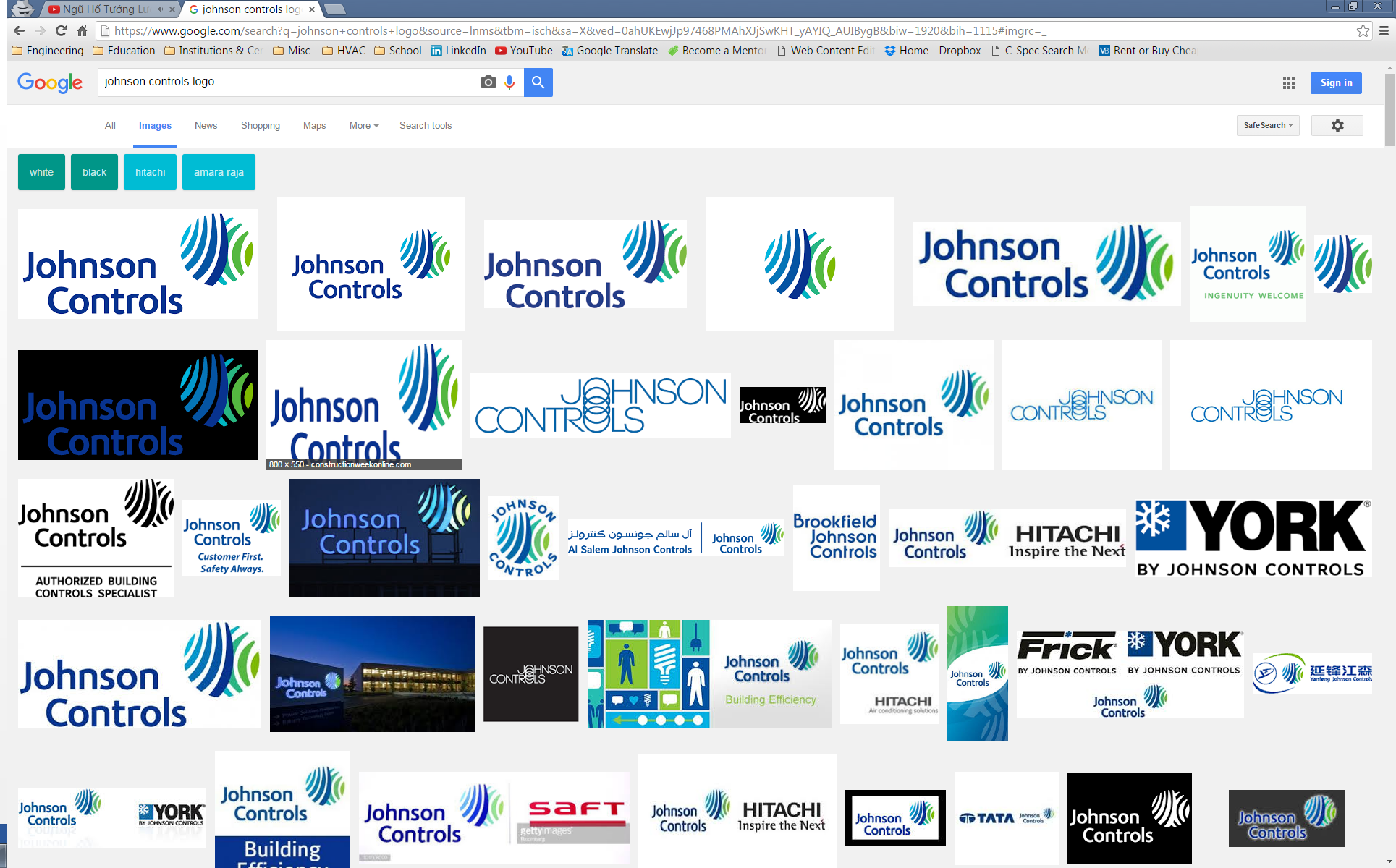
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**October 30, 2023**

**California Environmental Protection Agency**

**California Air Resources Board**

**1001 I Street**

**P.O. Box 2815**

**Sacramento, California 95814**

**Electronic submittal:** <https://ww2.arb.ca.gov/public-comments/public-comment-request-information-california-senate-bill-1206-assessment-report>

**Re:** Senate Bill 1206 Assessment Report: Request for Information (RFI)

**To Whom It May Concern:**

Johnson Controls appreciates the opportunity to provide comments on the California Air Resources Board Request for Information (RFI) for SB 1206’s Assessment Report for Transitioning Hydrofluorocarbons (HFCs) to Ultra-Low Global Warming Potential (GWP) and/or No-GWP Alternatives

Johnson Controls (JCI) is a leading global provider of heating, ventilating and air conditioning equipment, building controls, security and fire/life safety solutions which includes brands such as York, Metasys, Simplex, Grinnell, Zettler and Tyco. The company has nearly 100,000 employees and over 1,000 locations globally and has long been a leader in sustainable and energy efficient technology. Johnson Controls first set sustainability goals in 2002, and the company has reduced its Scope 1 and 2 greenhouse gas absolute emissions by 42% in 2022 compared to a 2017 baseline year. Further, we are AAA rated by MSCI and are recognized as among the Top 100 Most Sustainable Companies by Corporate Knights, and number one in our industry segment. JCI has numerous low and ultra-low GWP product offerings currently in production or soon-to-be launched across its portfolio of residential, light commercial, VRF and applied[[1]](#footnote-1) products both domestically and globally.

JCI is also a participate in the Department of Energy’s Cold Climate Heat Pump Challenge[[2]](#footnote-2) and recently committed to supporting California’s goal of having six million electric heat pumps installed by 2030[[3]](#footnote-3).

JCI is currently engaged in efforts to not only launch is industry leading residential and light commercial product offering of low GWP stationary AC and Heat Pump’s (HP’s) with the industry leading low GWP refrigerant R454B beginning early in 2024[[4]](#footnote-4) but is also diligently working to update state and provincial building codes in the US as well as Canada to adopt the latest model codes which allow for increased quantities of A2L refrigerants.

**RFI Question Responses**

**Section 2: Stationary Air Conditioning & Space Conditioning Heat Pumps**

5) There are limited ultra-low-GWP and/or no-GWP technologies for this sector. How can technological innovation be encouraged?

Response:

JCI believes there is sufficient incentive to spur the development of new ultra-low and/or no-GWP technologies based on the US Stationary Market size and its resulting rewards for those companies willing to invest. JCI estimates there are tens of millions of existing high GWP system currently operating in the US and millions of new such systems introduced to the market every year thus providing ample market incentive for product development. As JCI is a user of such refrigerant technologies, we believe producers have invested hundreds of millions of dollars and 10+ years in research and development in an attempt to find a variety of low and ultra-low GWP solutions which all have trade-offs with multiple features such as GWP, efficiency, capacity, flammability, glide, cost/price, availability, etc. GWP is but one feature of a refrigerant’s characteristics used as the basis for selection for a particular application. For example, there are low / ultra-technologies currently available or in development with GWP levels significantly below that of CARB’s 750 GWP maximum limit for this sector however their capacity is nearly ~30% lower than that of today’s incumbent high GWP refrigerant R410A which has a GWP of ~2,088 (AR4 – 100 yr.). The resulting ~30% capacity drop results in significantly larger, more expensive components such as heat exchanges / coils and compressors. These larger components require larger cabinets which directly impacts transportation and installation cost as well as contributing to additional carbon emissions. Cabinet sizes are often limited to key dimensions such as van transport spacing and gate / door widths for residential applications which if exceeded would be prohibitive to produce thus forcing the installation of multiple units whereas previously a single unit would have sufficed. Such components presently do not exist in the market and will require at a minimum 5+ years or longer to commercialize. Other low / ultra-low GWP non-flammable options are significantly less efficient (for this sector) and inhibit JCI’s ability to meet Department of Energy minimum efficiency standards as well as voluntary incentive standards like that of EPA’s Energy Star program required by the Inflation Reduction Act for the low-income focused rebate programs. Highly flammable, ultra-low GWP options such as R290 / R600 would require product safety standards such as U.L. 60335-2-40, ASHRAE 15.2 (residential applications) to be revised to allow for increased charge sizes necessary for larger capacity systems typically found in the majority of U.S. single-family homes. ASHRAE 15 (commercial applications) would also have to be updated for rooftop units, commercial splits and VRF systems some of which require hundreds of pounds of refrigerants. Given the recent, painful lessons learned with the A2L safety standards updates, national model codes (IAPMO and ICC) amendments and finally the subsequent state and city building code adoptions, JCI believes the code adoption process for highly flammable ASHRAE Class 3 refrigerants presents a significant barrier to widespread commercialization in the U.S. and would almost certainly require multiple, lengthy update cycles to address without any assurances of success. JCI is also adamant that any future low, ultra-low GWP limits for a given sector prohibition have established, EPA SNAP approved alternatives multiple years prior to any required widespread commercialization date. To propose maximum GWP limits for which there are no EPA SNAP approved alternatives is a dangerous game of regulatory “chicken” which could result in products not being available for California consumers and cost OEM’s like JCI as well as refrigerant producers millions of dollars in lost investments. This actual scenario nearly played out in CARB’s original HFC rulemaking whereby a prototype, non-flammable fluid that initially had great promise failed to be commercialized and ultimately resulted in a GWP limit being set at the federal level which would have resulted in a “California Only” market. While it is true the other mildly flammable alternatives also did not have EPA SNAP approval until very late in the rulemaking process; the same scenario could have also occurred had either of those fluids failed to secure EPA SNAP approval.

6) What types of ultra-low GWP technologies for this sector are available in other markets globally, but not in the US? What do you see as the primary market barriers to the adoption of these technologies in the US?

Response:

There are other low, ultra-low technologies available for use in other countries due primarily to the absence of or less stringent energy efficiency requirements and equipment safety standards as well as significantly lower liability cost. For example, the U.L equipment safety standard U.L. 60335-2-40 in the US severely restricts the quantity of hydrocarbons like R290 inside the occupied space which limits the capacity of systems to smaller “self-contained” appliance such as window units and packaged terminal air-conditioners and heat pumps. These self-contained products typically do not have enough capacity to cool most US single family homes (unless multiple units are deployed in each space). The majority of the US Single Family Housing stock utilizes a ducted system for moving air throughout the space and is typically larger than most housing stock in Asia or Europe and is heating focused (rather than cooling). These systems also utilize air-to-water designs and require secondary pump systems as well as secondary heat exchangers. Converting an existing ducted, air-to-air system to an air-to-water system has not been well studied however it is clear such a transition will add significant cost and time. There is also no existing performance standard from AHRI or others by which to measure the efficiency of such a system in a residential application. In most cases, these smaller window units, PTAC’s/HP’s are also less efficient than today’s DOE regulated stationary systems which could result overall increased emissions when installed at scale.

7) How can centralized ducted AC systems be transitioned to ultra-low GWP or no-GWP technologies?

Response:

Either safety standards in the US would have to be revised to allow for increased charge sizes of flammable, ultra-low GWP technologies like that of propane (R290) or energy efficiency minimums would need to be lowered to accommodate the less efficient technologies like that of CO2 (R-744). In some cases, like that of CO2, even if energy efficiency standards could be met, the cost of such systems would be significantly great enough to deter consumer adoption. CO2 will also likely require updates to the U.L. safety standards due to its significantly higher operating pressures > 2,000 psig which have yet to be addressed. JCI has conducted and is continuing to conduct research into the challenges with CO2 in stationary AC and HP applications as well as other ultra-low and no-GWP alternatives in hopes of finding future solutions.

8) Many other countries don’t use centralized air conditioning systems. Do you have recommendations for creating a market for small self-contained modular heat pump technology (vs. central systems) in California?

Response:

New US homes could be specifically designed to use smaller self-contained HVAC equipment however the existing housing stock would provide significant cost and consumer preference barriers. The typical US Single Family home would require multiple self-contained units for each space or zone as well as access to an outside wall (assuming no ductwork). Some interior spaces simply could not be accommodated with window units or would require some sort of ductwork. JCI’s research has noted that consumers of single-family homes typically do not like the appearance of window units or the indoor coils (heads) of ductless units. While such self-contained systems such as PTAC/HP’s are sometimes better suited for small, multi-family construction including some apartments, they need to be specifically designed to accommodate such applications. There are existing “small residential packaged products” currently in the market which combine both heating and cooling in a single, self-contained cabinet which is installed outside the conditioned space however such systems still require ductwork. These residential packaged products are typically applied in older homes or even manufacturing housing applications where ductwork is located underneath the conditioned space. It’s important to note that even though these residential packaged products, widow units, PTAC/HP’s, etc. are classified as self-contained, they are still classified by U.L. as high probability systems as any leak on the indoor coil could migrate to the indoor space. The challenge of Indoor Air Quality (IAQ) also needs to be addressed for health and safety reason which includes sufficient ability to remove moisture and humidity as well as including a mechanism for including outside air. While most traditional ducted systems do not have outside air mechanisms included in their installations; the fact that they are “ducted” systems does provide a means to do so. It is now obvious that IAQ is of paramount importance in the era of COVID and other viruses thus all HVACR systems should have means to incorporate such features.

9) Do you have recommendations for creating a market for secondary loop/indirect cooling systems in California, particularly for residential and light commercial applications?

Response:

The best option for creating such a market would be via new construction codes where the housing was specifically designed for such systems. Converting an existing “air-to-air” direct system will be costly and time consuming and would likely require multiple, expensive renovations to the home. An appropriate performance standard (e.g., AHRI standard) also needs to be developed for such systems to measure their true efficiency. These secondary loop systems would include an additional pump and secondary heat exchanger; thus, a new efficiency standard and test procedure needs to be developed which includes these loads and losses in addition to the tradition loads of compressors, motors, etc. operating in both heating and cooling. As these secondary loop systems also utilize water or a water/brine solution to inhibit freezing in colder climates; water conservation measures would also need to be explored to minimize water resources.

11) What mechanisms, policies, and or incentives can be used to increase recovery and reuse of high-GWP HFCs from existing AC or HP systems, particularly in the residential sector?

Response:

While California’s own HFC regulations as well as that of the EPA American and Innovation and Manufacturing Act (AIM) will drive increased reuse, recovery and reclamation of high-GWP HFC’s, CARB could implement mandatory inspections similar to that required by EPA for larger charge systems however JCI would defer such a decision to California contactors and others directly involved in the servicing of such residential systems. In order to ease the cost burden to consumers and particularly low income, homeowners, CARB or other state entities may want to provide a mechanism for free or low-cost inspections incentivized by the state. JCI would encourage CARB to hold stakeholder meetings directly with contactors and their trade organizations to better understand their position. As an OEM, JCI strongly supports the recovery, reuse, and reclamation of all high GWP refrigerants; we are open to collaborative ideas and marketing efforts to broadcast this message.

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12) What type of safety testing and safety standard updates are needed for the transition to ultra-low GWP (such as hydrocarbons) and/or no-GWP alternatives?

Response:

JCI believes much research and endorsement from multiple industry stakeholders and in particular the fire community / California State Fire Marshals / etc., will be needed to increase charge quantities of highly flammable ASHRAE A3 refrigerants like propane(R290) in residential / light commercial systems. The lessons learned from the recent efforts to approve increased charge quantities of ASHRAE A2L, mildly flammable refrigerants like that of R454B and R32 should serve as a lesson learned by engaging all stakeholders early and often. Testing and research should involve input from all stakeholders and involve “real world” test such as wildland fire scenarios and various residential applications. The U.L. Equipment Safety Standards 60335-2-40 also needs to be revisited. Safety must be the primary focus for highly flammable A3 refrigerants used in direct, high probability systems. Research and testing also needs to be conducted for low probability, indirect systems such as secondary loop systems whereby any A3 / propane system is retained outside the conditioned space. Standards should be updated to ensure clearances and ignition sources are addressed for such systems. JCI would also urge CARB consider the litigious risk associated with the application of A3 refrigerants like that of propane and not indiscriminately follow the EU based solely on GWP limits. The EU and the US have different legal standards which CARB should carefully evaluate when considering highly flammable, hydrocarbon technologies such as R290 / propane in direct, high probability systems.

**Section 6: Recovery and Reclamation**

24) Despite venting prohibitions, refrigerant recovery rates are low, especially in the residential sector. What practices and processes can be put in place to ensure proper recovery?

Response: (same response as to question 11)

While California’s own HFC regulations as well as that of the EPA American and Innovation and Manufacturing Act (AIM) will drive increased reuse and recovery of high-GWP HFC’s, CARB could implement mandatory inspections similar to that required by EPA for larger charge systems however JCI would defer such a decision to California contactors and others directly involved in the servicing of such residential systems. In order to ease the cost burden to consumers and particularly low income, homeowners, CARB or other state entities may want to provide a mechanism for free or low-cost inspections incentivized by the state. JCI would encourage CARB to hold stakeholder meetings directly with contactors and their trade organizations to better understand their position. As an OEM, JCI strongly supports the recovery, reuse, and reclamation of all high GWP refrigerants.

25) What incentives can be provided to technicians for investing their time and effort to properly recover HFCs from equipment, especially from the residential sector?

Response:

See response question 24.

26) What are some of the barriers that technicians face in transporting recovered HFCs to reclamation facilities and how can those barriers be addressed?

Response:

CARB should seek input directly from California contactors and their trade organizations. JCI’s Independent California distributors and their contractors often site the lack of space in service vehicles for multiple recovery cylinders (in order to not mix different, recovered gases), the lack of collection / drop off sites and the associated time away from the job in high traffic areas as well as the uncertainty in the value or cost (in the case of destruction fees) for the recovered gas. While JCI is aware that several nationally known reclaimers have recently modified their cylinder exchange programs; the negative history associated with low payout of recovered gas, the surprise destruction fees and the time lag between recovery and payment, need additional marketing efforts to correct. CARB may want to offer additional incentives in the form of state sponsored “drop off sites” to enable recovery efforts as well as initiating a statewide marketing campaign. JCI is willing and able to help support this effort and looks forward to working with all stakeholders in this effort.

29) How can the State enable financial and/or regulatory mechanisms, like extended producer responsibility schemes or other fees, to improve the recovery and reclamation of HFC refrigerants? Are there successful examples from international markets that can be applied in California?

Response:

JCI believes that the current HFC mechanisms that both CARB and the EPA have in place will help drive contractor behavior change (40% reduction in supply by 1/1/2024, price escalation, no low GWP, A1 substitute for R410A, etc.). Unlike previous refrigerant transitions in the stationary sector where there were replacements for gases being prohibited (e.g., HCFC-22) there is no replacement for today’s predominant high GWP HFC – R410A which is both an ASHRAE A1, non-flame propagation fluid with a GWP < 700. While JCI understands that all contractors may not yet be aware of this fact, we believe that market forces will drive this reality very soon. OEM’s like JCI are working diligently to communicate the coming changes including many states and nationally known contractor trade and training organizations such as IHACI, ACCA, PHCC, ESCO, AHRI, etc. JCI cautions against additional expenses a traditional PRO would impose as such additional expenses will only increase the cost of an already costly transition occurring right on the heels of the recent DOE regional efficiency standards which just took effect on January 1, 2023. OEM’s like JCI will begin to launch the majority of their low GWP offerings beginning early in 2024 which means the entire Stationary HVAC sector will have roughly ~ 15 months to prepare for a completely new product offering of residential and light commercial stationary AC and HP systems. JCI believes the additional cost and burden (record keeping and reporting) of a PRO will not add significant value to curb HFC reductions. JCI urges CARB exercise caution and take the time to review the national impacts of EPA’s recently proposed refrigerant management rulemaking within subsection “h” (currently in the 60-day comment period). JCI is willing to further engage on this topic with CARB and other stakeholders.

**Section 7: Workforce Training**

30) How can workforce training for technicians, particularly AC technicians, be improved to reduce leakage and increase HFC recovery?

Response:

While JCI offers a number of incentives for its contractors to follow our equipment specific installation instructions, JCI recommends that CARB also reenforce this message and offer financial incentives for any type of certified training from an established, credentialed HVACR training institution such as ESCO, ACCA, PHCC, NATE/AHRI, IHACI or others. While some of these are in-person, proctored administered training courses, several are also available on-line. CARB should seek input from training stakeholders as to what training programs and credentials would be best and use the input gathered from the contractor and distributor focus groups to determine the best incentive. JCI would note that most credentialled training programs have established procedures for leak inspection and repair thus the need isn’t to develop the training material itself but rather to dramatically increase contractor engagement to attend the training that is presently available. JCI and its distribution partners are presently engaged in such training and stand ready to support any further efforts that can be mutually agreed to.

31) How can technicians be held accountable for better refrigerant management?

Response:

While JCI provides incentives to technicians to follow our installation and maintenance instructions via extension of warranties as well as deterrents for not following proper procedures by denying warranty claims for improper or delinquent work; CARB can also play a role by providing additional financial incentives. JCI believes technician incentives (carrots) will result in better outcomes as opposed to penalties and additional regulation (sticks). Ideas for incentives could include additional payments on each pound of returned HFC gas regardless of quality (annual rebate) or lower permitting fees or even an expedited permitting approval process which could also help California tackle its lack of HVACR permitting. One of the largest hurdles to improving technician refrigerant management practices is making such work financially accretive thus anything that can be done to improve this will help to incentivize behavior change. Innovation in evacuation pump technology with faster pull-down times and faster methods of charging provide technology innovation opportunities for multiple entities.

32) What workforce training will be required for technicians to transition to ultralow GWP and/or no-GWP alternatives?

Response:

As all of the stationary AC and HP low / ultra-low GWP alternatives are classified by ASHRAE as A2L mildly flammable; specific training requirements regarding servicing, transportation and storage are required. This will be particularly important in the high-volume residential sector where A2L refrigerants were not previously allowed in larger charge volumes required for traditional split and packaged systems. Of the utmost importance will be the need for installing contractors to determine if a Refrigerant Detection Systems (RDS) will be required for a particular job using A2L refrigerants. While engineers may be responsible for some commercial applications, commercial “like-for-like” replacements and certainly for most residential applications, calculations of the “releasable charge” and the occupied space volumes will need to be undertaken to confirm the requirement for an RDS (per U.L. 60335-2-40, ASHRAE 15 & 15.2). In the case of industrial refrigeration sector, manufacturers training on trans-critical CO2 systems will be needed. While technicians operating in this space are often factory trained; there are few such CO2 systems in the market thereby necessitating the need for such training in order to increase commercialization capacity.

33) How can the necessary training become more available and accessible for technicians?

Response

OEM’s like JCI offer “factory certified” training; both remotely and in-person / hands-on. Many of our distribution partners also offer such training much of which is supplied and or supported by OEM’s such as JCI. There are multiple independent organizations which also offer third party “generic” training on a variety of HVACR products. JCI believes there are sufficient training materials available in the market for contractors to partake of; convincing contractors to incur the time and expense for such training is often the largest hurdle. JCI and its distribution partners have invested hundreds of thousands of dollars in training materials and training labs across the country in addition to supporting local trade / vocational school training. JCI would urge CARB to promote “certified” training centers across the state as well as factory certified training for California contractors at OEM facilities or approved satellite locations.

34) What is the role of the State, equipment manufacturers, and/or other industry stakeholders in providing and standardizing training and best practices, and how could this be enhanced?

Response:

While JCI believes factory OEM training on the actual products technicians will be installing is the most effective; credible training organizations such as ACCA, ESCO, IHACI, etc. could work together to provide generic HVACR training applicable to all equipment types. JCI would recommend CARB identify these organizations and engage in meaningful dialog as to the best approach for standardized, generic, training. Such training would include the basics of charging, evacuation and recovery which is already taught in most HVACR classes. CARB should also consider meaningful incentives to increase the attractiveness of such training. Incentives could include an “approved contractor list” including an opportunity to advertise or promote their businesses to a broader statewide audience.

**Section 8: Other Non-Refrigerant HFC Sources (Fire Protection, Aerosol**

**Propellants, Foams, Solvents, MDI)**

35) Are there emerging technologies for non-refrigerant HFC end-uses (including products with application-specific allowances) that show promise in addressing the transition to ultra-low GWP or no-GWP alternatives?

Response:

JCI is a member of the Halon Alternatives Research Corporation, Inc. (HARC) and supports their submitted, formal comments.

**Section 10: Overarching Questions**

38) What factors around PFAS (per- and polyfluoroalkyl substances) should be considered as California transitions to ultra-low- and/or no-GWP alternatives?

Response:

JCI believes that sound science and societal benefits should play a paramount role in any future regulation of PFAS including refrigerant gases “products of degradation” associated with some low / ultra-low GWP alternatives. The science is clear that all PFAS are not the same (short chain vs long chain, etc.) and thus should not be regulated as a single class based solely on chemical structure. Many low, ultra-low technologies would be eliminated by a single class regulation being proposed in the EU and some states. CARB should objectively weigh the trade-offs of science based PFAS regulation against other low, ultra-low and non-GWP alternatives on a sector-by-sector basis noting that a single, solution could, if done incorrectly result in worse emissions either through lower efficiency, reduced capacity and in some cases no or not enough products to supply market demand. JCI has experts in this field on staff is willing to discuss this topic further should CARB desire to do so.

39) What types of ultra-low GWP and/or no-GWP pilot or demonstration projects from other regions or countries could be implemented in California? Please be specific as to types of equipment/applications.

Response:

CARB could certainly explore projects for small charge, self-contained residential or multi-family applications for use with low / ultra-low GWP technologies with limited conditioned spaces such as apartments or even tiny homes with access to outside windows. Other applications to explore could include converting an existing single-family home from a traditional “air-to-air” system to an “air-to-water” system to better understand the cost and challenges associated with such a conversion. Note however there is still no formal AHRI efficiency performance standard for such a product thus the actual equipment design requirements would remain unknown until such a standard is established and approved but important lessons could still be learned.

40) Are there additional control measures for refrigerant management, such as requirements for maintenance, servicing, and leak detection/repair, that could support California’s climate goals?

Response:

JCI would support the requirement for annual leak inspections similar to those required and proposed for large charge systems. We believe this along could provide major emissions savings from the millions of installed high GWP HFC systems currently installed in the state. As previously noted, JCI would recommend engagement with contractor trade organizations as well as those representing low-income homeowners and tenants in rental properties to provide incentives and resources for such efforts.

41) Do you have any suggestions for legislative, or regulatory changes that are needed to transition away from HFCs and to ultra-low GWP and/or no-GWP alternatives?

Response:

JCI believes California’s State Implementation Plan (SIP) provides a roadmap to account for all major source emissions in addition to those solely from HFC’s. JCI understands that while HFC’s are potent greenhouse gases, that CARB should carefully balance the tradeoffs of overly aggressive or unachievable HFC mandates versus obtaining those overall emission reductions from other sources which could have lower implementation cost and greater environmental benefits. JCI also would urge that CARB consider the beneficial impacts of federal action under the American Innovation and Manufacturing Act (AIM) passed in 2020 and its nationwide contribution to reducing HFC emissions. While JCI understands CARB desire to be a leader in the decarbonization movement and specifically in addressing HFC emissions it is clear that national, uniform efforts will produce greater benefits versus a patchwork unique state and provincial requirements. While JCI understands that CARB will likely continue to promulgate its own HFC regulations we urge alignment federal and global efforts.

JCI appreciates the opportunity to comment on this RFI and thanks CARB and its staff for its willingness to engage all stakeholders in the next steps of its critical HFC rulemaking process.

Please let us know if you have any further questions.

Respectfully,



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1. <https://www.johnsoncontrols.com/media-center/news/press-releases/2023/03/10/johnson-controls-announces-industry-first-use-of-low-gwp-refrigerants> [↑](#footnote-ref-1)
2. <https://www.energy.gov/eere/buildings/residential-cold-climate-heat-pump-challenge> [↑](#footnote-ref-2)
3. <https://www.energy.ca.gov/news/2023-10/top-global-building-appliance-manufacturers-and-distributors-commit-help#:~:text=SACRAMENTO%20%E2%80%94%20Today%2C%2010%20of%20the,heat%20pumps%20installed%20by%202030%20>. [↑](#footnote-ref-3)
4. <https://www.johnsoncontrols.com/media-center/news/press-releases/2021/05/27/johnson-controls-commits-to-r454b-as-future-environmentally-sustainable-refrigerant-solution-in-nort> [↑](#footnote-ref-4)