Attachment B

Updated Costs and Benefits Analysis

Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols-Propellants, and Foam End-Uses Regulation

I. Introduction

As described in the 15-day notices, the Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols-Propellants, and Foam End-Uses Regulation (Proposed Amendments) have been modified. Due to the proposed modifications made to the Proposed Amendments (Modified Proposed Amendments), the costs and benefits are lower than estimated for the Proposed Amendments in the October 2020 Staff Report: Initial Statement of Reasons (ISOR) developed for this rulemaking.

This summary has been prepared to provide an overview of the changes to the emissions benefits and direct costs expected due to the modifications made to the Proposed Amendments, particularly the costs expected from the R4 Program. Please note that this document does not contain updates made to the macroeconomic and fiscal impact analysis, which will be part of the final rulemaking record.

II. Modifications Affecting the Costs and Benefits Analysis

Pursuant to the Board direction on December 10, 2020 in Resolution 20-37, the California Air Resources Board (CARB) released 15-Day Notices in response to comments submitted by stakeholders. The benefits and economic impact analysis in this document was updated to incorporate the changes which are described below:

A. Changes in the Effective Dates for Air-Conditioning and Variable Refrigerant Flow Equipment

The Board directed staff to update the effective dates, reflecting the current status and anticipated timeline for California Building Code approvals for the new refrigerant technologies. A single effective date for the global warming potential (GWP) limit on air-conditioning (AC) equipment is no longer appropriate given the different status of building code and safety standards across the AC types; therefore, the amendments include three effective dates for the separate types of specific end-uses in the AC category. The new compliance dates and categories are as follows:

- For new AC equipment, excluding certain AC and heat pump equipment,[1] the 750 GWP limit requirements were extended from January 1, 2023, to January 1, 2025; and

[1] The January 1, 2023 effective date for less than 750 GWP remains the same for the following new AC and heat pump equipment: room/wall/window AC, packaged terminal air-conditioners (PTACs), packaged terminal heat pumps (PTHPs), portable AC, and residential dehumidifiers.

- For new variable refrigerant flow (VRF) systems, the 750 GWP limit requirements were extended from January 1, 2023, to January 1, 2026.

B. Refrigerant Recovery, Reclaim, and Reuse Requirements (R4 Program)

CARB provided stakeholder proposals for a refrigerant reclaim program in the 45-Day Notice. Considering the language in the 45-day Notice and comments, staff included the R4 program in its presentation at the Board Hearing, and subsequently provided a 15-Day Notice to allow public comment on the language. The proposed requirements establish a minimum amount of reclaimed refrigerant that manufacturers must use in new air conditioning equipment and servicing in existing air conditioning equipment in 2023 and 2024, and for VRF manufacturers, for years 2023, 2024, and 2025. Reporting and record-keeping requirements were also established for enforceability. Use of reclaimed refrigerants has direct greenhouse gas (GHG) reduction benefits because it necessitates refrigerant recovery from equipment in use or at end of life, thereby preventing refrigerants from getting emitted or leaked. Key aspects of the R4 program are as follows:

- Requirements for manufacturers of AC equipment subject to the January 1, 2025 compliance date to use a minimum of 10 percent of reclaimed refrigerant in new equipment entered into the California market or for servicing existing equipment in 2023 and 2024; and
- Requirements for manufacturers of VRF equipment subject to the January 1, 2026 compliance date to use a minimum of 15 percent of reclaimed refrigerant in new equipment entered into commerce in California or for servicing existing equipment in 2023 and 2024, and a minimum of 25 percent of reclaimed refrigerant in new equipment entered into commerce in California or for servicing existing equipment in 2025.

Note: Other changes which do not affect the costs and benefits analysis are not included in this document but are described in both 15-day Notices.

III. Updated Emissions Benefits

On average, the GHG emissions reduction and corresponding climate benefits are 13 percent lower than those expected from the original Proposed Amendments in the ISOR. Between 2022 and 2040, the annual average reduction in hydrofluorocarbon (HFC) emissions from the refrigeration and AC sectors from the Modified Proposed Amendments are estimated to be 3.3 $MMTCO_2e$ instead of 3.8 $MMTCO_2e$ expected from the original Proposed Amendments in the ISOR. Cumulatively through 2040, the Modified Proposed Amendments are expected to yield 62 $MMTCO_2e$ in GHG reductions, instead of 72 $MMTCO_2e$ expected from the original Proposed Amendments in the ISOR.

The reduction in emission benefits is related to changes in regulation for the AC sector. The expected emissions reductions from the refrigeration sector are the same as those described in the ISOR. For the AC sector, the modifications to the Proposed Amendments are expected to result in lower emissions reductions than those estimated in the ISOR. This is due to the delay in effective dates for transitioning most new AC equipment to lower-GWP refrigerants.

The emissions reductions expected from the R4 program are modest. However, the program establishes and jump-starts a reclaim program in California, which CARB can build upon in the future. In the long term, a robust recovery and reclamation program is expected to be an important tool in California's strategy towards achieving a low-emissions, low-carbon future.

The monetary benefits of GHG reductions can be estimated using the Social Cost of Carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future. The methodology for estimating social cost of carbon benefits is described in the ISOR. The total benefits range for the Modified Proposed Amendments range between $1.46 billion to $6.30 billion through 2040, depending on the discount rate. These are lower than the benefits estimated for the originally Proposed Amendments in the ISOR ($1.7 billion to $7.2 billion through 2040).

IV. Updated Costs

The direct costs for the Modified Proposed Amendments are estimated to be lower than those described in the ISOR. The Proposed Amendments would have required manufacturers to produce and sell all AC equipment that use a refrigerant with a GWP value less than 750 starting January 1, 2023. Under the Modified Proposed Amendments, the effective date for this 750 GWP limit will vary from 2023 to 2026, depending on the type of equipment. The baseline and incremental costs per unit for new AC equipment are the same as those discussed in the ISOR. However, since all new AC equipment will not be required to use lower-GWP refrigerants starting 2023, the statewide costs are expected to decrease compared to the originally estimated costs in the ISOR. Some additional costs are expected to be incurred from the R4 program.

Under the Modified Proposed Amendments, the average annual direct cost are expected to decrease from $201 million to $164 million for the AC end-use sector through 2040. There are no changes in the costs estimated for the refrigeration sector (annual average costs, $26 million). Due to the reduction in AC costs, the combined annual direct costs for AC and refrigeration are expected to decrease from $227 million to $190 million through 2040. The direct costs comprise costs related to equipment, installation, maintenance, refrigerant replenishment, electricity, retrofit of manufacturing facilities, and the additional costs due to the R4 program.

The additional costs estimated to occur due to the R4 program are described below.

A. Costs Associated with the R4 Program

The R4 Program requirements apply only to manufacturers of AC equipment with a regulation compliance date of January 1, 2025, and VRF manufacturers with a regulation compliance date of January 1, 2026. Although none of these manufacturing facilities are located in California, the added cost of the R4 Program is assumed to be passed on to customers in California.

The total cost of the R4 Program is estimated to be approximately $9.3 million from January 1, 2023 to July 1, 2026, at which time the R4 Program requirements are discontinued. Costs were estimated as follows:

The amount of certified reclaimed refrigerant requirement for all AC and VRF manufacturers is estimated to be between one and two million pounds of R-410A, for an average of 1.5 million pounds. The current cost of both new and reclaimed R-410A is approximately $3 per pound. Due to the R4 Program, there will be an increased demand of reclaimed R-410A, which will likely result in an increase in the cost of reclaimed R-410A. Based on historical prices of R-22 refrigerant, which was phased down in production from 2010 to 2020, the price of R-22 fluctuated dramatically from year to year, which makes it difficult to estimate the future cost of a refrigerant being phased-out. Based on data shared by refrigerant distributors, the greatest increase in the cost of R-22 was approximately three times greater than the baseline cost before the R-22 phasedown began.[2] Therefore, CARB staff applied this maximum added cost of refrigerant to a future supply of reclaimed R-410A, as an upper-bound estimate on the cost of the R4 Program. This is an upper bound because the increase in price of R-22 was a result of a national phaseout whereas the R4 program is a California-only program, and the supply of reclaimed R-410A is not limited to being sourced from California. Based on reclaimer-reported data to the U.S. Environmental Protection Agency (U.S.EPA), current annual supply of reclaimed R-410A would fulfill the demand expected by this regulation.

Using the upper-bound cost increase of three times greater than baseline cost, the cost of reclaimed R-410A would increase from $3 per pound to $9 per pound, for an added incremental cost of $6 per pound. CARB staff included all added cost of the R4 Program within the added incremental cost per pound, except for recordkeeping and reporting, which is independent of the number of pounds of reclaimed refrigerant used. Since the $6 per pound incremental cost estimate for reclaimed R-410A is based on distributor data provided for R-22, it is reasonable to assume that all costs upstream of the distributors (e.g., costs associated with reclaim, handling and transportation, storage etc.) are included in that incremental cost.

The cost of using reclaimed refrigerant for all original equipment manufacturers (OEMs) combined for the duration of the R4 Program is calculated as follows:

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[2] Heating, Air-conditioning and Refrigeration Distributors International (HARDI), *Historical R22 Sales and Margins Data Spreadsheet* (May 19, 2021).

- 1.5 million pounds reclaimed R-410A required for the R4 Program × $6 per pound added incremental cost = $9.0 million.

(i) Recordkeeping and Reporting Costs for the R4 Program

All AC and VRF manufacturers subject to a 750 GWP limit effective date of January 1, 2025 or later must meet the requirements of the R4 Program. Manufacturers with a compliance date of January 1, 2023 are not subject to the R4 Program and therefore not subject to the additional reporting and recordkeeping requirements, which include manufacturers of room/wall/window ACs, PTACs, PTHPs, residential dehumidifiers, and residential portable ACs.

CARB staff estimate that only 45 of 200 OEMs will be subject to the R4 Program for a period of four years, from 2023 through 2026. CARB staff estimate an initial 60 hours to set up the reporting and record-keeping structure of the R4 Program, and another 50 hours per year for reporting in 2023-2025 for AC manufacturers and in 2023-2026 for VRF manufacturers. The estimated hourly rate is $45.16 for an environmental engineer to keep records and submit reports.[3] The total cost for R4 Program reporting and record-keeping is $325,000 for all 45 OEMs affected. The reporting and recordkeeping *cost per affected OEM* is $1,805 per year for 2023 through 2026 only.

(ii) Total Costs for the R4 Program

Summary of total R4 Program Cost to AC and VRF equipment manufacturers:

- $9.00 million for added incremental cost of using reclaimed R-410A.
- $0.33 million for recordkeeping and reporting cost.
- Total Cost: $9.00 million + 0.33 million = $9.33 million.

Since the R4 program will be in effect in 2023 and 2024 for AC and VRF equipment, most of the costs expected for the R4 program is expected to be incurred in those two years. VRF manufacturers will be required to comply with the R4 requirements until 2026, so only a small portion of the R4 costs are expected to occur in that final year.

B. Updated Annual Incremental Costs for AC Equipment

On average, through 2040, the annual incremental costs under the Modified Proposed Amendments are expected to be $164 million, which is 18 percent lower than the costs estimated under the originally Proposed Amendments in the ISOR ($201 million). As the

[3] U.S. Bureau of Labor Statistics, *May 2019 National Occupational Employment and Wage Estimates United States*, (https://www.bls.gov/oes/current/oes_nat.htm#15-0000, Last accessed August 2020); U.S. Bureau of Labor Statistics, *Economic News Release, Table 4. Private industry workers by occupational and industry group*. (https://www.bls.gov/news.release/ecec.t04.htm, Last accessed August 2020).

table below shows, the costs associated with compliance with the 750 GWP limit are expected to be zero in 2023 and 2024. This is because the types of AC equipment that are expected to have an incremental cost for complying with the regulation will not be required to comply before 2025. In addition, the annual costs for the R4 program, which will affect AC manufacturers from 2023 to 2026, are also included in the table below.

Table 1. *Annual Incremental Costs for the Modified Proposed Amendments for New AC Systems (Millions 2018$)*

Year	Updated Costs for the 750 GWP Prohibition		R4 Program Costs	Total Costs
	Equipment and Installation Costs	Service and Maintenance Costs		
2022	$0	$0	$0	$0
2023	$0	$0	$4.6	$4.6
2024	$0	$0	$4.6	$4.6
2025	$18.1	$4.5	$0.1	$22.7
2026	$36.2	$9.1	$0	$45.3
2027	$54.4	$13.7	$0	$68.1
2028	$72.7	$18.3	$0	$91.0
2029	$91	$23	$0	$114
2030	$109	$28	$0	$137
2031	$128	$32	$0	$160
2032	$146	$37	$0	$183
2033	$165	$42	$0	$207
2034	$183	$47	$0	$230
2035	$202	$52	$0	$253
2036	$220	$56	$0	$277
2037	$239	$61	$0	$301
2038	$258	$66	$0	$324
2039	$277	$71	$0	$348
2040	$281	$73	$0	$354
Average Annual Incremental Cost (2022-2040)	**$131**	**$33**	**$3.1***	**$164**
Total Cost	**$2,480**	**$635**	**$9.3**	**$3,124**

*Annual Average costs for the R4 Program from 2023 to 2026.
For comparison with the originally Proposed Amendments, the table above can be compared with Table 31 in the ISOR.