Opinion Dynamics
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MARKET READINESS FOR LOW-GWP REFRIGERANTS: HEAT PUMP WATER HEATERS AND HEAT PUMP CLOTHES DRYERS

PREPARED FOR THE CALIFORNIA PUBLIC UTILITIES COMMISSION

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I. INTRODUCTION

The state of California is seeking to lower its greenhouse gas (GHG) emissions. One strategy to achieve this is to encourage the installation of heat pump equipment for space and water heating in both existing and new construction buildings. Two building decarbonization pilot programs, the Technology and Equipment for Clean Heating (TECH) Initiative and the Building Initiative for Low-Emissions Development (BUILD) Program, both provide incentives to encourage heat pump adoption for space-conditioning and water-heating. Opinion Dynamics is evaluating both of those programs. Another strategy California is pursuing is to update policies and regulations that limit the sale and use of refrigerants with a high global warming potential (GWP). Several recent and upcoming legislative measures significantly impact refrigerant-based products and systems, including heat pumps, with implications for product availability, compliance, and market readiness.

The primary objective of this study was to evaluate the California market's readiness for low-GWP refrigerants in two key measure areas: heat pump water heaters (HPWHs) and heat pump clothes dryers (HPCDs). While most electric clothes dryers do not use refrigerants, HPCDs utilize a closed-loop refrigeration system, similar to those found in heat pump air conditioners or refrigerators. This feature allows them to dehumidify the air and reuse the recovered heat, improving energy efficiency, but also subjects them to refrigerant-related regulations. Specifically, we investigated the following research questions:

- What are the regulatory requirements for low-GWP heat pump water heaters and heat pump dryers?
- What is the availability of low-GWP heat pump water heaters and dryers in the market?
- Are there enough manufacturers and suppliers of these technologies to meet potential demand?
- What is the current level of competition among manufacturers for producing low-GWP heat pump water heaters and dryers?
- Are the necessary components, such as refrigerants and materials for low-GWP systems, readily available or subject to supply chain constraints?
- What is the current price differential between traditional and low-GWP heat pump water heaters/dryers?
- What are the primary market barriers to the adoption of low-GWP heat pump water heaters and dryers (e.g., cost, lack of awareness, limited availability)?

To complete this study, we reviewed legislation and industry literature to better understand the mandates in California around high- and low-GWPs. To determine product availability, we reviewed the ENERGY STAR® product list in October 2025.[1] We also conducted interviews with three HPWH manufacturers and two HPCD manufacturers. The interviews took place between September and December of 2025 and lasted 30 minutes to an hour.

[1] All product or company names mentioned in this publication are tradenames, trademarks, or registered trademarks of their respective owners.

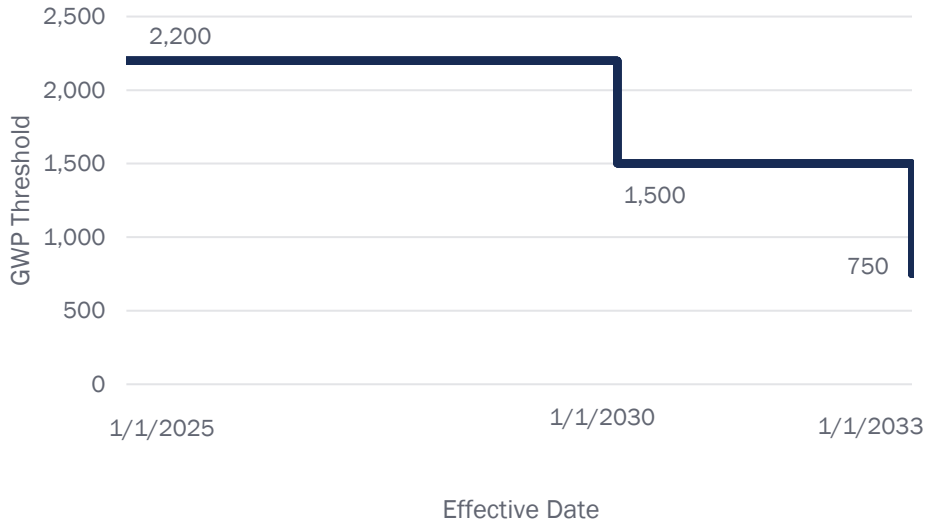
2. FINDINGS

The findings section begins with a description of legislation related to refrigerants relevant for HPWHs and HPCDs. Then, we review refrigerants used in HPWHs and HPCDs available in 2025 and their GWP ratings. We follow that with the number of manufacturers and models of low-GWP heat pump products. Then, we share findings about how HPWH and HPCD manufacturers are responding to these requirements, levels of customer demand, and the market readiness for low-GWP HPWHs and HPCDs.

2.1 LEGISLATION CALLING FOR LOWER GWP REFRIGERANTS

In California, Senate Bill 1206 (SB1206) and Assembly Bill (AB663) outline a schedule to phase out high-GWP refrigerants.[2] As illustrated in Figure 1, regulations effective January 1, 2025 prohibit the sale of virgin bulk refrigerants with a GWP of 2,200 or greater, with the allowable threshold further reduced to 1,500 GWP beginning January 1, 2030. By 2033, the sale of any virgin refrigerants with a GWP greater than 750 will be prohibited.[3] Virgin refrigerants are those that are newly manufactured and have not been used in a product or system before. As such, these restrictions do not apply to reclaimed refrigerants, so contractors can still service or repair existing systems that use higher-GWP refrigerants after these dates. Although servicing equipment that requires any refrigerant in excess of the GWP limits will require contractors to rely upon reclaimed refrigerant from Refrigerant Reclaimers certified by the Environmental Protection Agency (EPA).[4]

Figure 1. GWP Threshold Schedule in California



The Underwriters Laboratory's standards 60335-2-40 and 60335-2-11 address heat pump safety[5] and tumble dryer specifications and define refrigerant charge limits, which for HPCDs is 150 grams.[6]

[2] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202520260AB663
[3] Ibid
[4] Ibid
[5] https://www.ul.com/services/flammable-refrigerants-testing-air-conditioning-and-refrigeration
[6] https://webstore.ansi.org/standards/iec/iec6033511ed2019?srsltid=AfmBOoq84T5Efi6h14CliHhw0zgwzILld1x68OnbPeW9Hmvww3Ntgct3 and https://ozone.unep.org/system/files/documents/RTOC-assessment%20-report-2022.pdf

2.2 RELEVANT REFRIGERANTS ON THE MARKET AND THEIR GWP

Most HPWHs and HPCDs on the market use the refrigerant R-134a with a GWP of 1,430. According to our interviews with HPWH manufacturers, "the vast majority of unitary heat pump water heaters in America right now use R-134." One manufacturer reports they have been using R-134a in their water heaters for 15 years. An analysis of the HPWHs eligible for rebates in the TECH Initiative found that 94% of them use the R-134a refrigerant with a GWP of 1,430.[7] Heat pump clothes dryers also typically use R-134a.[8] HPCD manufacturers have explored a variety of refrigerant alternatives, and it seems R-290 with a GWP of 3 is being considered as a replacement for R-134a.[9] In Life Cycle Climate Performance tests, R-290 had 6% lower carbon footprint than R-134a, but required optimization of the clothes dryers' heat exchangers in order to stay below the 150 gram threshold.[10]

Table 1 lists refrigerants and their GWP used in HPWHs and HPCDs. They are organized in descending order from the highest warming potential to the lowest, which is carbon dioxide, with a GWP of 1.0. There are also notes on its application in equipment.

Table 1. Refrigerants on the Market and Their GWP

Refrigerant	GWP	Notes
R-410A	2,088	Commonly used refrigerant in many new residential and commercial AC systems pre-2025. Will be prohibited in California beginning in 2030.[11]
R-134a	1,430	Commonly used refrigerant in HPWH and HP clothes dryers
R-32	675	Commonly available in at least 30 countries and is an acceptable substitute (with caveats) in room AC units under U.S. EPA Significant New Alternatives Policy (SNAP) program. Expected efficiency and performance are thought equal or better than R-410A. As of 2021, this refrigerant was the only currently available lower-GWP alternative for small split system AC. Not a drop-in replacement for R-410A.
R-513a	630	Used in some HPWHs
R-1234yf	4	Commonly used in car air conditioning systems; used in one manufacturer's HPWHs
R-600/R-600a	3	Butane and isobutane have been used in some refrigerators.
R-290	3	This is propane. Acceptable substitute (with caveats) in room AC units under U.S. EPA SNAP program. Expected efficiency and performance are thought equal or better than R-410A

[7] HPWHs must be California Energy Commission JA13 compliant and either Northwest Energy Efficiency Alliance (NEEA) with EcoPort or ENERGY STAR ®. Incentive resources | The Switch Is On.

[8] Seonghwan Kim, Dongchan Lee, Yongju Lee, Soonbum Kwon, Yongchan Kim. 2025. Operating characteristics and design optimization of a heat pump clothes dryer using R290 as an alternative refrigerant to R134a. Applied Thermal Engineering. Volume 279, Part A. https://doi.org/10.1016/j.applthermaleng.2025.127609.

[9] Ibid

[10] Ibid

[11] https://ww2.arb.ca.gov/our-work/programs/sb-1206-and-ab-663/about

Refrigerant	GWP	Notes
R-744	1	R-744 is the technical designation for carbon dioxide (CO2) used as a refrigerant. It is non-flammable, non-toxic, but operates at very high pressures.

2.3 PRODUCT AVAILABILITY

We referenced the ENERGY STAR product list to assess the availability of low-GWP products in the United States in 2025.

2.3.1 HPWH

There are 45 models of HPWHs with refrigerants at 630 GWP or lower on the market right now, produced by 6 different manufacturers. There are 23 distinct manufacturers of ENERGY STAR-certified HPWHs and 19 of them use the R-134a high-GWP refrigerant (Table 2). Most of the manufacturers with a low-GWP model use the R-513a refrigerant with a GWP of 630. GE offers HPWHs made with the R-1234yf refrigerant with a GWP of 4 and the SANCO2 manufacturer makes a HPWH model that uses CO2 as a refrigerant.

Table 2. HPWH Manufacturers and Refrigerants

Category	Number	Percent
HPWH manufacturers of ENERGY STAR models	23	100%
HPWH manufacturers with models using R-134a (GWP: 1,430)	19	83%
HPWH manufacturers with models using R-513a (GWP: 630)	4	17%
HPWH manufacturers with models using R-1234yf (GWP: 4)	1	4%
HPWH manufacturers with models using R-744 (GWP: 1)	1	4%

Note: As of October 20, 2025

Source: https://www.energystar.gov/productfinder/product/certified-heat-pump-water-heaters/results

Among the 6 different manufacturers of low-GWP HPWHs, A.O. Smith offers 18 models and GE offers 11 models. Ariston and SANCO2 both offer six models each (Table 3). The SANCO2 models use the R-744 refrigerant with a GWP of 1, the GE HPWHs use the R-1234yf refrigerant with GWP of 4, while the other manufacturers in Table 3 offer HPWHs with R-513a, which has a GWP of 630.

Table 3. Low-GWP HPWH Manufacturers and Models

Manufacturer of HPWHs	Number of Low-GWP HPWH Models (n=45)
A. O. Smith	18
GE	11
Ariston	6
SANCO2	6
Eco-Logical	3
Cala Systems, Inc	1

Note: As of October 20, 2025
Source: https://www.energystar.gov/productfinder/product/certified-heat-pump-water-heaters/results

2.3.2 HPCD

Clothes dryers commonly use electricity; 64% (323 of 502) of ENERGY STAR-certified clothes dryer models are electric. Heat pump clothes dryers are less common; there are 56 unique models of HPCDs, or about 11% of all ENERGY STAR-rated clothes dryers.

Out of the 38 clothes dryer manufacturers, they all produce electric models, and over one-third (14 of 38; 37%) produce an ENERGY STAR-rated heat pump model (Table 4). Those 14 manufacturers produce 52 different models of HPCDs.[12] The ENERGY STAR dataset contains refrigerant information for 18 of those HPCD models, showing that 10 use the higher-GWP R-134a refrigerant, while 8 models use the low-GWP R-290 refrigerant with a GWP of 3. While it is unclear why the dataset does not contain comprehensive information on refrigerants, we can presume that these are the minimum values, and there may be more low-GWP HPCD models available.

Table 4. Clothes Dryer Manufacturers

Category	Number	Percent
Clothes dryer manufacturers	38	100%
Clothes dryer manufacturers with an electric model	38	100%
Clothes dryer manufacturers with a heat pump model	14	37%
Clothes dryer manufacturers with a low-GWP heat pump model (R-290)	4	11%

Note: As of October 20, 2025
Source: https://www.energystar.gov/productfinder/product/certified-clothes-dryers/results

There are at least eight models of HPCDs with low-GWP refrigerants on the market right now, produced by four different manufacturers. Bosch offers more low-GWP models than other HPCD manufacturers, as shown in Table 5. Again, please note that the ENERGY STAR dataset on which these findings are based contained refrigerant information for about one-third of the HPCD models.

[12] Whirlpool and Samsung also produce hybrid heat pump models, but they are not included in this analysis.

Table 5. Heat Pump Clothes Dryer Manufacturers

Manufacturer of HPCDs	Offers Low-GWP HPCDs with R-290 Refrigerant	Number of Low-GWP HPCD Models
Asko		
Beko	✓	2
Blomberg	✓	2
Bosch	✓	3
BREDA		
GE		
Gorenje		
LG		
Midea		
Miele		
Samsung		
Smeg	✓	1
Summit		
Whirlpool		

Note: As of October 20, 2025

Source: https://www.energystar.gov/productfinder/product/certified-clothes-dryers/results

2.4 MANUFACTURERS' RESPONSE AND MARKET READINESS

This section draws heavily from our interviews with the three HPWH manufacturers and two HPCD manufacturers.

2.4.1 HPWH

Opinion Dynamics' prior market assessments have consistently shown that the HVAC heat pump market in California is more advanced than the water-heating heat pump market. California's residential building stock is dominated by gas water heating, and there is not a significant volume of HPWHs being shipped into California. One interviewed manufacturer estimated that approximately 50,000 HPWHs were shipped into California across all manufacturers in 2024 and anticipated that the new construction code would increase shipments to roughly 100,000 units by 2026. Another manufacturer reported producing approximately 3 million water heaters annually for the U.S. market, indicating that HPWHs currently account for only about 3% of total production. As a result, manufacturers have relatively limited production runs of HPWH equipment and generally prefer to allow the market to mature and production volumes to increase before making fundamental design changes, such as transitioning to alternative refrigerants.

All of the HPWH manufacturers we spoke with used R-134a (GWP of 1,430) in their residential HPWH models, a refrigerant that can be used through December 2032 under current regulations. The manufacturers are paying attention to the legislation and have internal research projects underway to investigate viable lower-GWP refrigerant replacements. There are many types of refrigerants available, and they are currently exploring their options with one manufacturer considering R-32.

Refrigerant options come with tradeoffs between performance, safety, and GWP. For example, the R-744 (CO_2) refrigerant has a very low global warming potential (GWP) of 1, but it operates at much higher pressures, which increases the cost and complexity of ensuring safe system design and installation. One manufacturer explained that

"you have to overbuild the system because of that pressure," which brings higher associated costs, and the need for contractor training.

HPWHs using low-GWP refrigerants cost more than HPWHs using R-134a refrigerant. All of the interviewed HPWH manufacturers mentioned that the SANCO2 system is very expensive compared to other HPWHs. One described the SANCO2 system as "overly complex and probably way out of most people's price range," and another said that they could sell you three of their R-134a HPWHs for the price of a SANCO2 system.

Their typical product development cycles are four to five years long; therefore, finding an alternative to R-134a beginning in 2033 is not a current high priority. One manufacturer mentioned that they offer a large, commercial-capacity HPWH in California that uses the R-744 refrigerant, but described it as "pretty expensive and completely different from a residential unitary storage HPWH." While a different product and market, it demonstrates that this manufacturer has successfully designed and produced a HPWH model that uses a very low GWP refrigerant (GWP of 1).

HPWH manufacturers noted that their products, still relatively new to the market, have already been subject to numerous regulatory requirements. These include requirements related to specific components and functionality, such as thermostatic mixing valves and JA-13 communication compatibility. Manufacturers generally agreed that adding additional requirements would further increase the costs of HPWHs.

One interviewed manufacturer estimated that transitioning to low-GWP refrigerants would increase manufacturer-level costs by approximately $200 to $400 per unit. Based on their experience, contractor markups are typically three to four times the manufacturer's cost increase, which could result in HPWHs in California costing consumers up to $800 more per unit. This would represent an 11% increase over the typical cost of HPWHs, which, according to 14,080 HPWHs installed through TECH Clean California, had a median cost of $7,074.[13] Manufacturers expressed concern that , limiting refrigerant GWP to 750, while the HPWH market remains relatively immature, could significantly slow adoption and "kill the growth curve," while yielding only marginal incremental efficiency or greenhouse gas reduction benefits.

HPWH manufacturers also described the substantial adjustments required to production lines when regulations, such as refrigerant requirements, change. What may appear to consumers or regulators as a relatively minor modification often necessitates "immense R&D." For example, changing the refrigerant used in a residential, unitary HPWH would require the following steps:

1. Research and development to design the new model and test prototypes.
2. Ensure the supply chain has the materials they need and that they can procure them when they need.
3. Adjustments to the manufacturing and production line, including training workers.
4. Testing the product and obtaining necessary certifications so the product is approved for sale, which can take at least six months.

Therefore, changes to the refrigerant used by their HPWH models will be a significant undertaking, affecting many parts of the company, each with associated costs. One manufacturer anticipated that increased HPWH costs after 2033 could lead to fewer manufacturers participating in the California market.

One HPWH manufacturer explained that they are bolstering efforts to capture refrigerant at the end of the equipment life so that it does not escape into the air and further contribute to global warming. They are promoting classes approved by the Environmental Protection Agency on proper refrigerant handling and refrigerant capture at the end of the equipment life, which is a long-standing practice in California. They stated that retail big-box stores, such as Home Depot, and distributors in their network are currently capturing the R-134a refrigerant when old equipment is decommissioned, and even viewed recycled R-134a refrigerant as a potential future revenue stream.

[13] https://techcleanca.com/heat-pump-data/heat-pump-data-visuals/, "Cost Detail: HPWH" tab.

SUPPLY CHAIN CONSTRAINTS

Manufacturers indicated that there may be supply-chain constraints affecting their ability to produce the volume of low-GWP HPWHs required by 2033. Two manufacturers explained that compressors and evaporators designed for R-134a refrigerant are unlikely to be compatible with systems using alternative refrigerants, requiring the sourcing of different components. These compressors and evaporators are reportedly highly specialized, relatively expensive, and currently in limited supply, with manufacturers prioritizing the larger HVAC market over the water-heating market. One manufacturer further noted that achieving meaningful cost reductions for these specialized compressors would require purchase volumes in the millions of units, whereas current HPWH sales volumes are only in the hundreds of thousands.

Second, manufacturers indicated that there may be supply-chain limitations related to the availability of low-GWP refrigerants themselves. One manufacturer explained that while CO_2 (R-744) is expected to be relatively readily available, selecting a more specialized or proprietary low-GWP refrigerant produced by a single manufacturer could create sourcing challenges, particularly at the volumes required for large-scale HPWH production. They emphasized the importance of maintaining relationships with suppliers in the marketplace to ensure a reliable source of refrigerant.

WILL HPWH MANUFACTURERS BE READY?

In terms of whether they would be ready to meet the phase-out of R-134a in 2033, the HPWH manufacturers had the following sentiments:

- The first manufacturer did not express any concerns about being able to meet and comply with the upcoming regulations that will affect them in 2033.
- The second said that they are paying attention to the upcoming regulation changes and thinks they will be prepared, but it is too early to tell because the product is not on the market yet.
- The third explained that it is possible to transition to a lower-GWP refrigerant, but it will come with a cost.

What is currently having a bigger impact on their planning and production is preparing for compliance with updates to the National Appliance Energy Conservation Act (NAECA) that take effect on May 6, 2029. One update specifies that electric storage water heaters with capacities between 35 and 120 gallons must utilize heat pump technology, effectively requiring them to be HPWHs.[14] The U.S. Department of Energy estimates that this policy will increase the share of newly manufactured electric storage water heaters using heat pump technology to over 50%, up from roughly 3% today. Consequently, manufacturers are focused on retooling their manufacturing lines to accommodate a substantial increase in HPWH demand anticipated in 2029. One interviewed manufacturer indicated that it recently added a second production line in response to this expected growth.

2.4.2 HPCD

The two HPCD manufacturers we spoke with also use R-134a as the refrigerant in their HPCDs for the United States market. One added that they use R-32 (GWP of 675) in the European market and suspects they will switch to that in the future for the US. They noted that there is an Underwriters Laboratory standard that restricts the refrigerant charge they can use to 150 grams. Both manufacturers explained that because U.S. clothes dryers typically have larger drum capacities than European models, meeting performance requirements while keeping refrigerant charge below the 150-gram threshold represents a significant design challenge.

[14] https://www.hotwater.com/info-center/doe-regulations/doe-residential-regulations.html

HPCD manufacturers indicated that, under best-case conditions, their product development lifecycle is approximately two years; however, this timeline can be extended if technical challenges arise, such as the need to increase refrigerant charge. They emphasized that safety standards are their primary design constraint and that products are developed to meet these requirements first. Similar to HPWH manufacturers, they noted that extensive testing is required to demonstrate the safety of new products, particularly given the flammability of low-GWP refrigerants. Both manufacturers emphasized that Underwriters Laboratory standards will need to allow higher permissible refrigerant charge limits to enable a transition to lower-GWP refrigerants.

Consistent with HPWH manufacturers, HPCD manufacturers agreed that a change to a single component, such as the refrigerant, can trigger a cascade of additional design, manufacturing, and operational changes. When working with flammable refrigerants, manufacturers must ensure systems are properly sealed, that leaks can be reliably detected, and that shipping and storage protocols are clearly defined and rigorously followed to mitigate fire risk. They also noted that such changes may require updated training for both factory-line workers and field service technicians. As a result, what may appear to be a modification to a single component often necessitates coordinated changes across the broader supply, production, and service chain. One interviewed manufacturer did not see any supply chain challenges related to compressors because they said that their company makes their own compressors and should have sufficient supply.

WILL HPCD MANUFACTURERS BE READY?

The two HPCD manufacturers we spoke with differed in their outlooks for 2033 when the R-134a refrigerant will be phased out. The first believed it was possible for their company to be ready to design and produce low-GWP HPCDs, but that would come with added costs that would affect customer demand: they predicted the cost of a low-GWP HPCD would "definitely be significantly higher" than HPCDs on the market today.[15] They said this is because of the added refrigerant and the added materials costs. They reported, "You are talking about putting all of the elements of a refrigerator into a dryer." They noted that the increased cost of HPCDs limits consumer adoption, and program incentives are needed to help expand the market for these products.

The second said that their company's approach will be to discontinue HPCDs and only sell electric resistance clothes dryers instead. The engineering updates and workarounds they would need to implement to meet the Underwriters Laboratory standard for refrigerant charge would increase the price point to a level that makes it non-competitive. The one option they have is to use the R-1234yf refrigerant with a GWP of 4. They noted, however, that impending legislation in Maine and Minnesota will ban the yf molecule before 2040. Therefore, they are not interested in producing a HPCD using the R-1234yf refrigerant if it can only be sold for a few years. Absent a change to the Underwriters Laboratory standard, this manufacturer expects to discontinue the sale of HPCDs and only sell electric resistance dryers. They shared that this is their plan for New York State that has enacted GWP limits that will prevent them from selling their HPCDs using the R-134a refrigerant. They wanted to share this message with the CPUC:

> "Heat pump clothes dryers use a very small charge size, and they are a very small part of the market. At this point, attempting to regulate the low-GWP in this segment is likely to lead to a market withdrawal of this [product] segment in your state."

2.5 CUSTOMER DEMAND FOR THESE PRODUCTS

We describe the limited customer demand for low-GWP products below.

[15] In comments filed during the public review period, one person attested: "R-513a is a direct replacement for R-134a. The cost to change to R-513a should be minimum."

2.5.1 HPWH

In terms of consumer demand, one interviewed HPWH manufacturer did not think consumers were paying much attention or differentiating between HPWHs with various types of refrigerants, stating, "I don't think refrigerants have an impact on the HPWH market here in California at the moment."

In fact, the manufacturers agreed that HPWHs are not the top choice for most California consumers due to higher cost and limited awareness. One stated that "without incentives and without regulations, it's hard for a consumer to want to fork out multiple thousands of dollars for a heat pump water heater when they can fork out the same amount of money for a gas tankless that has endless hot water. And take up probably one-twentieth of the space." Another echoed this statement, stating that the NACEA changes will "be a big cost adjustment for homeowners to go from standard products that cost $1,500 to switch out to now $6,500 for a heat pump water heater."

Given the forthcoming NAECA policy requiring all electric storage water heaters with capacities between 35 and 120 gallons to incorporate heat pump technology beginning in 2029, demand for HPWHs is expected to increase substantially. One manufacturer emphasized the continued need for stakeholder support to improve consumer awareness and ensure consistent rebate availability, which they view as critical to easing the market transition in 2029—particularly given the significant price differential between HPWHs and conventional gas water heaters.

Manufacturers noted that they may continue using R-134a refrigerant beyond 2029 and suggested that, with sufficient advance planning, much of which is already underway, they should be able to meet anticipated growth in demand for low-GWP HPWHs after 2033. However, two interviewed manufacturers identified contractor readiness as their primary concern. One of them estimated that only about 5% of contractors nationwide currently possess the skills necessary to correctly install HPWHs, while another reported a goal of training approximately 30,000 plumbers per year nationally by 2029.

2.5.2 HPCD

Demand for standalone HPCDs is currently limited. The manufacturers interviewed echoed prior research we conducted with retailers and distributors in 2020, which found that market actors viewed them as a niche product sold only when there are limitations preventing the use of more traditional dryers.[16] For example, HPCDs are suitable when there are:

- Space limitations: the HPCD does not need the space required in the back of the unit for the vent hose.
- Venting limitations: When no vent is available, and it is not possible to put one in, such as in apartment buildings with interior units.
- Electric power limitations: When there is no circuit available for a 240V dryer. (While most HPCDs use 240V outlets, there are several models of HPCDs that use a 120V outlet.)

As a result, standalone HPCDs have most commonly been used in retrofit applications where space, venting, or electrical capacity constraints limit the feasibility of conventional dryers. In new construction, builders are generally able to plan ahead and accommodate the space and infrastructure requirements of traditional clothes dryers. Consumer demand for HPCDs is further constrained by performance considerations, as these units typically handle smaller loads and require longer drying times than conventional alternatives. Consequently, market actors viewed HPCDs as less suitable for families, though potentially well suited for single occupants or couples.

[16] https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf

In addition, standalone HPCD are very expensive. If a savvy consumer performed a cost-benefit analysis to determine how much they would save on lower electricity costs compared to a different electric dryer, the upfront cost is so high that the purchase would not pencil out. As a result, standalone HPCDs have sold very poorly in the US.

In 2023, however, manufacturers introduced combination washer-dryer models that combine a clothes washer and a HPCD into one unit. A manufacturer stated, "In two months, it became the fastest-selling product category in the US, so a heat pump clothes dryer was the best-selling clothes dryer in the country." As other manufacturers introduced similar combination units with HPCDs, they have become a significant part of the laundry market and are very popular with consumers right now. In 2025, one manufacturer introduced a combination unit without a HPCD. Reportedly, that has sold very well because it is cheaper than the combination units with HPCD. This model does require venting and, therefore, cannot be installed in places where ventless HPCDs can be.

The interviewed manufacturers and market actors viewed HPCDs as a "green" option that may appeal to a specific segment of consumers. They are perceived as more environmentally friendly than standard electric dryers because they are more energy efficient and do not rely on natural gas. One interviewed manufacturer noted that the combination units with the HPCD are all Wi-Fi connected and can respond to price signals from the grid. That means that they can participate in demand response programs and provide a benefit to the grid. For example, a customer could put the load of laundry in before they go to work, and the combination washer-dryer will turn on in the late morning when there is excess solar, using energy when it is most advantageous to the electric grid. One interviewed manufacturer said that, in California where electricity prices are high, the combination units "are the only way people are going to use heat pump clothes dryers en masse."

Both interviewed manufacturers felt that incentives would be important to encourage further adoption of HPCDs. Consumers are very price-conscious with washers and dryers. One manufacturer explained that "the number one issue for customers is price point." They said customers will make subjective, emotional decisions about what price band and quality they feel they deserve, and will choose the cheapest model in that price band. As manufacturers introduce more combination units that are less expensive than those with HPCDs, incentives will be necessary to encourage customers to purchase models with heat pump technology. Therefore, although a small number of manufacturers currently offer low-GWP HPCDs, demand remains limited enough that existing suppliers are able to meet current and near-term market needs.

3. SUMMARY AND CONCLUSIONS

There is a limited number of manufacturers that offer low-GWP HPWHs and HPCDs. There are two manufacturers of HPWHs that offer models with very low-GWP. There are four manufacturers that offer eight models of low-GWP HPCDs. However, consumer demand for low-GWP HPWHs and HPCDs is also very limited, so there are currently enough manufacturers to meet demand. In fact, demand for *higher*-GWP HPWHs and HPCDs also appears to be limited.

The Underwriters Laboratory standard that limits the total refrigerant charge in HPCDs will be a significant barrier to overcome in order to produce a low-GWP HPCD for the American market. Without a change to that standard, HPCD manufacturers may stop offering heat pump models and offer only electric resistance models instead (in addition to models using natural gas). The introduction of non-HPCD combination units at lower price points will be more attractive to consumers than HPCDs, necessitating consumer incentives.

The HPWH manufacturers are aware of the impending legislation and are proactively conducting internal research projects to explore their options. Some of the manufacturers we interviewed produce low-GWP models for the European market or other domestic markets. Therefore, they know they are capable of designing models that will meet California's low-GWP requirements, but it will come with an added cost.

Manufacturers indicated that their primary concern is not the technical feasibility of designing HPWHs with lower-GWP refrigerants, but rather the resulting increase in costs to consumers. After 2033, California consumers may face a choice between relatively affordable gas storage water heaters, gas tankless systems offering "endless hot water," and higher-priced low-GWP HPWHs. HPWH manufacturers questioned whether the incremental greenhouse gas (GHG) benefits of lower-GWP refrigerants justify these higher costs, noting that HPWHs contain relatively small refrigerant charges compared to HVAC systems, limiting the potential emissions reductions. They further explained that meeting new refrigerant requirements would necessitate additional manufacturing, testing, and supply-chain changes, resulting in increased production costs that would ultimately be passed on to consumers as higher upfront prices.

HPWH manufacturers reported that their near-term priorities are ramping up production and expanding worker and contractor training to meet the expected increase in demand beginning January 1, 2029, driven by NAECA requirements. NAECA Tier 4 will require customers purchasing electric storage water heaters to use heat pump technology; however, manufacturers expressed concern that the resulting cost differential may be difficult for some consumers to absorb.

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