



August 20, 2023

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Executive Officer

California Air Resources Board

Submitted per email to: <https://ww2.arb.ca.gov/applications/public-comments>

cc: Elizabeth Scheehle

Comments on the Public Hearing to Consider the Proposed Amendments to the Regulation for Small Containers of Automotive Refrigerant

Dear Dr. Cliff:

Thank you for the opportunity to comment on the proposed amendments of small can motor vehicle air conditioning (MVAC) refrigerant regulations. CARB has long been proactive in regulating small containers of mobile vehicle air conditioner refrigerants.

As detailed below, we find the assumptions underlying the July 3, 2023 Initial Statement of Reasons for Proposed Amendments to the Regulation for Small Containers of Automotive Refrigerant¹ to be so severely flawed, that staff must revise and redraft the document. This will allow staff to include two new alternatives, which we believe should have been proposed and discussed in the July 3 document. Both are variations on staff 's Alternative 2, a ban on small cans.

ADDITIONAL ALTERNATIVES FOR CARB'S CONSIDERATION

A. *Ban small containers and offset the cost of leak repair for persons with low income.*

The staff report notes that other states and countries already have bans.

“Several jurisdictions have prohibited the sale of small containers of automotive refrigerant. The European Union enacted a market prohibition, effective July 4, 2007, targeting “non- refillable containers for fluorinated greenhouse gases used to service, maintain or fill refrigeration, air conditioning or heat-pump equipment” which would include small containers of automotive refrigerant (OJEU, 2014). The

¹ This report will be referred to here as “the staff report.” It is available at <https://ww2.arb.ca.gov/rulemaking/2023/smallcontainer2023>

governments of Australia and Canada also prohibit the use of non-refillable containers of refrigerant (Australian Government, 2021; Government of Canada, 2022). Within the United States, the states of Vermont and Washington have prohibited the sale of small containers of automotive refrigerant (Vermont State Assembly, 2022; Washington State Legislature, 2021).”

If California must choose between an outright ban and the regulations proposed by staff, we believe a ban is preferable. Elimination of the deposit-and-return program may reduce the financial burden on disadvantaged communities (DACs), but it is sure to increase emissions and exacerbate global heating, which generally hurts low-income persons most and worst. On matters of public health California has in general not made exceptions for low-income persons. For example, smog checks and consequent repairs are required regardless of income level. It is difficult to see a distinction specific to HFC-134a refill cans.

However, there is a clear alternative, which is to provide financial support to low-income people who might be expected to have difficulty paying for repair of leaks by EPA certified technicians.² The state provides means tested rewards, such as SNAP, or compensation for expenses for climate-friendly programs, such as rooftop solar or electric school buses. It can provide support to low-income persons who need assistance in repairing their leaking MVAC systems.

There are three aspects to such a system: targeting the assistance, determining a realistic budget for the program, and funding the program.

Targeting. CalEnviroScreen finds that 25 percent of the population of California live in disadvantaged communities (DAC). This is the measure CARB uses to judge that 40 percent of the small cans are sold in disadvantaged communities. How to reach these people?

- One method of targeting persons needing assistance with MVAC leak repair would be to make vouchers available at auto service centers and auto parts stores in DACs.
- A second way would be to add MVAC leak detection to smog checks. Those needing assistance in paying for leak repair could be assisted as above.
- A third way would be to reimburse low-income persons through a tax rebate pegged to their income. The advantage of the latter is low-income persons throughout the state could receive a rebate. Also, since it is done in privacy it avoids social stigma. Disadvantages are that people would receive payment only at tax time, and that many low-income Californians pay no tax.

Budgeting. The amount of required state-supported financial support for repairing leaks among low-income persons would actually be much lower than as shown in the staff

² There needs to be a requirement in CA that all automotive air conditioner servicing is done by EPA certified technicians. In 2006 CARB sent “mystery shoppers” to 50 southern California service centers. The resulting recommendations for service are a catalogue of horrors, with most of them recommending some degree of replacement without clearly detecting and fixing the leak. *Evaluation of the Potential Impact of Emissions of HFC-134a From Non Professional Servicing of Motor Vehicle Air Conditioning Systems* CARB Agreement No. 06-341 https://ww2.arb.ca.gov/sites/default/files/2020-03/06-341_0.pdf

report's cost-benefit analysis. This is because, according to EnviroScreen numbers noted above, the benefit would be needed by only a fraction of the approximately 25 percent of Californians who are low-income or disadvantaged persons; and because the assumption of one can per year per person is severely flawed. In fact, vehicles that with failing air conditioners frequently use multiple cans in a year; this means that the number of *vehicles* being "treated" with small cans in disadvantaged communities is far fewer than the number of cans being sold.

Funding the program.

- The staff report says "...the revisions to the expenditure of unclaimed deposits are proposed to be limited to repairing MVAC systems or projects that increase the availability of reclaimed refrigerant in California." If the deposit-and-return system was NOT discontinued, unclaimed deposit fees could be used to run a pilot of the MVAC leak repair program for low-income persons to determine exactly how many low-income people would need how much help.
- The state could require extended producer responsibility for cars manufactured before 2021. All cars leak refrigerants. The average for *new cars* in 2016, according to Minnesota data, is 11.5 grams a year, or 1.1 percent of the charge. A CARB study in 2014 found that on average cars on the road leaked 10.1% per year and that the end-of-life loss rate was 30 percent. This situation demands extended producer responsibility for automakers. After all, when HFCs were adopted it was with wide knowledge of their impact on global warming. Thus a surcharge on all replacement R-134a is well justified.
- Smog checks cost what the smog checker plus an \$8.25 fee for administering the program. The fee could be increased to cover all or part of MVAC repair costs for persons with a low income.
- It would also make sense to use Cap and Trade funds for this purpose as repairing MVAC leaks directly reduces greenhouse gas emissions.

B. Ban small cans with GWP over 150, and create a market for the new, low-GWP drop ins.

As noted below, reducing small can emissions must come from either eliminating the cans or reducing the GWP of the refrigerant used. There are in fact two refrigerants that peer-reviewed research finds can be used as drop-in replacements for 134 in MVAC systems: R430a with a GWP of 97, and R456a with a GWP half that of R-134a, 687.

- A 2019 study noted that "The refrigerant R134a is to be phasing out soon in automobile air conditioning applications due to its high global warming potential of 1430. Hence, it is essential to identify a sustainable alternative refrigerant to phase out R134a in automobile air conditioners.... The results [of this study] confirmed that

R430A is a good drop-in substitute to replace R134a in existing automobile air conditioning systems.³

At this point, no manufacturer is making R430A as a drop-in replacement for MVAC systems using R-134a. The State of California could incentivize this process, which would not only allow replacing the small cans with refrigerant 15 times less warming but could be extended to *all* R-134a MVAC leak repairs. Establishing a ban on R-134a for MVAC repairs after 2025 would be one such incentive. We have faith that CARB could make this happen, to the substantial benefit to the planet – as other states would surely follow suit.

- A less satisfactory approach would be to require R456A in the same way: less satisfactory because R456A is GWP 687. However, this substitute for R134a is already being offered in Great Britain by Koura, as the Klea 456A Vehicle A/C System.⁴ The Klea website says: “The volume of R-134a that can be legally imported into the European Union continues to decrease year-on-year, as a result of the F-Gas Regulations. Overall, the F-Gas Regulations aims to cut F-Gas emissions by two-thirds from 2014 levels by 2030. Answering the need for low GWP solutions, Klea® 456A has been developed as a lower GWP drop-in alternative to R-134a, suitable for application in the automotive aftermarket sector.” Klea claims that R456A is non-flammable and cost-competitive with same energy efficiency as R-134a and that it can be handled using existing R-134a servicing equipment. R456A is safe to intermix with R-134a. Honeywell has licensed it for use in US but has not yet sent it to market.

In order to adopt this approach CARB would likely have to petition the federal Environmental Protection Agency to adopt these two refrigerants as alternatives to R-134a under SNAP. CARB could offer to perform some of the performance and safety testing necessary for these refrigerants to be market-ready.

Obviously, this approach has potential benefits far beyond the small cans issue as with a lower GWP alternative on the market, CARB could ban R-134a from automobiles sold prior to the requirement for using R1234yf, thus greatly accelerating reductions in HFC emissions. Since MVAC emissions made up 28 percent of HFC emissions in 2019, this approach could greatly accelerate phasing out of high GWP HFCs.

- C. Ultimately, CARB could combine the two approaches above: Ban all MVAC refrigerants over a specified GWP, including small cans, and provide for financial assistance in repairing MVAC leaks to low-income persons. It might be prudent for CARB to announce its intention to adopt option A (banning the cans) but to institute a grace period to help low-income persons with repairs first, and then require replacement of R-134a with much lower GWP refrigerants after EPA approval.

³ Andrew Pon Abraham, J. D., and M. Mohanraj. "Thermodynamic performance of automobile air conditioners working with R430A as a drop-in substitute to R134a." *Journal of Thermal Analysis and Calorimetry* 136 (2019): 2071-2086.A

⁴ <https://www.klea.com/next-gen-refrigerants/r456a/>

ANALYSIS ISSUES IN THE STAFF REPORT

A. In our view, “topping up” with small cans is an inappropriate activity with costs to the DIY customer (as well as to the climate). Here are two quotes about the hazards of do-it-yourself refrigerant repairs (there are many):

- “‘Topping up’ with any refrigerant is not recommended, as this does not allow measurement of the correct quantity of refrigerant charge in the vehicle.”⁵
- “DIY service using small cans is an inexpensive alternative to having a professional technician perform the recharge. But it has several drawbacks. A do-it-yourselfer usually is unable to determine the amount of refrigerant remaining in the AC system or the amount of refrigerant added to the system. This drawback usually leads to undercharging or overcharging, both of which are associated with potential AC performance problems, damage to the compressor, and/or refrigerant emissions.”⁶

Use of do-it-yourself cans is not simple—especially if, as all experts recommend, the do-it-yourselfer attempts to locate and repair leaks, rather than just adding gas to a leaking unit. During use of the small cans, refrigerant can leak, and the operation can be hazardous. Please see the summary of California regulations and DIY guidelines from National Refrigerants Inc. i.⁷

The staff report never comes to grips with this issue of inappropriate use by DIYers, and the proposed regulations ignore it. Interestingly, a 2008 report CARB-commissioned proposed a solution:

“It would be possible to allow DIYers to continue recharging their MVAC systems without using the small containers of automotive refrigerant. Instead of buying small cans, DIYers could rent the use of a recovery & recharge machine at an auto-parts retailer. This approach would be similar to an individual inflating the tires on his automobile. A person does not buy a compressor to do this operation but typically goes to a gasoline service station. In addition, a DIYer could perform a leak check on his MVAC by renting a UV lamp from the auto-parts retailer. This would be a relatively simple process If UV dye is included with the refrigerant charge at the factory when the vehicle is being manufactured. The dye could also be injected by either a professional or a DIYer using a small can with dye.”⁸

Unfortunately, while addressing some of the DIY issues, this does not address the basic problem of repairing leaking units competently.

⁵ <https://www.klea.com/wp-content/uploads/2021/12/KLEA-R456A-VEHICLE-SERVICE-GUIDE.pdf>

⁶ Zhan, Tao, Winston Potts, John F. Collins, and Jeff Austin. "Inventory and mitigation opportunities for HFC-134a emissions from nonprofessional automotive service." *Atmospheric Environment* 99 (2014): 17-23. https://www.sciencedirect.com/science/article/abs/pii/S1352231014007444?casa_token=q0e2xB3e7m4AAAAA:T wF7fwF5Exzuz8DPK674412sN0ZnxULJfOYsgEJt4xx0j-3Q-AXRiF3VN9iWFdxwaidghqMqw#bib9

⁷ https://refrigerants.com/wp-content/uploads/2020/01/NRI-R134_CalifRegLITGuide.pdf

⁸ Evaluation of the Potential Impact of Emissions of HFC-134a From Non Professional Servicing of Motor Vehicle Air Conditioning Systems CARB Agreement No. 06-341 https://ww2.arb.ca.gov/sites/default/files/2020-03/06-341_0.pdf

B. The staff analysis uses an averaging methodology that obscures possible ways to address the problem. In particular, staff report that 1.53 million cans are sold each year,⁹ and do it yourselfers recharge only annually. This ignores the fact that most repairs require more than one can, and many leaking units need recharging more frequently than once a year. So in fact, the number of *vehicles* recharged with small cans is likely to be much smaller than 1.53 million.¹⁰ Several sources support this interpretation:

- As noted above, consumers recharge their AC systems when the charge drops to 50 percent of the recommended functional level. This fact is supported in another CARB document: “Cooling performance data indicated that about 50 percent of the refrigerant charge has to be lost before the system ceases to perform adequately.”¹¹
- “A field study was conducted in southern California to quantify the rate of refrigerant emissions from nonprofessional recharging practices and identify emission mitigation opportunities. Based on the results of the study, an average of 489 g of HFC-134a is used when recharging the sample vehicles with an average nominal charge of 858 g.... A comparison with two other independent studies indicates that the findings of the current study may be applicable not only to southern California, but also to the entire U.S.”¹²

This implies that CARB staff’s estimated cost of Alternative 2, a ban on small cans and the requirement that MVAC systems be repaired by certified professionals, is greatly inflated—because the number of affected vehicles is overestimated. This likely applies particularly to the 40 percent of cans sold in disadvantaged communities, as leaks are more likely to be addressed with do-it-yourself cans there than in other income levels. So the number of vehicles needing repair that is hard to pay for is not 1.53 million per year but a smaller percent of vehicles in disadvantaged communities. By our calculations that would be 40 percent of the total cans divided by 1.44 cans per vehicle, or 425,000 vehicles, declining each year as a percentage of the older vehicles using R-134a leaves the road.

C. One adverse consequence of the proposed removal of the small can deposit, which is mentioned in the staff report but not analyzed in the cost-benefits section is this: “With the

⁹ The number of cans is given in the staff report incidentally: “Adjusting for inflation, the deposit and return program costs manufacturers \$1.04 per container or \$1.59 million for 1.53 million containers (Bureau of Labor Statistics, 2023a).” The staff report also uses an average of 12 oz. per can, which we used to get the number of kilograms. Table 1 in the staff report shows an average of 1.35 million cans per year over 11 years, but it was 1.7 million in 2020 and 1.6 million in 2021.

¹⁰ The staff report assumes 1.3 cans per vehicle, but we believe this to be too low. A can is 12 ounces, or 340.2 grams. So 1.3 cans would be 442 grams. A CARB study reported that in their sample it was 489 grams. See footnote 12. If true, each “top up” would require 1.44 cans.

¹¹ *Non Professional Servicing of Motor Vehicle Air Conditioning Systems, CARB Agreement No. 06-341* https://ww2.arb.ca.gov/sites/default/files/2020-03/06-341_0.pdf

¹² Zhan, Tao, Denis Clodic, Lionel Palandre, Arnaud Trémoulet, and Youssef Riachi. “Determining rate of refrigerant emissions from nonprofessional automotive service through a southern California field study.” *Atmospheric Environment* 79 (2013): 362-368. A 12 oz. can contains 340.2 grams.

removal of the deposit and return program, retailers may see an increase in sales.” That is, the policy may result in more DIY mishandling of leaks and more *emissions* of R-134a.

D. The cost benefit analysis suffers from three problems, each of which renders it less than useful or in violation of the requirement for economic analysis:

- a. Quoting from the staff report: “To be conservative, staff estimates emission reductions to be 50 percent of HFC-134a reclaimed for use in small containers. This 50 percent rate is specific to the application of small containers and the resulting estimated emission reductions should be considered the lower bound of expected emission reductions.”

This is flawed logic. Using reclaimed refrigerant does not in itself reduce emissions from the small can. An HFC R134a molecule is the same whether new or reclaimed and the small can leak rate can be expected to remain the same for now and only slowly decline. Therefore there are no emissions savings from the new policy.

Consider: there are four ways to reduce HFC emissions:

1. Reduce the supply so over time less gas can escape. The EPA restrictions and those of SB 1206 will be responsible for reductions in the overall amount of R-134a that is emitted in California. Reclamation is helpful if the supply is constricted—because it means more recapture at end of life. In fact, the new regulation does not reduce the supply of R-134a overall. It would require reclaimed refrigerant to be used for small cans, but that just allows some other industry to use virgin R-134a, which is unlikely to be restricted in supply until after 2033, when SB 1206 limits go to 1400.
2. Increase enforcement of end-of-life regulations by the use of incentives.
3. Reduce the GWP of HFCs, as with blends like R456a AND R430A.
4. Reduce operational leaks.

The use of reclaimed refrigerants in small cans does not constitute an emissions reduction at all. The small cans will still leak with just as much damage to the atmosphere as before. *Banning small cans or requiring refrigerant of much lower GWP are the only ways to reduce small can emissions.*

- b. The social cost of carbon used in the staff report is projected for 2025 to be \$19, \$63, or \$93, depending on the discount rate. However, these figures became outmoded with new analyses performed in 2022. The EPA has proposed a *current* social cost of carbon of \$190 using a 2 percent discount rate.¹³ The University of Berkeley and Resources for the Future proposed in *Nature* a social cost of carbon figure of \$185 with a 2 percent discount rate.¹⁴ With a 1.5 percent discount rate it

¹³ Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances. September 2022. National Center for Environmental Economics Office of Policy.

https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf

¹⁴ Rennert, Kevin, Frank Errickson, Brian C. Prest, Lisa Rennels, Richard G. Newell, William Pizer, Cora Kingdon et al. "Comprehensive evidence implies a higher social cost of CO2." *Nature* 610, no. 7933 (2022): 687-692.

would be \$308. Given the accelerating damages around the world, a 2 percent discount rate (which discounts future damages in favor of present value) is the *maximum* that should be used.¹⁵

CARB is the leading climate regulatory agency in the world. To be using a social cost of carbon so out of step with the EPA and leading economic estimates (including those of other countries) is embarrassing to California. ***The Social Cost of Carbon must be updated for the small cans analysis and all State of California analyses, including a review of the 2022 Scoping Plan.***

- c. Missing from the cost-benefit analyses is a computation for the alternative scenario, namely, banning the small cans and thereby reducing substantially R-134a emissions. We calculate the emissions of 1.5 million cans comes out to be 541,061kg,¹⁶ or 54,106 metric tons, which is equal to 703,378 MT of CO₂e. The social cost of these emissions for one year would be \$134,000,000 if the EPA figure of \$190 is used. A ban would avoid these costs. The staff report estimates 15.7 million cans will be sold through 2040, so the social cost of carbon avoided until 2040 would be ten times the amount per one year, or \$1.34 billion.
- E. The proposed regulation would eliminate the deposit and return program. The staff report inadequately addresses what would happen to the unreturned cannisters. A personal communication from CalRecycle to CARB says: “Empty containers can be treated as any other metal container and disposed of in consumer recycling bins. Local recycling centers are responsible for implementing appropriate recycling options for non-empty used containers to ensure proper disposal.” **Do all waste and recycling facilities have the equipment necessary to safely remove the R-134a left in used cans (the “heel”).** This seems doubtful since they are not doing it now. What happens now to the 1/3 of all small

<https://www.nature.com/articles/s41586-022-05224-9>. The new projections include updated data, better climate modeling, and quantification of many risks that have previously not been included. Nonetheless, this estimate is clearly an *underestimate*: “A limitation of this study is that other categories of climate damages—including additional non-market damages other than human mortality—remain unaccounted for. The inclusion of additional damage sectors such as biodiversity, labour productivity, conflict and migration in future work would further improve our estimates. Current evidence strongly suggests that including these sectors would raise the estimates of the SC-CO₂, although accounting for adaptation responses could potentially counteract some of that effect. Other costs of climate change, including the loss of cultural heritage, particular ways of life, or valued ecosystems, may never be fully valued in economic terms but would also probably raise the SC-CO₂ beyond the estimates presented here.... Although we approximate the effects of a rapid Antarctic ice sheet disintegration tipping point within the BRICK sea-level component, incorporating additional potential discontinuities in the climate system would further improve our SC-CO₂ estimates.” To be somewhat more specific, the \$190 estimate does not include the loss of 90% of ocean species by 2100 if emissions are not abated (<https://phys.org/news/2022-08-marine-species-extinction-greenhouse-gas.html>) or the fact that the thawing of the world’s permafrost has already passed its tipping point (<https://www.nature.com/articles/s41893-023-01132-6/figures/5>).

¹⁵ In the future, our revenues will have to cover escalating costs of adaptation *and* cover the costs of completing the energy transition. In our view, the discount rate should be negative to account for all the phenomena omitted from the updated social cost of carbon estimates. See note 7.

¹⁶ See footnote 9.

cans that are not returned for the deposit? There was a very good reason that returned cans were shipped to the manufacturers to recover what was left in the can.

Toxic waste is regulated and managed by the Department of Toxic Substances Control (DTSC). This includes aerosol cans including those containing R-134a.¹⁷ On the DTSC website disposal procedures for aerosol cans are described as puncturing and draining. Consumers are advised that if they push the button of an aerosol can and “nothing comes out, and the nozzle isn’t clogged, then you can throw the can in the trash or take it to a scrap metal recycler.”¹⁸ Presumably the reason why the “heel” averages only 3.6 percent of the contents of a small can is because no more came out during a test.¹⁹ So following the advice of DTSC, in the absence of a deposit and return program, small cans of R-134a would be trashed and *not* brought to the attention of the toxic waste part of the recycling center. **In short, it is inadequate to suggest that the procedures in place for the last 13 years to deal with the “heel” of the cans are no longer necessary. Return to the manufacturer for extraction of the remaining refrigerant is still the only prudent course.**

In summary, we do not believe the staff report has made a solid case for the staff-preferred alternative.

- The economic analysis wrongly assumes reclaiming will reduce emissions.
- The economic analysis assumes the costs for all users of small cans would be \$1,000 whereas the relevant number is a *much* smaller number.
- The costs to the environment of continuing to tolerate leaks is not computed.
- Costs to the environment are radically under counted due to use of a Social Cost of Carbon calculus that is seven years out of date.
- No adequate provision is made for disposal of cans that still have refrigerant in them.
- The report acknowledges that elimination of the deposit is like to increase use of small cans.
- No acknowledgement is made of the problems of use of small cans for the DIYer, including the likelihood of more extensive air conditioner damage.

With this letter we request that staff review and revise the Proposed Amendments to the Regulation for Small Containers of Automotive Refrigerant, correcting the cost-benefit analysis and employing the current Social Cost of Carbon. We ask that you include in the revised analysis our recommended additional alternatives, which will greatly reduce emissions of R-134a, especially if combined in a program that addresses both emissions and environmental justice issues.


¹⁷ <https://www.cnshining.com/134a-refrigerant-aerosol-can.html>

¹⁸ <https://dtsc.ca.gov/universalwaste/uw-foRResidents-non-empty-aerosol-cans/>

¹⁹ A description of the process says: In re-charging a MVAC with a small container, the DIYer connects the charging hose assembly to the small can and the low-pressure service valve and shakes the can while charging the system until the can feels empty.” However, this was before the requirement of self-sealing cans.

We will be happy to discuss these possibilities further at your convenience.

Sincerely,



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