Gauging Consumer Appetite for Super Efficient (Heat Pump) Dryers

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ABSTRACT

The fundamental technology and efficiency levels of residential clothes dryers in North America have remained largely unchanged for decades while other energy-intensive appliances in homes have seen substantial efficiency improvements. Heat pump technology offers a way to substantially reduce the energy use of dryers. However, it is unclear how interested consumers will be to purchase heat pump-based dryers, as they cost substantially more than mainstream dryers (unless heavily rebated), require longer drying times, and present a somewhat altered drying experience with operating sounds that differ from those of conventional dryers and lower operating temperatures that result in cooler clothes upon retrieval from the dryer. Hybrid dryers offer a compromise on drying time with a loss of some of the energy efficiency benefits associated with heat pump-only dryers.

This paper presents results of a consumer study completed in 2016 to inform an anticipated program initiative to promote heat pump-only or hybrid dryers. Consumer research explored household considerations and practices when shopping for dryers, their response to heat pump-only and hybrid dryer technology, and how they would weigh trade-offs in purchase cost, drying time, and energy consumption between mainstream, heat pump-only, and hybrid dryers. The authors also discuss how the study results informed the initiative program strategy, providing insights about collaboration between research and evaluation teams on one hand and program teams on the other.

Introduction

The Northwest Energy Efficiency Alliance (NEEA) is a regional collaborative serving over 140 utilities and energy efficiency organizations in the northwestern United States to drive market adoption of energy efficiency products, services, and practices for the benefit of utilities, consumers, and the region. NEEA does this by conducting research, designing and implementing energy efficiency programs, and tracking their progress toward key performance indicators through market progress studies.

In 2010, NEEA began exploring opportunities to advance the market for clothes dryers that use heat pump technology to reduce laundry-related electricity use by residential consumers. NEEA collaborated with like-minded organizations serving other regions in the United States to form the Super Efficient Dryer Initiative and began conducting technical and consumer research to better understand whether and how to support adoption of this technology by consumers most effectively in the region NEEA serves.

One component of this research was a market characterization to investigate both the supply and demand components of the dryer market and the potential adoption of dryers that use heat pump technology (Evergreen Economics 2016). Evergreen Economics conducted the study for NEEA. This paper focuses on the consumer (demand) components of this research and the manner in which these insights were applied by NEEA's initiative planners and managers.

Research questions addressed in this paper include:

- What is consumer awareness and understanding of dryer technology types?
- What are consumers' dryer preferences and purchasing behaviors?
- What is the consumer's willingness to pay for more efficient dryers?
- Which non-energy benefits and attributes of heat pump-based dryers would attract purchasers?
- Are heat pump-based dryers suited for the mainstream market or more promising for a niche market?
- What opportunities and barriers exist to changing consumer purchases?
- Can a NEEA initiative for dryers focus on just clothes dryers, or does it need to address clothes washer purchases too?

This component of the research drew from a series of focus groups, a web survey of consumers, and a stated preference analysis.

In parallel (but not addressed in this paper), the study examined manufacturer and retailer practices concerning heat pump-based dryers, regulatory standards, technology research, and market penetration. The broader study also examined the role of natural gas dryers in the market.

The research into manufacturer and retailer practices revealed a supply chain that is still exploring its strategy. Manufacturers were deciding how to position themselves in the market with familiar domestic brands tending toward more cautious introduction of hybrid models (for those that have chosen to enter the market) in ways that do not interfere with sales of their existing laundry equipment, while a lesser known foreign brand was promoting a smaller, European-styled heat pump-only model with more enthusiasm. Large-scale national retailers tended to be cautious about product placement on the retail floor, wanting to see evidence of consumer demand first, while some independent retailers showed greater willingness to allocate floor space and create demand for heat pump-based dryers.

The natural gas component of the study was intended to provide complementary insights about customer perspectives on natural gas dryers to inform a separate set of efficiency efforts that are unrelated to heat pump-based dryers.

Technology and Market Background

Clothes dryers are a pervasive, albeit not universal, home appliance. In the United States, 81 percent of homes have a clothes dryer, while 79 percent of those appliances are electric dryers and 19 percent use natural gas (EIA 2013). In the Northwest, electric dryers have an even greater market share among households with dryers—ranging from 88 percent in Montana to 94 percent in both Idaho and Washington (NEEA 2014a-d).

Heat pump technology in clothes dryers takes one of two forms. Some dryers rely solely on heat pumps to generate heat and remove moisture from wet clothes while they tumble in a drum, while others (so-called hybrid models) combine heat pumps and traditional electric resistance heaters to achieve greater efficiency than traditional dryers but with faster drying speeds than heat pump-only dryers. (We use the terms "heat pump-based dryers" and "super efficient dryers" to refer to both dryers that use heat pumps only and hybrid models.)

Internal field testing conducted by NEEA and federal efficiency standards for conventional dryers indicate that heat pump-only dryers provide efficiency gains over conventional dryers. They dry six or more pounds of laundry per kilowatt-hour, compared to about 2.5 pounds for conventional dryers (Evergreen Economics 2016). Hybrid dryer performance depends on operator choices, but hybrid dryers generally dry about 3.5 pounds of laundry per kilowatt-hour.

Heat pump-based dryers have been available in Europe since the mid-2000s, but have been introduced more slowly—and have not achieved significant market share—in North America. A handful of appliance manufacturers introduced hybrid models in North America in 2015, and only two are offering a heat pump-only model. These appliances cost more than basic dryers that are often available for as little as $400, but tend to be comparable in retail price with high-end traditional dryers, generally costing about $1,400 to $1,600 without any rebate. Members of the broader Super Efficient Dryer Initiative and NEEA program staff have worked with manufacturers to roll out their heat pump-based dryers and support them with marketing efforts and cost reductions for consumers. These marketing efforts do—or could—include local rebates, development of in-store collateral material, training for sales staff, and co-marketing or marketing grants. In some locations such as Vermont, rebates have been as high as $400 and have spurred increased market activity.

One of the potential concerns about heat pump-based dryers is the amount of time they require to dry a load of laundry. Heat pump-only dryers operate at a lower temperature—which offers efficiency advantages and may be gentler on clothes—but could be a deterrent to potential customers. Hybrid dryers compromise some of the efficiency gains, and give consumers the choice to operate at comparatively faster or more efficient modes than heat pump-only dryers or traditional dryers, respectively. (Their efficiency falls between conventional and heat pump-only dryers regardless of mode.) According to the Natural Resources Defense Council, cycle times for heat pump-based dryers tend to range from 75 to 120 minutes, while conventional electric and natural gas dryers have cycle times of 30 to 60 minutes (NRDC 2014).

Consumer Practices

Consumer research for NEEA's study of the heat pump dryer market concentrated on the four Northwest states that the alliance serves: Washington, Oregon, Idaho, and Montana. Research activities comprised six focus groups involving a total of 50 participants and a web panel survey of 620 households in this geographic area. The focus groups explored prevalent laundry habits, the dryer shopping process, what drives consumer dryer purchase decisions, and how heat pump-based dryers would fare in a shopping process in which consumers are presented with choices. The web survey investigated similar topics as the focus groups, but in a more closed-ended fashion. That is, some of the themes that arose during focus group discussions became response choices for more narrowly crafted survey questions to allow us to quantify the extent to which themes were prevalent among potential dryer purchasers. The web survey also included a series of questions that explored trade-offs that respondents would make in response to varying dryer characteristics and offers; responses to these questions provided data for a stated preference analysis.[1] Focus group and survey questions were informed by extensive background research and involvement of NEEA staff. Participants and respondents were screened to ensure that they owned a dryer and were (or could soon be) in the market for one, so that questions about dryer purchases were relevant and real. Screening was based on the current dryer's age and self reports of active shopping for a new dryer. All of the consumer research was completed in the winter and spring of 2016 by Evergreen Economics.

General Practices and Priorities

The study's focus groups explored broader issues about household laundry practices and likely dryer purchase processes before obtaining more direct reactions to heat pump-based dryers. This broader context provided insights about features and equipment attributes that are important to

[1] A stated preference analysis examines preference indicated by study participants who choose between competing options presented to them. We provide more detail on the dryer choices presented to survey respondents later in the paper.

households, as well as the likely contexts and information sources that would influence their purchase decisions.

Among participating households, we found that there is no typical person in charge of doing laundry. Both men and women take care of laundry – sometimes for the entire household and sometimes only for themselves. As a result, purchases of new laundry appliances are seen as consequential by multiple stakeholders in many households.

The timing and sequencing of laundry varies as well. Some households do laundry on specific days of the week, while others wait until hampers are full or particular items of clothing are needed. Those with fixed laundry days seemed more interested in being able to complete multiple loads back-to-back, for which alignment of washer and dryer cycle times was valued. For these households, dryer cycle times would likely be more important.

The degree to which households separate clothes by color and isolate specific articles of clothing for more gentle drying (such as air drying) varies as well. A small number of participants indicated that they take great care to remove certain items from dryers or do not dry them mechanically at all in order to protect the fabric or keep them from shrinking. These households may find dryers that operate at lower temperatures or that are convincingly gentler on clothes to be appealing.

Dryer Purchase Scenarios and Considerations

Focus group participants indicated that they would most likely purchase a new dryer when a prior one breaks or stops functioning properly, but may also replace a dryer as part of a paired purchase with a new washing machine. In both of these scenarios, the dryer purchase may not receive extensive consideration. In an "emergency replacement" scenario, households would want a replacement within a few days. In a paired purchase, the washer receives the majority of the attention because washers are perceived to be the appliance with more features, choices, and importance. For a share of purchasers, the dryer paired with their selected washer becomes the default choice. This default selection appears to be particularly prevalent for those who place value on the aesthetics of paired laundry equipment and matching designs for machine controls. Others are willing to consider washers and dryers that are not as consistent, however.

Focus group participants identified multiple information sources with which to educate themselves about dryer choices. Specifically, they mentioned personal contacts (friends and family), repair technicians, ratings from other consumers and independent consumer organizations, and general Internet searches, where they are likely to find manufacturer and retailer information. When prompted to discuss whether they get information from energy utility providers, participants indicated they trust their utilities' advice, but also stated that they would not think of their utilities when looking into clothes dryers. Dryers appear to be primarily a laundry appliance and not foremost an energy-using device in consumers' eyes.[2]

We recognize that these information sources were provided by consumers in the absence of the time pressure posed when an appliance fails. It is conceivable that consumers would also simply check for retailer offerings and prices either in stores or on the Internet. Hence, retailer messaging may be more important than focus group responses suggest.

Size and capacity, energy efficiency, reliability, drying time, price, and value are all features the focus group participants stated that they would emphasize in their purchase decisions. Energy efficiency was seen as a positive and was generally associated with the ENERGY STAR label and the Energy Guide.

[2] In conjunction with NEEA technical staff, we estimated average annual household energy costs for conventional dryers to be in the $80 to $95 range (for ENERGY STAR-certified and non-ENERGY STAR-certified dryers, respectively), while average annual energy costs in the West Census region average about $1,600 according to the Energy Information Administration's 2009 Residential Energy Consumption Survey.

However, few focus group participants had much awareness of how much energy dryers use, how much they pay to operate them, or how much less energy an ENERGY STAR-certified appliance uses than non-ENERGY STAR-certified appliances.[3]

Reaction to Heat Pump and Hybrid Dryers

The focus groups also explored participants' awareness of heat pump technology, heat pump-based dryers, and potential interest in acquiring one when next purchasing a new dryer. Participants were generally unaware of heat pump-only and hybrid dryers, although those closer to the metropolitan areas of Seattle and Portland had some general awareness and even experience with heat pump technology for space and water heating. After asking focus group participants general questions about laundry habits, features, and appliance replacement strategies, we described heat pump-only and hybrid dryers to them and presented a full range of conventional and super efficient dryer options available. Our description compared different conventional and heat pump-based dryer types along the dimensions of technology used, purchase cost, operating cost, drying temperature, drying time, requirements for venting and water drains, and the availability of other, optional features. This information led to an exercise in which we had focus group participants identify which dryer types they would consider among their top choices if they were shopping for a clothes dryer.

Results show that participants would consider energy efficient (ENERGY STAR-certified) conventional and hybrid dryers, as well as high-end conventional dryers. As shown in Table 1 below, participants were noticeably less inclined to consider basic, low cost dryers and heat pump-only dryers. These results suggest that low purchase cost is not a primary driver, but that features do matter. Energy efficiency is of interest to consumers (as shown by the greater self-reported interest in modestly more expensive ENERGY STAR-certified models than non-ENERGY STAR-certified conventional dryers in this exercise), but higher cost machines need to provide either the flexibility of hybrids or other features (not related to energy efficiency) typically available with high-end dryers. (These features can include a steam feature, wrinkle guard, settings for heavier loads, and the availability of matching appliances). In other words, value is more important than price. Energy efficiency is in the mix of features that matter, but not as an isolated feature separate from other considerations. For those who rated hybrid dryers highly, the choice between an eco mode and conventional operation was an important feature. (The eco mode is the setting on hybrid dryers that allows users to select a slower but more efficient drying process that relies on the heat pump technology.)

[3] We note that ENERGY STAR certification for dryers had been introduced only recently (in 2015), although the ENERGY STAR has been in existence for nearly two decades and is well recognized. We anticipate that consumer expectations concerning savings from ENERGY STAR-certified products would be based on a general sense of savings associated with the certification and not deviate greatly from appliance to appliance.

Table 1. Focus group participant dryer choices (among those selecting electric dryers)

	Number of participants who selected (among top two)
Conventional electric	6
Conventional electric – ENERGY STAR	24
Conventional electric – high end	17
Hybrid electric (ENERGY STAR)	14
Heat pump electric (ENERGY STAR)	6

Consumer Trade-Offs

We used a stated preference questionnaire within the web survey to elicit respondents' preferences for the following dryer features: energy use, drying temperature and time, ENERGY STAR designation, and price. We asked each respondent to choose one of four alternative dryers, each with a different set of attributes available in a conventional or super efficient dryer (a term that comprises both heat pump-only and hybrid dryers). Presenting choices this way removes the influence of actual in-store experiences, brand advertising, and stocking practices, thereby providing insights about what consumers might choose if super efficient dryers were as available and were marketed in a similar way as conventional dryers.

Figure 1 below illustrates how we presented the first of two panels of choices to study participants. In this first panel, we presented respondents with four dryer choices (A, B, C, and D), each with a unique set of four key characteristics: purchase price, energy savings compared to a base case, drying temperature and time, and ENERGY STAR status. We asked respondents to choose one of the dryers and then presented them with a second panel of dryer choices in which the order of the dryers differed and the price of either or both the heat pump-only and hybrid dryer randomly changed within a predefined range based on the respondent's dryer choice from the first panel. We presented purchase costs in dollars, but energy savings in percentage terms relative to a basic, non-ENERGY STAR-certified dryer.

It is important to note that stated preference surveys, such as this one, only elicit what respondents say they would choose, which is not the same as revealing what they actually did. Because of this, stated preference surveys, while providing valuable and potentially actionable information, are not as reliable as revealed preference surveys, in which the researcher observes the actual choices made by an individual. Consequently, we cannot be certain that the choices made by respondents in our survey are the same choices they would make when purchasing a dryer. It is also equally important to note that the hybrid and heat pump-only dryers are not widely available and most consumers are unfamiliar and even unaware they exist. Therefore, stated preference is the only practicable means for gathering information on consumer dryer preference.

The primary benefit of this exercise is that it allows us to gauge *potential* interest in hybrid and heat pump-only dryers in the absence of a marketplace where such dryers are widely available and product placement and presentation affect consumer choices. Presenting survey respondents with alternative dryers and asking them to choose the dryer with the preferred set of characteristics allowed us to understand consumer trade-offs and preferences within a controlled environment and allowed us to estimate the impact on dryer choice associated with changes in the price of the dryer. This is important information when considering the level of rebate that may be required to induce a consumer to consider a super efficient dryer.

	Choice A	Choice B	Choice C	Choice D
Cost	$600	$1,200	$1,000	$700
Energy Savings (reduced energy consumption compared to basic dryer	0%	50%	25%	10%
Drying temperature and time	Normal temp (with standard drying times of 45-60 minutes)	Lower temp (with drying times that are 50% longer, but safe for a fuller range of clothes)	Normal and lower temp (setting that lets you choose)	Normal temp (with standard drying times of 45-60 minutes)
ENERGY STAR	No	Yes	Yes	Yes
Your Preferred Choice	○	○	○	●

Figure 1. Example of the first panel of stated preference questionnaire

When ENERYGY STAR and non-ENERGY STAR-certified conventional, heat pump-only, and hybrid dryers were presented side-by-side, respondents showed a clear preference for energy efficient dryers of either the conventional type or those that use some form of heat pump technology. As shown in Figure 2 below, only 9 percent of respondents indicated a preference for conventional dryers that are not ENERGY STAR-certified even though these dryers were presented with the lowest purchase price ($600). Thirty-seven percent showed a preference for conventional dryers that are ENERGY STAR-certified (when priced at $700). The largest share of respondents—54 percent—indicated a preference for super efficient dryers, which were presented with prices ranging from $800 to $1,400.

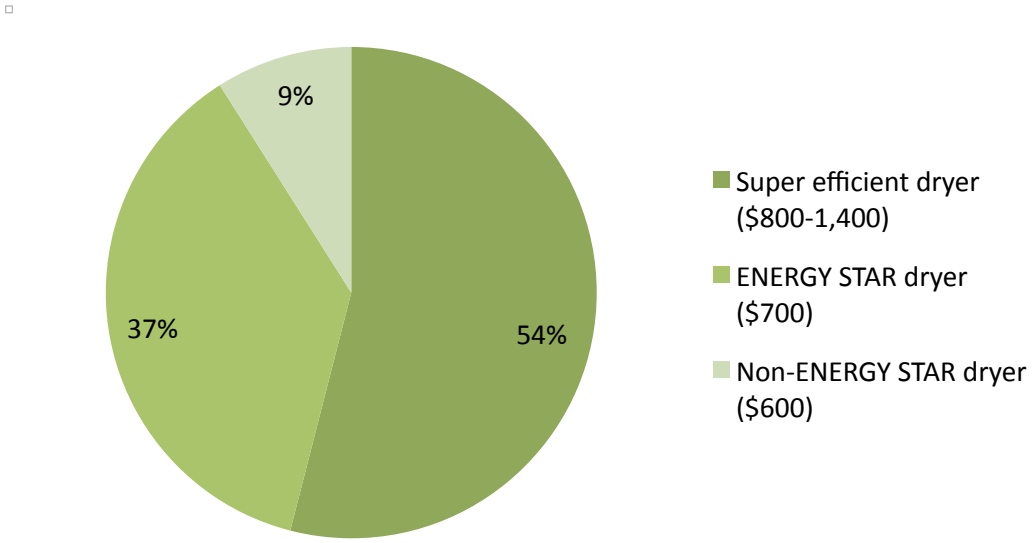

Figure 2: Customer dryer efficiency preferences, from choice modeling

Of those survey respondents that chose a super efficient dryer, 43 percent preferred a hybrid model, while 57 percent chose a heat pump-only dryer. We recognize that actual product availability, placement in stores, and messaging about the dryer options would have substantial impacts on actual choices. Hence, these results should be taken as an inclination or predisposition rather than as predictive of future market shares.

Through stated preference modeling, we were also able to estimate impacts of varying pricing through rebates or other discounts for heat pump-only and hybrid dryers, as well as observe the effect of two different levels of energy savings for conventional ENERGY STAR-certified dryers. Results of six different scenarios are presented in Table 2 below.

As expected, consumer interest in super efficient dryers increased as we dropped their purchase prices, but the detailed results reveal an interesting and important dynamic. At a price of $800, respondents prefer the super efficient dryers to the conventional, but among super efficient dryers, hybrid models are more popular than heat pump-only models. This is due to the model predicting that respondents will shift their preference for the conventional ENERGY STAR dryer to the hybrid dryer as the price of the hybrid dryer decreases. In contrast, the share of respondents who prefer a heat pump-only dryer changes comparatively little with the lower price. This suggests that one share of the population is more price sensitive and has a tendency toward the relative conventionality of the hybrid dryer, while another share of the population has an inherent interest in the heat pump-only dryer and shows less sensitivity to price.

We inferred from these results that, not surprisingly, energy savings are important to consumers, but are only one factor they consider. Comparatively short dry times are also an important consideration. Some attitudinal characteristics matter as well. Respondents who chose a super efficient dryer (of either type) were much more likely to indicate that they "tend to like trying the newest technology" (60% versus 39%).

Table 2. Market share simulation of stated preference model results

Scenario	Description	Percentage of Respondents			
		Conven-tional	ENERGY STAR (ES)	Hybrid	Heat Pump
Base	Price of Hybrid Dryer is $1,400 Price of Heat Pump-Only Dryer is $1,400 ES Dryer reduces energy use by 10%	*9%*	*37%*	*23%*	*31%*
1	Price of Hybrid Dryer is $1,400 Price of Heat Pump-Only Dryer is $1,400 ES Dryer reduces energy use by 20%	8%	47%	20%	26%
2	Price of Hybrid Dryer is $800 Price of Heat Pump-Only Dryer is $800 ES Dryer reduces energy use by 20%	5%	31%	37%	27%
3	Price of Hybrid Dryer is $800 Price of Heat Pump-Only Dryer is $1,400 ES Dryer reduces energy use by 10%	7%	26%	48%	21%
4	Price of Hybrid Dryer is $1,400 Price of Heat Pump-Only Dryer is $800 ES Dryer reduces energy use by 10%	8%	31%	19%	43%
5	Price of Hybrid Dryer is $800 Price of Heat Pump-Only Dryer is $800 ES Dryer reduces energy use by 10%	6%	23%	41%	31%

*Note these percentages represent statistical estimates based on stated preferences of respondents.

Implications for Heat Pump-Based Dryers

These insights about consumer awareness, priorities, and interest have several implications for the promotion of heat pump-based clothes dryers in North America.

Consumers have limited information about heat pump-based dryers, so education and consumer information needs to be part of any campaign to encourage their adoption. As noted in the portion of the study that investigated supply chain practices, stocking of heat pump-based dryers in stores appears to lag behind potential consumer interest, so third parties need to be the conveyors of information to help spur demand.

Conventional dryers with energy-efficient features that qualify them for the ENERGY STAR label do not appear to need much, if any, price support. Consumers seem willing to pay the marginal cost of these models for their energy savings and seem to trust the ENERGY STAR label as an indication of energy efficiency. Interestingly, consumers do not know how much they might save with ENERGY STAR models, but that does not appear to serve as a substantial barrier to their preference for these models as they appeared to be interested in ENERGY STAR-qualified models without expressing an innate need for quantified savings.

The full cost of heat pump-based dryers of $1,400 (or more) does appear to be a deterrent to many consumers. Those interested in heat pump-only dryers seem more willing to pay this price, but lower costs would shift demand from conventional dryers toward hybrid dryers. Price support for hybrid dryers would be more effective for a program, while price support for heat pump-only dryers brings the risk of free ridership due to the seemingly low price elasticity in the demand for the heat pump-only dryers.

Energy efficiency and the use of new technology seem to create the strongest appeal for heat pump-only and hybrid dryers, while the flexibility to use an eco mode or to dry clothes faster with the use of standard technology is an essential attribute for many who would consider buying a hybrid dryer. Gentleness on clothes and the option to forego external venting are substantially less important to interested consumers.

Study Application by Program Initiative

NEEA's research, program, and marketing staff were all closely involved throughout the study in numerous ways, which strengthened the quality of the study, tailored the research to the key issues any future NEEA initiative will need to consider, and led to more actionable insights for the NEEA team. We discuss this interactive approach and subsequent application of study insights.

NEEA staff helped frame the research questions of interest during the study scoping process, and provided feedback to all data collection instruments. In particular, NEEA feedback in framing the questions for the focus groups and web survey proved helpful to ensure that the dryer options were presented as realistically as possible and that potential price discounts were in line with the ranges that a program might actually offer. Interaction between the Evergreen Economics research team and NEEA staff representing research, program, and marketing ensured a sound study that was well rooted in the key questions NEEA needed to address. In-project interaction made the study more actionable than a turnkey study could possibly have been.

Likewise, direct observation of the focus groups by multiple NEEA staff and presentations of interim and final study results by Evergreen Economics to NEEA with interactive discussion of the implications helped communicate results to make them more actionable. These presentations provided an additional avenue for relaying study results, thereby reinforcing and complementing the report. Beyond that, however, the discussions helped NEEA staff and the Evergreen Economics research team better combine research results and program implications into deeper insights.

Subsequent to the market characterization study, NEEA's program team developed a set of three main strategies that were partially based on and confirmed by the market characterization, and further informed by more narrowly constructed marketing research. These strategies involved:

- Developing a consumer value proposition;
- Persuading retailers to floor super efficient dryers; and
- Developing initial market demand for super efficient dryers in the multifamily market.

The first of these strategies—developing a consumer value proposition—is a common approach in determining the nature of consumer-facing messaging and program strategies. The market characterization study provided key input and overall insights about consumer preferences, priorities, and considerations to this process through the findings that:

- The general appeal of energy savings and the ENERGY STAR label translate to clothes dryers and are one driver behind potential interest in super efficient dryers;
- There is a generally positive response to improved technology and features and heat pump technology specifically;
- Some specific non-energy benefits of super efficient dryers, such as possible gentler treatment of clothes, had a more limited appeal or resonated with only subsets of consumers;
- Households' dryer purchase practices and varied in-home approaches to laundry result in somewhat differing needs and preferences across the full range of dryer models available on the market.

NEEA's program team commissioned a follow-on marketing research and prioritization project to explore consumer value propositions and to build on the market characterization findings. This effort concluded that positioning super efficient dryers as a "better dryer" with cutting-edge yet proven technology, emphasizing the dryers' ENERGY STAR labeling, and quantifying their energy savings are likely to appeal to potentially interested consumers.

The second strategy—persuading retailers to floor super efficient dryers—was under consideration prior to the market characterization study and arose as a key strategy based on the findings that potential consumer interest in super efficient dryers appears to be greater than actual adoption of the technology, which is likely held back by the lack of visibility of super efficient dryers as an option during the purchase process.

The third strategy—developing initial market demand for super efficient dryers in the multifamily market—was influenced only minimally by the market characterization study, which had found ambiguous results in a brief exploration of super efficient dryer's application in this sector. The program team's approach is tactically significant as a way to achieve an initial market lift for the technology.

Not all of the market characterization study's results translate into actionable program strategy, however. Program or organizational strategy and competing objectives sometimes dictate a different direction than a focused research study might suggest. For example, NEEA's program team will likely continue offering incentives for heat pump-only dryers in parallel with hybrid dryers for both equity reasons and due to their desire to signal support for both types to the supply chain even if consumer research alone would point to differing responses by purchasers.

Conclusions

North American consumers are conceptually open to the idea of more efficient heat pump-based dryers and find their greater energy efficiency appealing, but numerous barriers need to be addressed before these products would be considered by mainstream consumers.

One of the most prevalent barriers is lack of awareness and visibility. Due to the emergency replacement nature of many dryer purchases, visibility of heat pump-based models among retailers is essential. Because most retailers do not yet offer any floor space or prominence to heat pump-based dryers, energy efficiency programs can play a useful role in promoting awareness, interest, and demand.

The current retail prices of heat pump-based dryers are a deterrent for many consumers, especially during emergency replacements when they have little time to conduct product research and recognize the benefits of one type of dryer over another. Cost reductions through rebates or cost buy-downs are likely to make these dryers more competitive, but their effectiveness may differ between heat pump-only and hybrid dryers.

Our analysis of stated willingness to pay suggests that there is more fluidity in consumer interest and price sensitivity among consumers in regards to hybrid dryers than heat pump-only dryers. Price reductions—either through market forces, scaled up production, or program interventions—are likely to shift interest from conventional energy-efficient dryers toward hybrid dryers. Demand for heat pump-only dryers—which appears to be similar as that for hybrid dryers at full prices—is less price elastic. That is, price reductions are less likely to affect demand for heat pump-only dryers.

References

EIA (Energy Information Association) 2013. *Residential Energy Consumption Survey (RECS)*. Washington, DC: U.S. Department of Energy.

Evergreen Economics 2016. *Characterization of the Super-Efficient Dryer Market*. Prepared for the Northwest Energy Efficiency Alliance.

NEEA (Northwest Energy Efficiency Alliance) 2014a. *Montana Single-Family Homes: State Summary Statistics*. Portland, OR: NEEA. http://neea.org/docs/default-source/rbsa/montana-state-report-final.pdf

NEEA (Northwest Energy Efficiency Alliance) 2014b. *Idaho Single-Family Homes: State Summary Statistics*. Portland, OR: NEEA. http://neea.org/docs/default-source/rbsa/idaho-state-report-final723c7c30979363e3870cff0000917d48.pdf

NEEA (Northwest Energy Efficiency Alliance) 2014c. *Oregon Single-Family Homes: State Summary Statistics*. Portland, OR: NEEA. http://neea.org/docs/default-source/rbsa/oregon-state-report-final.pdf

NEEA (Northwest Energy Efficiency Alliance) 2014d. *Washington Single-Family Homes: State Summary Statistics*. Portland, OR: NEEA. http://neea.org/docs/default-source/rbsa/washington-state-report-final.pdf?sfvrsn=2

NRDC (National Resources Defense Council) 2014. *A Call to Action for More Efficient Clothes Dryers: U.S. Consumers Missing Out on $4 Billion in Annual Savings.* New York, NY: National Resources Defense Council. Retrieved from https://www.nrdc.org/sites/default/files/efficient-clothes-dryers-IB.pdf.