A Roadmap to Achieve Equitable Access to Efficient Home Appliances

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ABSTRACT

Opening price point (OPP) appliances, the cheapest models in the store, are an untapped savings and equity opportunity for the efficiency industry. OPP appliances sell in remarkably high volumes and are rarely efficient. Their purchasers have lower median incomes than buyers of higher priced appliances, nearly one-third are renters and nearly half are people of color.

New research conducted in 2021 and jointly funded by seven program administrators revealed five key market and technical barriers to appliances that are both low priced *and* high efficiency. For each of the three product categories studied - clothes washers, refrigerators, and window air conditioners, the barriers differ and so too the strategies needed to address them. Major manufacturers, for example, *do* make low-cost ENERGY STAR® refrigerators, but they are not available at retail, requiring a strategy in which retailers are encouraged to bring these models into stores. In contrast, the lowest-cost ENERGY STAR washers *are* available at retail but are still too expensive for many buyers, requiring an approach that incentivizes the design and manufacture of efficient but lower cost models.

This paper describes the research methods and findings, including engineering analysis of component- and feature-level differences between OPP and ENERGY STAR models. It also describes how the funding utilities will work to convene manufacturers, retailers, policy makers, and advocates in a collaborative effort to overcome the identified barriers and create more equitable access to efficient home appliances for buyers shopping at the lowest price points.

Introduction

Opening price point (OPP) appliances, the cheapest models in the store, are an untapped savings and equity opportunity for the efficiency industry. In the major appliance categories, it is not unusual for five of the lowest priced models (out of thirty or more total models on the sales floor) to make up 30% of total sales. The outsized market share of OPP appliances gives them an equally disproportionate impact on the category as a whole and makes them an important target for energy savings and greenhouse gas emissions reductions.

There is another reason for the energy efficiency industry to prioritize opening price point products. The buyers of cheap appliances have different demographic characteristics than buyers of higher priced models: OPP buyers have lower incomes, are more likely to be people of color, and more likely to live in multifamily buildings. They include a large proportion of renters and those under financial strain. All of which would designate them as "underserved," "disadvantaged," or "hard to reach" by utility programs (Frank 2020).

New research conducted in 2021 and jointly funded by seven program administrators acting in alignment as the Shift Consortium, revealed the extent and contours of the inequitable access to efficiency in today's appliance market (Shift Consortium 2021). This paper describes the research methods and findings, including the results of an engineering analysis of component- and feature-level differences between OPP and ENERGY STAR models. It concludes by describing how the funding utilities will work together in 2022, and after, to convene manufacturers, retailers, policy makers, and advocates in a collaborative effort to overcome the identified barriers and create more equitable access to efficient home appliances for buyers shopping at the lowest price points.

Research Approach and Methods

This research took place in the latter half of 2021 and focused on three core home appliance categories in which the sponsors' field work had shown a gap in availability of efficient models at low price points: clothes washers, refrigerators, and window air conditioners. In this research, ENERGY STAR qualification was used to designate energy- and water-efficient appliances and in reporting the findings the terms "ENERGY STAR" and "high efficiency" are used interchangeably. The three product categories on which the research focused were selected because, in each, retail sales data showed a disproportionately small market share of ENERGY STAR appliances at the opening price points compared to both higher price points and the category as a whole.

The three areas of research were the **availability** and **affordability** of low-cost, high efficiency appliances, and the **technical differences** between low-cost baseline-efficient appliances and the lowest cost ENERGY STAR models.

In examining efficient appliance availability and affordability, the research team sought to document the extent to which a household shopping for a low-cost appliance, either online or in a retail store, would have the opportunity to purchase an ENERGY STAR model (availability) and how much more the ENERGY STAR model would cost (affordability). In order to answer these questions, two types of primary research were undertaken:

- **Online survey**. An online survey of manufacturer product catalogues and retailers' in-store offerings (using information available on retailer websites) was performed by Shift Consortium staff in May and June 2021
- **In-person shelf survey**. An in-person survey was conducted at retailers in Sacramento, California by the Sacramento Municipal Utility District (SMUD), a publicly-owned electric utility and Shift Consortium sponsor, in April 2021

In exploring the technical differences between OPP and ENERGY STAR models, the Shift Consortium worked with Kannah Consulting, who assessed the individual technologies or groups of technologies that could enable baseline-efficient clothes washers and refrigerators to qualify for ENERGY STAR. Kannah's data sources for this work included DOE Technical Support Documents, other published research reports, and tear-down analyses commissioned by efficiency organizations.

Availability and Affordability: Key Findings

The approximately one-third of U.S. appliance buyers who shop at the opening price points will find it either expensive or difficult to purchase an ENERGY STAR clothes washer, refrigerator, or window air conditioner. Affordability and availability are the key barriers preventing OPP buyers from accessing today's high efficiency core home appliances. The availability barrier has two dimensions – availability on market and availability in store, for a total of three different barriers that will need to be addressed in order to improve equity in access to market-leading energy efficiency:

- **Affordability**. Affordability is a barrier when ENERGY STAR models have a substantially higher incremental cost than baseline-efficient OPP models. Shift sponsors' experience suggests an incremental cost of 20% and higher negatively impacts adoption, with higher incremental costs resulting in reduced sales.
- **Availability on market**. This barrier is present when there are few, if any, low-priced ENERGY STAR models being manufactured.
- **Availability in store**. This barrier is present when low-priced ENERGY STAR models are manufactured but are not on the floor in retail stores and thus unavailable for buyers to examine in-person.

These three barriers are present in different combinations in the clothes washer, refrigerator, and window air conditioner categories, giving each product a unique barrier profile and necessitating differentiated, targeted strategies in response. In the clothes washer category, for example, availability on market and affordability are co-equal primary barriers: there are no low-cost ENERGY STAR models being manufactured today. In the refrigerator and window air conditioner categories, in-store availability is the primary barrier. Manufacturers are producing low-cost ENERGY STAR models in both categories but these models are rarely available in retail stores and may also be difficult to find online. Table 1 shows the primary and secondary barriers for each product category.

Table 1. Summary of barriers to market-leading energy efficiency at the opening price points: clothes washers, refrigerators, and window air conditioners

	Barriers to efficiency at the lowest price points X = primary barrier / = secondary barrier		
	Affordability	Availability on market	Availability in store
Clothes washers – top load	X	X	/
Clothes washers – front load	X	X	/
Refrigerators – top freezer			X
Window air conditioners	/	/	X

The presence of the affordability barrier in the washer and window air conditioner categories is apparent in a quick scan of the difference in the manufacturer's suggested retail price (MSRP) between OPP models and the lowest cost ENERGY STAR models, as is the much less substantial incremental cost of ENERGY STAR in the refrigerator category.

Table 2 shows the five opening price points for each appliance category, the opening price point for ENERGY STAR, and the incremental cost of the lowest-cost ENERGY STAR model compared to the OPP model.

Table 2. The five opening price points for full-sized clothes washers, refrigerators, and window air conditioners vs. the ENERGY STAR opening price point

	Opening price points (MSRP)		Incremental cost (%) of lowest-cost ENERGY STAR model over OPP model
	OPP model Next four lowest price points	Lowest-cost ENERGY STAR model	
Clothes washers – top load	**$499,** $549**,** $599**,** $629**,** $649	$779	$280 (56%)
Refrigerators – top freezer	**$519,** $599**,** $669**,** $689**,** $699	$599	$80 (15%)
Window air conditioners	**$159,** $219**,** $229**,** $239**,** $279	$230	$71 (45%)

The presence of the availability barrier in refrigerators and window air conditioners is also clearly observable in reviewing three major retailers' in-store product offerings (Table 3). None of the three stores visited for the shelf survey had an opening price point, major brand ENERGY STAR refrigerator on the sales floor (although two of three had off-brand or private label ENERGY STAR models on display). Review of retailers' online catalogues and discussions with retailers about their refrigerator assortments confirmed that the gap in in-store availability observed in Sacramento is consistent nationwide.

In-store offerings in the window air conditioner category were assessed in the online review of retailers' websites using the "pick it up today" or "in stock at store today" options, both of which indicate that the model is on display in the selected store.[1] The online review showed that none of the retailers had the lowest-cost ENERGY STAR 5,000 BTU or 6,000 BTU window air conditioners in store.

Table 3. In-store offerings of the lowest-cost ENERGY STAR clothes washers, refrigerators, and window air conditioners

[1] The online review was necessary for window ACs because the shelf survey was conducted in early spring, before retailers bring these appliances into their stores.

Category Lowest-priced models	Did the store have at least one of the lowest-priced ENERGY STAR models on display in store?		
	Best Buy	Home Depot	Lowe's
Clothes washers – top load $779 GE or $799 Amana, Samsung, LG	Yes	Yes	Yes
Refrigerators – top freezer 18 cu.ft. $529 Midea, $679 Insignia, $749 Samsung	Yes	No	Yes
Window air conditioners – 5,000 and 6,000 BTU $219 Midea, $230 Frigidaire	No	No	No

Key finding in the clothes washer category

The key finding in the clothes washer category was the total absence of ENERGY STAR top load clothes washers and front load clothes washers being manufactured at the lowest price points. As a result, products with best-on-market energy and water efficiency are unaffordable to buyers shopping for a model with an MSRP under $750 (Table 5).

Table 4. Proportion of ENERGY STAR clothes washer models by brand and price point

Brand	Market share, 2017*	% ENERGY STAR models, by MSRP						
		$499	$549	$599	$649	$699	$749	$779 - $899
Whirlpool**	29%	0%	0%	0%	0%	0%	0%	50%
Maytag	16%	0%	0%	0%	0%	0%	0%	33%
GE	14%	0%	0%	0%	0%	0%	0%	100%
LG	10%	0%	0%	0%	0%	0%	0%	100%
Samsung	8%	0%	0%	0%	0%	0%	0%	75%
Weighted average, by market share		0%	0%	0%	0%	0%	0%	50%

* Statista. "Market share of washing machine brands among consumers in the United States, as of May 2017." Accessed May, 2021. ** Model data for Whirlpool brand only.

Key finding in the refrigerator category

The key finding in the refrigerator category was that the major U.S. brands (Whirlpool, GE, Frigidaire) manufacture low-cost ENERGY STAR models that have only a moderate incremental cost (typically $50) compared to the nearly identical baseline-efficient models. However, the ENERGY STAR models are never displayed in retail stores and rarely, if ever, purchased. Some retailers did display ENERGY STAR refrigerators from secondary brands, including Samsung, Best Buy's house brand Insignia, and Chinese brand Midea. Table 6 shows the number of ENERGY STAR models on the sales floor at three U.S. retailers, by price point.

Table 6. Retailers' top freezer, 17-19 cu ft, ENERGY STAR refrigerator offerings at three MSRP tiers: lowest (under $699), moderate ($700-799), and high ($819 and up)

	Number of ENERGY STAR top freezer, 17-19 cu ft refrigerators out of all models displayed			All price points	Brands of ENERGY STAR models displayed in-store
	Lowest MSRP < = $699	Moderate MSRP $700 - $799	High MSRP > = $819		
Best Buy	1 of 1	None displayed	1 of 2	2 of 3	Insignia Samsung
Home Depot	None displayed	0 of 1	0 of 2	0 of 3	None displayed
Lowe's	1 of 2	0 of 2	0 of 4	1 of 8	Midea
All stores	2 of 3	0 of 3	1 of 8		

Key finding in the window air conditioner category

The key finding in the window air conditioner category was that the lowest-cost ENERGY STAR window air conditioners in the smallest, most frequently purchased sizes (5,000 and 6,000 BTU) are rarely available in retail stores (Table 7). Lowe's was the only retailer to floor ENERGY STAR window air conditioners in the 6,000 BTU size. However at $329, the floored units were at a price point far higher than comparably sized baseline-efficient 6,000 BTU models and also higher priced than similarly-sized ENERGY STAR models available exclusively online ($230-250).

Table 5. Retailers' in-store ENERGY STAR window air conditioner offerings by size

	Number of ENERGY STAR models in each size, out of all models					
	5,000 BTU	6,000	7 - 8,000	9 - 10,000	11- 12,000	14,000
Best Buy	0 of 1	0 of 1	0 of 0	0 of 0	0 of 0	1 of 1
Home Depot	0 of 1	0 of 1	1 of 2	2 of 2	0 of 0	1 of 1
Lowe's	0 of 1	2 of 4	3 of 4	0 of 0	1 of 2	1 of 1
All stores	0 of 3	2 of 6	4 of 6	2 of 2	1 of 2	3 of 3

In contrast to their in-store offerings, retailers' websites included a larger number of 6,000 BTU ENERGY STAR models (Table 8).

Table 8. Retailers' in-store vs. online ENERGY STAR window air conditioner offerings

	Number of ENERGY STAR models	
	6,000 BTU models	
	In store	*Online*
Best Buy	0	2
Home Depot	0	3
Lowe's	2	6
All stores	2	11

Technical Differences between OPP and ENERGY STAR Models

Kannah Consulting's analysis of the component and feature-level differences between baseline-efficient and low-cost ENERGY STAR models showed a number of possible technology pathways that generate the ENERGY STAR models' higher energy and water efficiency.

Top load clothes washer technical pathways

The technology pathways for clothes washers were developed by comparing baseline-efficient top load OPP washer technologies and features to those in low-priced ENERGY STAR models. Researchers started with the baseline-efficient OPP models identified in the Shift Consortium's 2021 research and then identified the technologies or design changes that would be needed to enable the OPP models to become ENERGY STAR qualified (Table 9).

Table 9. Technologies or design changes that would enable baseline-efficient OPP washers to become ENERGY STAR qualified

Top load washer modifications	
Technology or design change	*Description*
Increase spin speed	Faster spin speed extracts more water, reducing dryer energy use. ENERGY STAR models spin at ~800 rpm vs. ~700 rpm for non-qualified models.
Eliminate manual water fill controls	ENERGY STAR models do not allow for manual water fill control
Use a wash plate instead of an agitator	Impeller technology reduces water use and is employed by top load ENERGY STAR qualified washers

To enable an OPP top load clothes washer to qualify for the ENERGY STAR program, three key upgrades to will be required, all of which employ well-established technologies:

1) **Increase spin speeds**. Spin speed correlates to water extraction. Higher spin speed at the end of the wash cycle reduces the remaining moisture content in clothing and thus drying energy use. ENERGY STAR qualified models spin at higher revolutions per minute (rpm) than non-qualified models (~800 rpm vs. 700 rpm). Spin speed can be increased with a higher horsepower motor, a larger diameter pully, and a longer belt. Alternatively, a direct drive motor could be used to increase spin speed more efficiently. An engineering tear-down compared a top

load ENERGY STAR qualified model with a non-qualified top load model from the same manufacturer and revealed that the ENERGY STAR model employed a higher horsepower motor (0.4 hp instead of 0.33 hp), a larger diameter pully, and a longer belt enable a spin speed of 800 rpm (instead of 700 rpm of a non-qualifying OPP model) (NEEA 2019).

2) **Eliminate manual water fill controls**. Baseline-efficient OPP washers allow the user to manual adjust the water fill level, in addition to including an automatic water fill control option. ENERGY STAR models, in contrast, rely exclusively on automatic water fill controls. This primarily requires a change to the control panel interface, but spray valves may also be needed to reduce water in the rinse cycle.

3) **Use a wash plate instead of an agitator**. Top load impeller technology maintains washing performance with reduced water use. The research team found that ENERGY STAR-qualified washers employ a wash plate instead of an agitator.

Front load washer feature differences

Despite their presence in the U.S. market for more than two decades, there are no front load washers available today that can compete on price with the lowest-cost top load washers. Front load washers have a price premium of $200 to $300, 30-60% more than the lowest priced OPP top load models.

The research team wanted to understand whether there were “extra” features present in the lowest-cost front load washers which, if eliminated, could further reduce their retail price and make them more price competitive with OPP top load washers. To this end, researchers compared baseline-efficient OPP top load models (average MSRP $586) to low-cost ENERGY STAR front load models (average MSRP $866).

Top load and front load OPP washers shared a number of similarities: all were white, most had stainless steel baskets (only one OPP top load washer had a porcelain basket), and both types of models offered a similar average number of programs and wash temperature settings. However, several distinct differences emerged between the lowest cost front load and top load models. Front load washers included three features not found in top load models:

- **Larger basket size.** OPP front load models were an average of 0.6 cubic feet larger than the top load models.
- **Time delay.** This feature enables the user to load clothes and detergent into the machine but delays the start of the cycle. This feature was not present in any top load models and was present in two of the three OPP front load washers.
- **Adjustable spin speed.** This feature was not present in any top load model but was in two of three OPP front load washers.

The two opportunities to reduce component costs (and features) in OPP front load models are to reduce the basket size and eliminate features that do not impact energy, water, or cleaning performance (Table 10).

Table 10. Design changes that may reduce cost in front load washers and make their size and feature sets comparable to baseline-efficient OPP top load washers

Front load washer modifications	
Design change	*Description*

Reduce the basket size	Basket size of OPP front load models could be reduced from 4.3-4.5 to 3.5-4.0 cu ft.
Eliminate features that do not impact energy, water, or cleaning performance and which are not found in OPP top load models	Features that could be considered for elimination include time delay and spin speed selection.

The component-level or bill of materials cost savings that may result from these changes is uncertain and further research on the cost benefits of a reduction in features is needed. It is possible that manufacturing and component supply efficiencies associated with leveraging existing front load designs (and their current features) may have a larger influence on component and manufacturing cost than the feature differences identified in this comparison. It is also possible that the price point of front load washers is being driven by manufacturers' desire to position them as a premium product, rather than component costs.

Refrigerator technical pathways and feature differences

There are many possible technologies or technology packages that could enable a top freezer refrigerator to save the approximately 9% annual energy use needed to qualify for the ENERGY STAR program. The technology pathways employed by any one manufacturer or model set likely depend on which efficient technologies that are *already present* in each baseline-efficient OPP model – data that can unfortunately only be obtained from the manufacturers or in a tear-down analysis, in which a product is disassembled in order to identify its component parts.

Lacking these product-specific design data, researchers used published research to develop a list of technologies or technology groupings that could be employed in today's low-cost ENERGY STAR refrigerators.[2] The technologies were categorized based on how likely the research team believes it is that manufacturers use them in their current low-cost ENERGY STAR models:

- **Most likely** technologies have between 1 and 10 percent efficiency improvement, relatively low cost, and are easy to implement in a non-qualifying model during assembly.
- **Somewhat likely** incremental technologies fall between these two extremes because they may be medium cost and/or may have intermediate difficulty to achieve during assembly.
- **Least likely** incremental technologies have a generally higher percent efficiency improvement (~20 to 30 percent), relatively high cost, and may be difficult to implement in a non-qualifying model during assembly.

In total, 21 efficient refrigeration technologies were identified that can, individually or in combination, reduce energy use by 9% or more (Table 11).

[2] The technical documentation used to assess energy savings and costs included DOE technical support documentation (US DOE 2011), a United Nations Industrial Development Organization (UNIDO) report on benefits and costs of energy efficient refrigeration (Abdelazziz 2020), an Electric Power Research Institute (EPRI) paper on adjustable speed drives (Dols 2014), a U.S. DOE funded report on high efficiency electric motors (Arthur D. Little 1999), and a paper on fan air flow straighteners (Munisamy 2015).

Table 11. Twenty-one incremental energy efficient technologies and their likelihood of being employed in current ENERGY STAR qualified OPP top freezer refrigerators

Most likely to be employed	
Efficient technology	*Description*
Improved brushless DC compressor motor	Reduces compressor energy use and requires an electronic controller
Improved brushless DC fan motors (condenser and/or evaporator)	Reduces fan energy use, and if employed on the evaporator side, also lowers the fan waste heat in the cooled cabinet (reducing the energy needed by the compressor to cool the interior cabinet)
Improved compressor (non- motor related)	Lowers energy use through compressor prime mover improvements, which is typically piston improvement, but could also be a swap to a linear compressor or a variable capacity compressor (also known as variable displacement compressor)
Larger condenser area	Reduces compressor energy use by enabling a lower refrigerant pressure and temperature on the hot side of the system; because the condenser area is larger, heat is more easily rejected into the room compared to systems with a smaller condenser area
Larger evaporator area	Reduces compressor energy use by enabling a higher refrigerant pressure and temperature on the cold side of the system; because the evaporator area is larger, heat is more easily absorbed inside the refrigerant cabinet compared to systems with a smaller evaporator area
Improved adaptive defrost	Minimizes the amount of required defrost heat
Expansion valve improvements	Could reduce the energy use of starting and stopping the cooling system by preventing the pressures on the two sides of the refrigerant loop from equalizing when the compressor is turned off; an improved valve could also allow customization of evaporator and condenser temperatures as exterior and interior temperatures change
Door gasket improvements	Could decrease the heat conduction through the gasket and reduce infiltration of warm air into the cabinet
Fan blade improvements	Optimizes the twist, taper, and cross-section (e.g., airfoil) of the blades to reduce fan energy use
Fan air flow straighteners	Reduces the swirling flow dissipated as heat in axial fans, which reduce losses and lowers fan energy use; when employed for evaporator fans, this can also slightly reduce compressor energy use
More thermally resistive foam	Lowers heat gain into the cooled cabinet and could include different foam blowing agents or a different polymer solid
Somewhat likely to be employed	
Efficient technology	*Description*
Thicker insulation*	Reduces heat gain to the cooled cabinet

Plastic insulated frame	Reduces heat transfer; if the insulating foam is completely encased in metal, heat moves into the cooled cabinet through the metal adjacent to the door gasket; plastic instead of metal near the gasket significantly reduces this heat transfer
Increased homogenization of in-cabinet air temperature	Reduces compressor cycling associated with hot spots near the thermostat; uniformity of in cabinet temperature also improves cooling performance for the consumer
Alternative refrigerants (such as isobutane)	Can enable a higher cooling system efficiency
Reusing condenser heat for defrost	Most OPP models use electric resistance heat for defrost; condenser heat is regularly produced during the cooling process and can be repurposed for defrost
Gas panel insulation	Reduces cabinet heat gain using more effective insulation with specialized insulative gas coupled with metal heat shielding
Least likely to be employed	
Efficient technology	*Description*
Vacuum insulated panels*	These evacuated (no air) panels combined with metal heat shielding are highly insulative and low volume; can also enable other efficiency improvements that require more volume, such as increased area of evaporators and condensers
Variable speed compressors*	Significantly reduces energy use by tailoring the cooling capacity to the cooling required in the interior cabinet; peak cooling capacity is usually not required, and in conventional systems, losses occur when the compressors start and stop
Variable speed fans	Reduces fan energy by scaling fan speed to what is required to keep the cabinet cool; these fans save the most energy when coupled with a variable speed compressor; variable speed fans also reduce fan waste heat generated inside the cooled cabinet, resulting in reduced compressor energy use
Microchannel heat exchangers	Enables more condenser and/or evaporator surface area per unit volume; can be used to further increase condenser and/or evaporator area, or enable higher volume efficiency measures, such as insulation; can also reduce the total amount of refrigerant, saving money and/or reducing global warming and ozone impacts associated with leaks

* Indicates a technology that can achieve at least 9% energy savings independent of other technologies

Using product inspection and publicly available technology/teardown research, the team compared baseline-efficient top freezer OPP models to ENERGY STAR-qualified models of identical brand and size. Inspection of marketing materials and online information revealed that the interior and exterior form factor and features of each "matched pair" (baseline-efficient and ENERGY STAR) were identical or nearly identical. This suggests that the two models are built using the same platform, and manufacturers swap out insulation or other components to achieve lower energy use of the ENERGY STAR models.

Two combinations of technologies were judged to be more likely to be employed in today's OPP ENERGY STAR top-freezer refrigerators:

- More thermally resistive foam and improved door gaskets, or
- Improved brushless DC compressor motor, improved brushless DC fan motors (condenser and/or evaporator), larger condenser area, and larger evaporator area.

One technology combination that was judged unlikely to be employed in today's OPP ENERGY STAR models is the use of a microchannel heat exchanger, alternate refrigerant, and variable speed fan(s). These technologies are relatively unlikely because heat exchangers are a relatively new technology for domestic refrigeration, alternative refrigerant requires redesign of other aspects of the refrigeration system, and variable speed fans are most cost-effective with variable speed compressors (but not as cost-effective as a standalone measure).

Five Action Items to Increase Access to Efficient Appliances and How to the Shift Consortium is Addressing Them

The unique combination of barriers in each product category yields five action items across the three product categories. Increasing equitable access to efficient appliances will require accomplishing each of these action items (Table 12).

Table 12. Five action items to increase equity in access to today's high efficiency appliances

Clothes washers	
Opportunity	Barrier and action item
Top load washers: Improve affordability and availability	*Barrier* Manufacturers do not offer ENERGY STAR top load washers to the US market at any of the five opening price points. *Action item* Bring to market an ENERGY STAR top load washer at one or more opening price points ($499, $549, $599). The new ENERGY STAR model(s) should be available in-store at all major retailers and available to independent retailers.
Front load washers: Improve affordability and availability	*Barrier* Manufacturers do not make front load washers at any of the five opening price points. *Action item* Bring to market a front load washer at one or more opening price points ($499, $549, $599, $649, $699). The new ENERGY STAR model(s) should be available in-store at all major retailers and available to independent retailers.
Refrigerators	
Opportunity	Barrier and action item
Top freezer fridges: Improve availability	*Barrier* Retail stores do not place full-size ENERGY STAR top-freezer refrigerators from major brands on the sales floor. *Action item* Amend in-store offerings to ensure low-cost, full-size ENERGY STAR models from major brands are widely available.
Window air conditioners	

Opportunity	Barrier and action item
6,000 BTU models: Improve availability	*Barrier* Retail stores do not place 6,000 BTU ENERGY STAR window air conditioners on the sales floor. *Action item* Amend in-store offerings to ensure low-cost ENERGY STAR models are widely available at retail stores.
5,000 BTU models: Improve affordability and availability	*Barrier* Most manufacturers do not make a 5,000 BTU ENERGY STAR window air conditioner at the lowest price points. *Action item* Bring to market additional 5,000 BTU ENERGY STAR models at opening price points ($150-200). The new ENERGY STAR model(s) should be available in-store at all major retailers and available to independent retailers.

The Systemic Causes of Inequitable Access to Efficient Appliances

The situation in which we find the present-day appliance industry is a near-textbook case of a “systemic” or “structural” or “complex” problem, in which there are many interrelated causes of disfunction rather than a single, isolated issue. As in any systemic problem, the barriers to more equitable access to efficient appliances are experienced differently by each participant in the system. Manufacturers experience the barrier as higher costs for producing efficient products and a lack of demand for lower-cost efficient models. For retailers, the slightly-higher cost of efficient models makes them undesirable to bring to the sales floor, where retail space is dominated by the very lowest-cost models and mid- to high-priced models. Utilities, some of which have dollars available to help customers buy efficient appliances, find few models where their limited per-unit amounts can even come close to covering the customer’s incremental cost.

The multi-faceted nature of the barriers in a complex system is itself a barrier to action because “it’s difficult to get people to agree on even what the issue is, much less what the solutions might be.” (Ehrlichmam 2021) Adding to this communication barrier is the challenge of coordination. When barriers are interrelated, individual or isolated changes will not move the system as a whole. Only organized, coordinated action can do that.

Using a Network Approach to Induce Change in the Appliance “System”

Organized, coordinated action across an entire industry does not happen by chance. It requires intentional collaboration. The Shift Consortium was founded in 2019 to promote action-based collaboration among efficiency program sponsors. In the years since, Shift sponsors’ research and continued field work demonstrated that utility programs alone were insufficient to induce the structural changes needed to promote greater equity in the appliance market. As a result, in 2022, the Shift Consortium initiated a broader effort aimed at bringing together not just efficiency sponsors but also community advocates, policy makers, and the appliance supply chain. The goal of this “convening” work is to, eventually, change the fundamental structure of the appliance supply chain to increase affordability and availability of efficient appliances.

The Shift Consortium convening work is guided by an approach to systemic change that employs principles of network building, in which organizations and individuals work together to bring about a shared vision of social change (Ehrlichman 2021). The effort is catalyzed (funded and originated) by the Shift Consortium, guided by a network builder (a skilled facilitator) and informed by a design team (a group of 8-10 volunteers who are representative of the stakeholder community).

The process itself is relatively straightforward. The design team, guided by the network builder, will meet monthly in Spring and Summer 2022 to identify key questions and issues that need to be addressed in order for system change to be achieved. The network builder, working with the Shift Consortium administrators (Efficiency for Everyone and VEIC) will build the agenda for a first "convening," a six- to nine-hour virtual meeting held over three days in Fall 2022. At the first convening, participants from across the appliance supply chain as well as utilities, non-profit and community organizations, advocates, and policy makers will come together to share knowledge and research findings, develop shared goals for the future and shared action items for the present.

The goal of the convening process is first and foremost to build trust among the participants. Moving at the speed of trust, and perhaps not until the second, third, or later convenings, the group will be guided to identify specific obligations or activities that each stakeholder is willing to commit to. Retailers, for example, may commit to flooring low-cost ENERGY STAR models. Efficiency program administrators may commit to subsidizing the retail cost of efficient models to enable retailers to sell them at typical opening price points. Manufacturers may commit to design and produce OPP models that meet high efficiency goals without extensive feature sets. Federal agencies may commit to including equity metrics in their policies and programs in ways that encourage the design, manufacture, and sale of high-efficiency OPP appliances.

Conclusion

Today's OPP buyers have little to no access to high efficiency washers, fridges, and window ACs. These inequities persist despite the fact that well-established technologies that improve efficiency are widely available. Further, there are clear opportunities to reduce the cost of efficient appliances by removing features from ENERGY STAR models that do not contribute to efficiency and are not present in today's baseline-efficient models.

OPP buyers' inequitable access to today's high efficiency appliances is a problem that can, and should, be addressed. Accomplishing the five actions highlighted in the Consortium's research will require close collaboration between manufacturers, retailers, efficiency program funders, and policy makers. Each will play a critical role in helping bring about more equitable outcomes for U.S. appliance buyers. If the present state of inequity in the appliance market teaches anything, it is that a new approach to making change is needed. The complexity of the market, the interconnectedness of the stakeholders, and the structural nature of the barriers suggests nothing less than a collective, collaborative effort will be necessary.

References

Abdelaziz, O., N. Cotton and P. Cazelles. 2020. *Guidance Report on Net Benefits and Cost for Energy Efficient Refrigeration Design Options.* Report produced for Kigali Cooling Efficiency Program. 31 May. www.unido.org/sites/default/files/files/2020-07/Guidance%20Report%20on%20net%20benefits%20and%20cost%20for%20different%20energy%20e fficient%20refrigeration%20design%20options%20Final%20200720.pdf

Arthur D. Little Inc. 1999. *Opportunities for Energy Savings in the Residential and Commercial Sectors with High-Efficiency Motors*. Prepared for the U.S. DOE Contract Number DE-AC01-90E23821. library.cee1.org/system/files/library/1103/268.pdf

Dols, J., B. Fortenbery, M. Sweeney, and F. Sharp. 2014. *Efficient Motor-Driven Appliances Using Embedded Adjustable-Speed Drives.* American Council for an Energy Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings. Asilomar, CA. www.aceee.org/files/proceedings/2014/data/papers/9-886.pdf

Ehrlichman, David. 2021. *Impact Networks: Create connection, spark collaboration, and catalyze systemic change*. Oakland, Calif.: Berrett-Koehler Publishers.

Frank, M., C. Badger, R. Crews, A. Kogut, J. Starrh, L. Wentz, and J. Folks. 2020. "A Collective Approach to Increase Equity in the Appliance Market." In *Proceedings of the 2020 ACEEE Summer Study on Energy Efficiency in Buildings* 2:139–150. Washington, DC: ACEEE. aceee.org/files/proceedings/2020/event-data/pdf/catalyst_activity_10647/catalyst_activity_paper_20200812131025963_71fd8ab6_7153_4a76_8b89_e3a9e4cb50ea

Munisamy, K.M., R. Govindasamy, S. K. Thangaraju. 2015. *Experimental Investigation on Design Enhancement of Axial Fan Using Fixed Guide Vane.* iopscience.iop.org/article/10.1088/1757-899X/88/1/012026/pdf

Northwest Energy Efficiency Alliance (NEEA). 2019. Comments to U.S. DOE on the Energy Conservation Standards for Residential Clothes Washers. 17 October. Docket number EERE-207-BT- STD-0014. www.regulations.gov/comment/EERE-2017-BT-STD-0014-0019

Shift Consortium. 2021. *Equity and ENERGY STAR Appliances: A Roadmap to Increase Opening Price Point Buyers' Access to Today's High Efficiency Clothes Washers, Refrigerators, and Window Air Conditioners*. drive.google.com/file/d/1uQMyAnD1GMsqk78UXhWUJPElmoD-cNXQ/view?usp=sharing

U.S. DOE. 2011. *Technical Support Document for Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers*. Docket: EERE-2008-BT-STD-0012. 1 September. www.regulations.gov/document/EERE-2008-BT-STD-0012-0128

U.S DOE. 2021. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers. 22 Sept. p. 5-29. www.regulations.gov/document/EERE-2017-BT-STD-0014-0024