers	95	$400	20	4860
Laundry	Clothes washers	93	$600	130	1232
	Clothes dryers (electric heat pump)	100	$1,200	130	3960
Electronics & Smart Home	Televisions	95	$100	810	810
	Advanced Power Strips (Tier 2)	N/A	$50	560	400
	LED light bulbs	85	$5	30200	208
	Smart Thermostats	N/A	$150	240	1859
Other	Air purifier	97	$200	20	1044
	Dehumidifiers	90	$200	10	2592
	Pool pumps	95	$700	20	11110

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Kitchen	Refrigerators	97	$600	400	6314
	Freezers	95	$400	30	4860
Laundry	Clothes washers	93	$600	160	1232
	Clothes dryers (electric heat pump)	100	$1,200	160	3960
Electronics & Smart Home	Televisions	95	$100	1010	810
	Advanced Power Strips (Tier 2)	N/A	$50	700	400
	Smart Thermostats	N/A	$150	300	1859
Other	Air purifier	97	$200	30	1044
	Dehumidifiers	90	$200	10	2592
	Pool pumps	95	$700	30	11110

[15] Savings were estimated as the difference between the 90th percentile product in terms of Annual Energy Consumption and the 10th percentile product currently offered for sale (as of 30 June 2018) and featured on choose.enervee.com.