

DOCKETED

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DRAFT SOLICITATION ATTACHMENT

Developing Next Generation, All Electric Heat Pumps Using Low Global Warming Potential Refrigerant

Proposed Electric Program Investment Charge Solicitation

No proposals are being accepted at this time. This is a draft solicitation attachment for project requirements regarding the research, development and demonstration of next generation electric heat pumps that use low Global Warming Potential (GWP) refrigerant. Do not design or submit proposals according to this DRAFT. The actual solicitation is subject to change.

The purpose of this draft solicitation attachment is to solicit public feedback on the impacts of the requirements. (See Section 5 for specific questions). Staff will accept comments submitted to the California Energy Commission (CEC) Dockets Unit or by email until **February 16, 2024**. (See Section 6 for additional details on how to comment.)



<http://www.energy.ca.gov/contracts/index.html>

State of California

California Energy Commission

January 10, 2024

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Comments are due February 16, 2024, at 5:00 p.m.

I. INTRODUCTION

This document outlines the requirements under consideration for the Building Decarbonization Program's competitive grant solicitation, "Next Generation, All Electric Heat Pumps Using Low Global Warming Potential (GWP) Refrigerants."

This solicitation will consider funding 3 groups of electric heat pump technologies that include water heating, combination water and space conditioning, and space conditioning systems using low GWP refrigerants for use in California. Each funded project will aim to accelerate the technology development of electric heat pumps that can use low GWP refrigerants (GWP < 150) while maximizing energy efficiency and equipment performance, maintaining cost-effectiveness, and meeting customer needs.

II. ELIGIBILITY

This solicitation will have three groups total. Two of the groups will not require that funded projects be demonstrated. Projects in the group that require demonstration can obtain additional scoring criteria points by illustrating how the project can benefit disadvantaged or low-income communities.

III. FUNDING

The solicitation will be a one-phase solicitation that consists of three groups with a funding breakdown totaling \$9.375M in available funds.

IV. APPROACH, TARGET METRICS AND FUNDING

Group 1: Design and Test Low Voltage, High Efficiency Heat Pump Water Heaters with Low GWP Refrigerants (TRL 3-4)

This group will target the development and testing of low GWP, cost-effective, 120V electric heat pump water heaters (HPWHs) that can be readily deployed, particularly in under-resourced communities, to address a critical gap in the U.S. market. 120V electric HPWHs are a relatively new product that is expected to have a high impact on the transition to building electrification due to its lower voltage, potentially reducing electric panel upgrades. However, commercially available HPWHs use standard refrigerants with high GWPs, such as HFC134a, which is 1,430 times more potent than CO₂ over a 100-year time horizon. By expanding the HPWH market to include competitive options with lower GWP refrigerants, climate change mitigation and building electrification efforts could be accelerated.

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Each eligible advanced or emerging technology must meet the technical requirements described in the Target Metrics as well as the following requirements:

- 120 V power.
- Refrigerants with a GWP \leq 150.
- Stage of Development: Applied Research and Development (TRL 3-4). Equipment is not commercially available. Laboratory testing required, and applications with pilot testing at sites will be scored more favorably.
- Research team includes at least one HPWH manufacturer.
- Capability to control the unit to reduce load during the net peak periods.

Laboratory tests and/or site demonstrations that demonstrate benefits to disadvantaged or low-income communities will receive additional points.

Group 2: Applied Research and Development of Combination Heat Pump for Domestic Hot Water (DHW) and Space Conditioning with low GWP refrigerants (TRL 3-5)

This group will target the research and development of an all-electric integrated mechanical heat pump system that will deliver hot water and space conditioning in a modular unit. The intent is to expand upon efforts from two current EPIC-funded projects (EPC-19-032 and EPC-20-023) to accelerate the expansion of integrated mechanical systems within one easily deployable package. The combined unit should demonstrate a greater level of energy efficiency and performance than achieved by operating separate units installed in existing buildings.

Each eligible advanced or emerging technology must meet the following required criteria:

- Design combined space conditioning and domestic hot water (DHW) heat pump systems.
- Use refrigerants with GWP \leq 150.
- Meet the Applied Research and Development Stage of Development: (TRL 3-5)
- Achieve energy and cost savings compared to individual space conditioning and DHW heat pumps.
- Demonstrate functionality for grid interactivity.
- Estimate maintenance costs and installation requirements that are competitive with individual space and DHW heat pumps.
- Provide energy consumption, reliability, and operation similar to, or better than, individual space and DHW heat pumps.
- Demonstrate applicability and scalability for multiple applications, such as single-family, multifamily, and commercial building settings.
- Include the capability to control the heat pump unit to reduce load during net peak periods.

Laboratory tests and/or site demonstrations that show these units can benefit disadvantaged or low-income communities will receive additional points.

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Group 3: Design and Demonstrate Electric Heat Pump Space Conditioning System with Low GWP Refrigerants (TRL 6-8)

This research will develop and demonstrate a heat pump system that delivers space conditioning using low GWP refrigerants. The intent is to complement another CEC solicitation for HVAC decarbonization in large buildings (GFO-22-308¹), which focuses on air-source heat pump systems between 20 and 50 tons in large commercial buildings in its Group 2. In this solicitation, the group will focus instead on units using low GWP refrigerants that are up to 20 tons for commercial and multi-family buildings and up to 5 tons for residential buildings. Each eligible advanced or emerging heat pump technology project must meet the technical requirements in the Target Metrics table as well as the following requirements:

- Stage of Development: Technology Demonstration & Deployment (TRL 6-8).
- Refrigerants with GWP \leq 150.
- Strengths and weaknesses of alternative refrigerant HVAC systems are addressed, including energy use and safety compared to traditional refrigerants currently in use.
- Capability to control the unit to reduce load during net peak periods.
- Research team includes at least one space conditioning heat pump manufacturer.
- Systems are up to 20 tons in commercial and multi-family buildings, or up to 5 tons in single family residential buildings.
- All demonstration sites are both located in and benefit disadvantaged or low-income communities.

¹ <https://www.energy.ca.gov/solicitations/2023-06/gfo-22-308-decarbonizing-heating-ventilation-and-air-conditioning-systems>

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TARGET METRICS

Metric	Baseline	Research Goal	Relevance
High Efficiency, Electric Heat Pump Water Heaters with Low GWP	Current heat pump water heaters with high GWP refrigerants (GWP≈1400 to 2000) at 120V or 240V	<ul style="list-style-type: none"> • Similar or better operational efficiencies, cost, product life, and maintenance requirements • Low-GWP ≤150 refrigerants using 120V • Reduction in peak grid energy use 	Using low GWP refrigerants typically results in lower efficiency and higher capital and operational costs and may have different or more onerous maintenance requirements than standard heat pump water heaters.
Combination Heat Pump HVAC and Domestic Hot Water Heating with Low GWP	Separate conventional HVAC and water heating equipment with high GWP refrigerants (GWP ≈1400 to 2000)	Similar or less total cost of ownership of combination heat pump with low-GWP ≤150 refrigerants and reduction in peak grid energy use.	Effective, efficient, and affordable combination systems would likely increase uptake of cleaner space and water heating and reduce GHG emissions.
Space Conditioning Electric Heat Pump with Low GWP	Current space conditioning heat pumps with high GWP refrigerants (GWP ≈1400 to 2000)	Similar or better operational efficiencies, cost, product life, and maintenance requirements with low-GWP ≤150 refrigerants and reduction in peak grid energy use	Using low GWP refrigerants typically results in lower efficiency and higher capital and operational costs, and may have different or more onerous maintenance requirements than standard space conditioning heat pumps.

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FUNDING

Project Group	Available Funding	Minimum Award Amount	Maximum Award Amount
Group 1: High Efficiency, 120V Electric Heat Pump Water Heaters	\$4,000,000	\$1,000,000	\$2,000,000
Group 2: Combination Heat Pump for Domestic Hot Water (DHW) and Space Conditioning	\$3,000,000	\$1,000,000	\$2,000,000
Group 3: Heat Pump for Space Conditioning	\$2,375,000	\$1,000,000	\$2,000,000

V. QUESTIONS FOR STAKEHOLDERS

CEC staff are seeking responses and comments to the following questions to shape the direction and scope of this solicitation:

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.
2. Are the GWP limits of 150 reasonable for the 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?
3. What are the near-term and medium-term technical targets (e.g., costs, efficiency, ramp rate, emissions levels) to advance low GWP heat pump technologies to a higher TRL?
 - a. What should be the starting and target TRLs for these groups?

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4. Are the proposed levels of project funding for each group appropriate to achieve the desired outcomes? If not, why?
 - a. What would be the typical range of costs (e.g., capital costs) for the anticipated projects, and could projects leverage CEC funding to encourage private investments?
 - b. A minimum 20% match would likely be required with the funding levels listed above, and this requirement would be waived for projects sited in and benefitting Disadvantaged Communities (DACs) and Low-Income Communities (LICs). Is this sufficient to encourage DAC and LIC projects? If not, how could this be improved?
5. Should Group 1 in Section IV also include small commercial? If so, why?
6. Should Group 3 in Section IV narrow its focus? e.g., to only residential or only commercial. If so, which one and why?
7. Is four years a feasible project timeline? Are there potential barriers or challenges in implementing the proposed projects in that timeframe?
8. Which end-use sectors, facilities, or communities are expected to be most positively impacted by these types of projects?
9. How could this solicitation encourage projects to more fully center equity and community engagement?

VI. WRITTEN COMMENTS

Comments on this Draft Solicitation document **are due by February 16, 2024, at 5:00 PM.**

Please submit comments to the CEC using the e-commenting feature by accessing the comment page for this docket at

<https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=23-ERDD-01>.

A full name, e-mail address, comment title, and either a comment or an attached document (.doc, .docx, or .pdf format) are mandatory. Please include "Low GWP Heat Pump Draft Solicitation" in the comment title. After a challenge-response test is used by the system to ensure that responses are generated by a human user and not a computer, click on the "Agree & Submit Your Comment" button to submit the comment to the CEC's Docket Unit.

Please note that written comments, attachments, and associated contact information included within the documents and attachments (e.g., your address, phone, email) become part of the viewable public record. This information may become available via Google, Yahoo, and any other search engines.

Interested stakeholders are encouraged to use the electronic filing system described above to submit comments. If you are unable to submit electronically, you may email your comments to: DOCKET@energy.ca.gov and include "Low GWP Heat Pump Solicitation Concept 23-ERDD-01" in the subject line.