DOCKETED	
Docket Number:	23-ERDD-01
Project Title:	Electric Program Investment Charge (EPIC)
TN #:	254509
Document Title:	Honeywell Comments - Low GWP Heat Pump Draft Solicitation
Description:	N/A
Filer:	System
Organization:	Honeywell/Erica Corser
Submitter Role:	Applicant
Submission Date:	2/16/2024 6:02:54 AM
Docketed Date:	2/16/2024

Comment Received From: Erica Corser
Submitted On: 2/16/2024
Docket Number: 23-ERDD-01

Low GWP Heat Pump Draft Solicitation

Honeywell appreciates the opportunity to provide feedback for the draft solicitation 23-ERDD-01 open to public comment for developing next-generation electric heat pumps using low global warming potential (low-GWP) refrigerants with the California Energy Commission.

Additional submitted attachment is included below.

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February 16, 2024

California Energy Commission
715 P Street
Sacramento, CA 95814

RE: Comments to the California Energy Commission regarding "Low GWP Heat Pump Solicitation Concept" DOCKET: 23-ERDD-01, efiled

To Whom It May Concern:

Honeywell appreciates the opportunity to provide feedback for the above-referenced draft solicitation open to public comment for developing next-generation electric heat pumps using low global warming potential (low-GWP) refrigerants with the California Energy Commission ("CEC" or the "Commission").

Honeywell is a diversified U.S. technology and manufacturing company, serving customers worldwide with specialty materials and process technologies, aerospace products and services, control, sensing, security and life safety technologies for buildings, homes, and industry. Honeywell's Energy and Sustainability Solutions division is a global manufacturer and producer of hydrofluoroolefins ("HFOs") and HFO blends which are an ideal choice for high efficiency electric heat pumps. Honeywell was recently selected by the US Department of Energy ("DOE") as a grant awardee for Inflation Reduction Act funding [1] meant to increase domestic production of electric heat pumps and heat pump-enabling technologies.

Honeywell applauds the Commission's admirable goal to install at least 6 million electric heat pumps by 2030 in California and offers its full support to CEC as it works to achieve this. Honeywell appreciates the opportunity to provide feedback on this critical topic and would be more than happy to follow up on any of the information below. Please contact Atashi Bell, Atashi.Bell@honeywell.com, Sr. Director Government Affairs, for further information.

Question 1: *What type of considerations should CEC consider to encourage participation and achieve project success, and why? Please provide relevant comments regarding other considerations not explicitly listed above.*

To achieve program success, Honeywell recommends close collaboration with different stakeholders within the supply chain such as component suppliers that may need to be involved with development of devices, original equipment manufacturers (OEMs), refrigeration manufacturers, or service technicians that will be involved in the specification and innovation for sustainability and new technology needs in the future.Partnership with each of these groups and CEC will ensure collaborative engagement for continued process improvement. Utilizing webinars and face-to-face meetings with these technology groups and end-user groups may also be effective tools to make sure the projects remain fluid for both the speed of innovation as new information, ideas, and opportunities arise within the project scope and timelines.

[1] Press release; https://www.energy.gov/mesc/defense-production-act-heat-pump-program-selections

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Question 2: *Are the GWP limits of 150 reasonable for current state of the art systems? If not, why and what should the limit be? Do the three Project Groups in Section IV of this document address the primary objectives of expanding and improving heat pump technology? If not, why? Are there alternative pathways or priorities that should be considered?*

Honeywell recommends that CEC consider a tiered approach for GWP limits assigned to the groups outlined in this proposal as per below:

Group 1: ***High Efficiency, Electric Heat Pump Water Heaters with Low GWP Refrigerants***

Honeywell Recommended GWP limit: GWP (AR4) <150 for A1 refrigerants and GWP (AR4) <10 for A2L refrigerants

Rationale: Ultra-low GWP (<10) A2L refrigerants such as HFO-1234yf and HFO-1234ze have been shown to work well for this application (Nawaz et al., 2017[2]; Munk et al., 2023[3]). For Low GWP (<150) there are A1 HFO-based solutions that can perform well and require no flammability mitigation. These include R471A (GWP AR4 146) and R482A (GWP AR4 148). As water heaters need between 2-4 kW capacity for an average residence and will run for 2-5 hours per day, HFO ultra-low GWP refrigerants can safely provide that capacity at high efficiency and can heat water up to 180^{o}F.

Although some HFC-32 Domestic Hot Water (DHW) systems have been installed in Europe, they are not able to reach temperatures above 140^{o}F, with most manufacturers recommending setting the water temperature to a maximum of 130^{o}F. To keep system costs down, Honeywell recommends setting the GWP limit at 150 in this end use so that A1 solutions can be used which can forego any flammability safety precautions or mitigations.

Group 2: C*ombination Heat Pump HVAC and Domestic Hot Water Heating with Low GWP*

Honeywell Recommended GWP limit: GWP (AR4) < 700

Rationale: Combination Heat Pump HVAC with DHW require significantly more capacity with an average residence requiring approximately 3 tons (36000 Btu, 10.6 kW) of heating capacity to fulfill both heating and DHW demands[4]. A high-pressure refrigerant would be needed to provide these capacities at reasonable system size and refrigerant charges. The only viable solutions currently on the US market are R454B and R32, which perform closer to R410A, but with lower GWPs (466 for R454B and 675 for R32).

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[2] Kashif Nawaz, Bo Shen, Ahmed Elatar, Van Baxter, Omar Abdelaziz, ***R1234yf and R1234ze(E) as low-GWP refrigerants for residential heat pump water heaters*** 2017 https://www.sciencedirect.com/science/article/pii/S0140700717302657#s0130

[3] Munk, Jeffrey, Hunt, Walter, Gehl, Tony, Rendall, Joseph, and Metzger, Cheryn E. ***Field Performance of R-1234yf Heat Pump Water Heaters*** 2023 https://www.osti.gov/biblio/1986029

[4] https://www.nrel.gov/docs/fy11osti/51603.pdf, *Figures based on the heating demand for Chicago and Orlando homes, assuming California will lie somewhere in between, and that 1T is roughly need for DHW, however, DHW demand is less constant than space heating, so a 3T system should be able to fulfill the average California residence heating and DHW needs, especially considering that low-income houses often have poor insulation.*

Setting the GWP limit for this application at 150, would eliminate these important options and require use of options such as R454C and R455A, which have lower capacities per pound of refrigerant and size of system, which in turn would lead to increased capital expenditure on this residential system and make it more difficult to implement in low-income communities.

We recommend reconsidering the 150 limit in the future as CA collects more information on the rollout of <700 GWP combination heat pump HVAC and domestic hot water systems in CA.

Group 3: ***Space Conditioning Electric Heat Pumps with Low GWP***

Recommended GWP limit: GWP (AR4) < 500 until 2035, GWP (AR4) < 150 post 2035

Rationale: The current US EPA and CARB state regulations mandate the use of refrigerants < 700 GWP and < 750 GWP respectively in residential/light commercial air conditioning and heat pump equipment starting with a manufacturing prohibition in 2025. The industry is currently preparing for this transition and end user adoption will begin in 2025. The average life of a refrigerant-charged residential heat pump unit is 10 years. Mandating an additional transition 4-5 years after the adoption of new refrigerants in 2025 will prove very expensive for both end users and OEMs and force early retirement of equipment before the end of its useful lifetime. A GWP limit of 150 will be better suited for adoption post-2035 when the units are at end of life. Honeywell believes this sector follows a similar case as Group 2, with R454B being able to fulfill the requirements at a reasonable capital expenditures near-term, and eventual advancement in system/components/refrigerants allowing for possibly GWP < 150 systems that would be viable for homeowners and especially those in low-income communities post-2035.

Honeywell believes the segments outlined in the three groups cover several heat pump applications and largely address the primary objectives of developing, expanding, and improving heat pump technology. However, it is worth noting that the second project group including the combined space conditioning and DHW heat pumps covers an **emerging technology** that needs further development and field demonstration in CA before further GWP limitations are implemented. Premature GWP restrictions may stifle innovation in this specific application sector.

Question 5: *Should Group 1 in Section IV also include small commercial? If so, why?*

Group 1 in Section IV should not include small commercial, as the specifications for this group will likely require higher voltage for commercial applications. Domestic Hot Water (DHW) for residential applications can operate in line with the current electric circuitry in most residences (with 120V and 15-20A). Commercial systems would require capacities that surpass these electrical limits and possibly the space constraints of a residence. Including both sectors in Group 1 would not allow for a properly optimized system for residential applications.

Question 6: *Should Group 3 in Section IV narrow its focus? e.g., to only residential or only commercial. If so, which one and why?*

Honeywell recommends the CEC's focus remain on both residential units up to 5 tons and commercial units up to 20 tons. The system design of these units is very similar, so any development in one can be easily translated to the other, maximizing benefit and resource utilization from this CEC grant program.

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Question 7: *Is four years a feasible project timeline? Are there potential barriers or challenges in implementing the proposed projects in that timeframe?*

Honeywell believes that four years is feasible timeline from an equipment prototype development for field trials and availability perspective. However, widespread/full scale availability and adoption of technology will heavily depend on equipment readiness and could likely take 8-10 years as evidenced by the ongoing transition timeline from R410A to R454B. R454B refrigerant submission to ASHRAE was made in 2014[5], however, 454B containing equipment is expected to be commercially available starting 2025. With this example in mind, 10 years may be a more realistic timeframe.

Question 8: *Which end-use sectors, facilities, or communities are expected to be most positively impacted by these types of projects?*

Apartment buildings, multi-family homes, and commercial buildings such as offices will be positively impacted by these projects. By integrating these technologies into these end-use sectors, it will reduce dependance on traditional, fossil-based energy sources, promoting higher efficiencies in networked/district heating, resulting in a positive impact on constrained resources, such as power grids within the state of CA.

Question 9: *How could this solicitation encourage projects to more fully center around equity and community engagement?*

To encourage optimal engagement, Honeywell offers the following recommendations.

- The solicitation program can provide matchmaking support for partners with other supply chain stakeholders with an equal interest in promoting these energy initiatives. This matchmaking could help better bring in end users from low-income or underrepresented communities to ensure that benefit from the program flows to these places.
- The solicitation program can consider standing up energy efficiency programs that include free or subsidized energy audits and weatherization services. These programs can help identify areas of improvement in homes and provide recommendations for installing heat pumps as a more energy-efficient heating and cooling solution.
- The solicitation program can include educational campaigns to raise awareness about the benefits of heat pumps and their cost-saving potential. These could include information on available incentives, energy savings, and environmental benefits. Target outreach efforts could focus on low-income communities and work with community organizations to ensure the information reaches those who can benefit the most.
- The solicitation program could collaborate with local community organizations, non-profits, and housing agencies to promote and facilitate the installation of heat pumps. These partnerships can help identify eligible households, provide assistance with the application process, and connect residents with reputable contractors.
- Beyond the solicitation program, CEC could also work with other state and local agencies to promote training programs to educate and certify local residents in heat pump installation and maintenance, in turn creating job opportunities within the community and ensure that residents have access to qualified local technicians for installation and servicing.

[5]ANSI/ASHRAE Standard 34-2019
https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/34_2019_f_20191213.pdf