

## **APPENDIX H – FURTHER DETAIL ON COST AND ECONOMIC ANALYSIS**

If California did not adopt its own Phase 2 regulation, manufacturers would still need to meet the federal Phase 2 standards to legally sell vehicles in the U.S. Hence, most of the costs and cost savings associated with Phase 2 in California are due to the federal Phase 2 GHG regulation, and would occur regardless of the proposed California Phase 2 GHG regulation. The proposed California Phase 2 GHG regulation would align with the federal Phase 2 GHG regulation with minor California differences and require manufacturers to certify their engines, vehicles, and trailers in CA. These minor California differences with respect to the federal regulation result in a small supplementary California compliance cost relative to the federal Phase 2 cost baseline. For owners of Phase 2 vehicles, Phase 2 costs will be offset over time by the fuel savings associated with Phase 2 technologies.

### **I. Costs of Proposed Requirements**

Staff estimated the proposed California Phase 2 GHG regulation costs using the federal Phase 2 costs as baseline (as mentioned above, in the absence of California Phase 2, manufacturers would still need to comply with federal Phase 2 regulation). The proposed California Phase 2 GHG regulation would regulate medium- and heavy-duty engines/vehicles/trailer manufacturers. The direct cost impacts on those affected manufacturers would be the sum of the following costs: (Note – All costs were updated to 2017 dollar values and rounded to the nearest \$1000)

- No “deemed to comply” provisions – Unlike the California Phase 1 GHG regulation, staff is not proposing to include “deemed to comply” provisions in the California Phase 2 GHG regulation. Manufacturers would be required to submit information directly to CARB to certify their engines, vehicles, and trailers with the California Phase 2 GHG regulation. The CARB would independently review the certification submissions before issuing an EO.
- Additional labeling requirements for tractors and vocational vehicles
- Detailed reporting of A/C system information to support A/C leakage standard
- Separate California credit tracking due to California differences in credit provisions mentioned in the next bullet
- California credit provision differences:
  - Extra emission credits to manufacturers for use of low-GWP refrigerants
  - Additional requirements for PHEVs to qualify for federal advanced technology multiplier credit

- Credit adjustment to meet primary vocational standards for transit buses certified to the federal custom chassis provisions (U.S. EPA, 2016) and produced for sale in California
- Consumer label requirements for Class 2b/3 pick-ups and vans

Table H-1 below summarizes annual direct costs to all affected manufacturers for each difference mentioned above from 2018 to 2028. A detailed discussion of the cost estimate for each listed difference is provided in subsections 1 through 5, following the table. Specifically, the first two cost components (no “deemed to comply” provisions and tractors and vocational vehicle labeling requirements) are described together in subsection 1. The costs for the rest of the California differences are described separately in subsections 2 through 5.

**Table H-1: Direct Costs to All Affected Manufacturers due to the Proposed California Phase 2 Regulation from 2018 to 2028 (2017\$)**

Calendar Year	Cost of No "Deemed to Comply" Provisions + Additions to Tractor & Vocational Vehicle Label (\$)				Cost of Detailed Reporting of A/C Systems (\$)	Cost of Separate California Credit Tracking (\$)	Cost of California Credit Provision Difference (\$)			Cost of Class 2b/3 Consumer Label (\$)	Total Cost (\$)
	Engine	Tractor and Vocational Vehicle	Trailer	Class 2b/3 Pick-ups and Vans			Low-GWP Refrigerant Credits	PHEV Credits	Transit Bus Custom Chassis Provisions		
2018	-	-	-	-	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	891,000	-	-	-	-	-	-	-	<b>891,000</b>
2021	88,000	2,129,000	891,000	30,000	73,000	1,000	2,772,000	431,000	4,000	298,000	<b>6,716,000</b>
2022	131,000	2,718,000	891,000	-	92,000	2,000	2,988,000	431,000	6,000	124,000	<b>7,382,000</b>
2023	131,000	2,718,000	891,000	-	69,000	2,000	3,248,000	431,000	6,000	124,000	<b>7,620,000</b>
2024	131,000	2,718,000	891,000	30,000	69,000	4,000	3,404,000	1,006,000	6,000	124,000	<b>8,382,000</b>
2025	131,000	2,718,000	891,000	-	69,000	5,000	854,000	1,006,000	6,000	124,000	<b>5,804,000</b>
2026	131,000	2,718,000	891,000	-	69,000	5,000	868,000	1,006,000	6,000	124,000	<b>5,818,000</b>
2027	131,000	2,718,000	915,000	-	69,000	6,000	882,000	1,581,000	6,000	124,000	<b>6,432,000</b>
2028	131,000	2,718,000	915,000	-	69,000	6,000	897,000	1,581,000	6,000	124,000	<b>6,448,000</b>
<b>Total Cost over 11 Years (\$)</b>	<b>1,007,000</b>	<b>21,156,000</b>	<b>8,067,000</b>	<b>59,000</b>	<b>576,000</b>	<b>31,000</b>	<b>15,913,000</b>	<b>7,475,000</b>	<b>43,000</b>	<b>1,167,000</b>	<b>55,494,000</b>

Most of the affected manufacturers are located outside of CA, so the vast majority of the direct costs on all affected manufacturers listed in Table H-1 occur outside the state. Those direct costs are assumed to be passed on to California heavy-duty vehicle fleets who purchase the California Phase 2-certified vehicles and trailers, including local and state government fleets. Table H-2 summarizes the proposed California Phase 2 GHG regulation costs to private California heavy-duty vehicle fleets from 2018 to 2028 (excluding costs on local and state government fleets, which are discussed separately, following the table).

**Table H-2: Total Statewide Dollar Costs to Private California Businesses to Comply with the Proposed California Phase 2 Regulation (Excluding Cost Impacts on Local and State Government) (2017\$)**

Calendar Year	Total Compliance Costs for Private California Businesses (\$)
2018	-
2019	-
2020	780,000
2021	5,874,000
2022	6,455,000
2023	6,663,000
2024	7,330,000
2025	5,074,000
2026	5,085,000
2027	5,623,000
2028	5,637,000
<b>Total Cost over 11 Years (\$)</b>	<b>48,520,000</b>

The costs to local and state government fleets that are excluded from Table H-2 include the following:

- Costs associated with the proposed California Phase 2 transit bus custom chassis provisions since these cost impacts would be passed on to transit bus consumers, which are local transit agencies; and
- 12.5 percent of the rest of the listed cost components (excluding transit bus cost component) since the local and state government heavy-duty vehicle population is estimated at approximately 9.4 and 3.1 percent, respectively (using CARB's EMFAC data)

Costs to state and local governments are considered fiscal impacts on local and state government, and are discussed further in this Appendix, in the section *Fiscal Impact to Local and State Agencies*

1. Cost of No “Deemed to Comply” Provisions, and Tractor and Vocational Vehicles’ Labeling Requirement

Manufacturers are deemed to comply with CA’s Phase 1 GHG regulation requirements if they comply with the federal Phase 1 GHG regulation. CARB issues a California EO contingent on U.S. EPA’s Phase 1 approval (certificate of conformity). Hence, CARB certification staff relies on U.S. EPA’s review of all Phase 1 certification data and does not generally do an independent review of that data. For the California Phase 2 GHG regulation, staff is not proposing to include “deemed to comply” provisions. Manufacturers would be required to submit information directly to CARB to certify their engines, vehicles, and trailers. CARB would independently review the certification submissions before issuing an EO. This would provide CARB the ability to verify compliance separately from U.S. EPA. The exclusion of “deemed to comply” provisions would lead to additional reporting costs relative to the federal Phase 2 GHG baseline for manufacturers.

In the federal Phase 1 GHG regulation, tractor and vocational vehicle manufacturers are required to have emission control identifiers listed on vehicle labels. In the federal Phase 2 GHG regulation, however, emission control identifiers on vehicle labels are now optional for tractors and vocational vehicles due to the larger number of potential GHG technologies to be listed on the vehicle labels. Listing emission control identifiers on vehicle labeling would still be required for tractors and vocational vehicles in the proposed California Phase 2 GHG regulation. This would lead to additional California compliance costs relative to the federal Phase 2 baseline for tractor and vocational vehicle manufacturers.

The increased reporting and labeling costs are detailed in the following subsections (the increased labeling cost would only apply to tractor and vocational vehicle manufacturers).

a. Engine:

Staff estimated engine reporting costs using U.S. EPA and NHTSA’s respondent burden and cost estimate (federal Phase 2 Supporting Statement for Information Collection

Request (ICR)) (U.S. EPA, 2016a). The engine reporting costs due to the proposed California Phase 2 regulation relative to the federal Phase 2 baseline would be the costs on manufacturers to do the following: prepare and submit certification and “carry-over” applications<sup>1</sup> and update the end-of-year production report for each engine certification application submitted to CARB. Using the federal ICR’s data, staff estimated the annual CA Phase 2 engine reporting cost of \$1,251 per certification application (2017\$).

Based on California Phase 1 certification records, there were approximately 70 engine certification applications per engine MY submitted to CARB. These 70 applications were all from large businesses, as small businesses are not subject to Phase 1 requirements. For California Phase 2 certification, staff expects no significant change in the number of large business engine certifications compared to Phase 1, thus staff estimated there would be the same number of 70 engine certification applications submitted to CARB annually from large businesses.

Small businesses will be subject to federal Phase 2 requirements starting in 2022. For the federal Phase 2 regulation, U.S. EPA and NHTSA estimated there are approximately 12 large engine manufacturers and six small engine manufacturers, resulting in a ratio of 2:1 between numbers of large businesses and small businesses. Staff applied this same ratio to estimate the number of applications from small businesses in CA. With that assumption, there would be approximately 35 applications submitted to CARB coming from small businesses under the proposed regulation.

Thus, given the one-year delay in federal Phase 2 compliance for small businesses, there would be a total of 70 engine applications submitted to CARB for review in 2021, solely from large businesses, and an estimated 105 engine applications (include both large and small businesses) submitted to CARB for review in 2022 and beyond. As a result, the total annual engine certification reporting cost was estimated at \$88,000 (\$1,251/application x 70 applications) in 2021 and \$131,000 (\$1,251/application x 105 applications) annually thereafter (calculated annual and total costs were rounded to nearest \$1,000).<sup>2</sup>

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<sup>1</sup> “Carry-over” applications are required when manufacturers want to carry over the emission credits generated in current certified model year into future model years.

<sup>2</sup> Annual engine certification cost = (reporting cost per engine application) x (number of engine applications)

b. Tractor and Vocational Vehicle:

The vehicle reporting and labeling costs due to the proposed California Phase 2 regulation relative to the federal Phase 2 baseline would be the costs on manufacturers to do the following: prepare and submit certification and “carry-over” applications, comply with labeling requirements, and complete end-of-year production reports and ABT emissions credit reports for each vehicle certification application submitted to CARB. Staff estimated tractor and vocational vehicle certification reporting and labeling costs using U.S. EPA and NHTSA’s respondent burden and cost estimate (federal Phase 2 Supporting Statement for ICR) (U.S. EPA, 2016a). Using the federal ICR’s data, staff estimated the annual CA Phase 2 reporting and labeling costs of \$13,080 per vocational vehicle certification application and \$38,836 per tractor certification application (2017\$). (For vehicle certification application cost estimates, staff doubled the ICR’s cost estimates for certification and “carry-over” application preparation and submissions due to the additional Phase 2 GEM inputs required for certifying tractor and vocational vehicles).

Based on California Phase 1 certification records, there were approximately 39 tractor and 47 vocational vehicle applications per vehicle MY from large businesses submitted to CARB. For California Phase 2 certification, staff expects no significant change in manufacturers’ vehicle product line from Phase 1, thus staff estimated there would be the same number submitted to CARB annually from large businesses for Phase 2 certification (86 total). For the number of small business application estimates, staff used the same methodology discussed in the engine certification cost estimate above. There would be approximately 45 vocational vehicle applications submitted to CARB from small businesses. Currently, there are no small business tractor manufacturers, thus staff assumed there would be no tractor application from small businesses. Given the one-year delay in federal Phase 2 compliance for small businesses, there would be a total of 86 large business vehicle applications submitted to CARB for review in 2021 and an estimated 131 vehicle applications submitted to CARB for review in 2022 and beyond (including both large and small businesses). As a result, the total annual vehicle certification reporting and labeling cost was estimated at \$2,129,000 ( $\$13,080/\text{vocational application} \times 47 \text{ vocational applications} + \$38,836/\text{tractor application} \times 39 \text{ tractor applications}$ ) in 2021 and \$2,718,000 ( $\$13,080/\text{vocational application} \times 92 \text{ vocational applications} + \$38,836/\text{tractor application} \times 39 \text{ tractor}$

applications) in the subsequent years (calculated annual and total costs were rounded to nearest \$1,000).<sup>3</sup>

c. Trailer Certification:

Staff estimated the trailer certification reporting cost using U.S. EPA and NHTSA's respondent burden and cost estimate (federal Phase 2 Supporting Statement for ICR) (U.S. EPA, 2016a). Staff assumed trailer manufacturers would incur California Phase 2 trailer certification costs that would be similar to those costs associated with certifying trailers federally. The trailer reporting costs due to the proposed California Phase 2 regulation relative to the federal Phase 2 baseline would be the costs on manufacturers to do the following: prepare and submit certification applications, complete end-of-year production reports, and keep records. For box-van trailer manufacturers in 2027 MY and later, trailer reporting costs would also include the cost to submit the averaging emissions credit report for each trailer certification application. The ICR report provided separate cost estimates for large and small businesses and estimated that 25 large businesses and 75 small businesses would certify trailers in 2018. Staff assumed the same number of manufacturers would also certify each year in CA. Using the federal ICR's data, the annual California Phase 2 trailer certification reporting costs for all businesses were estimated to range from \$891,000 (2017\$) for years 2020 through 2026, and increase to \$915,000 (2017\$) for 2027 and beyond (calculated annual costs were rounded to nearest \$1,000). Tables H-3 and H-4 provide a breakdown of the California trailer certification cost estimates.

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<sup>3</sup> Annual tractor and vocational vehicle reporting and labeling cost = [(reporting and labeling cost per vocational application) x (number of vocational applications)] + [(reporting and labeling cost per tractor application) x (number of tractor applications)]



**Table H-3: Estimated Annual Total Cost to All Trailer Manufacturers for California Trailer Certification (2020 through 2026) (2017\$)**

	Annual dollars/year (\$)
<i>Large businesses</i> (Estimated number of businesses: 25)	
Prepare and submit certification applications	169,788
End-of-year report	54,816
Store, file, maintain	52,719
<i>Small Businesses</i> (Estimated number of businesses: 75)	
Prepare and submit certification applications	291,064
End-of-year report	164,447
Store, file, maintain	158,156
<b>Total</b>	<b>\$891,000</b>

**Table H-4: Estimated Annual Total Cost to All Trailer Manufacturers for California Trailer Certification (2027 and beyond) (2017\$)**

	Annual dollars/year (\$)
<i>Large businesses</i> (Estimated number of businesses: 25)	
Prepare and submit certification applications	169,788
End-of-year report	54,816
Store, file, maintain	52,719
Averaging, Emission credit reporting	14,900
<i>Small Businesses</i> (Estimated number of businesses: 75)	
Prepare and submit certification applications	291,064
End-of-year report	164,447
Store, file, maintain	158,156
Averaging, Emission credit reporting	9,313
<b>Total</b>	<b>\$915,000</b>

d. Class 2b/3 Pick-ups and Vans Certification:

For Class 2b/3 pick-ups and vans, staff estimates that based on seven engine families per major Class 2b/3 manufacturer and a total of approximately six major manufacturers, an estimated 42 Class 2b/3 engine families would be affected. Reporting costs were estimated to be \$1,411 (2017\$) per engine family redesign submission based on previous CARB cost analyses (CARB, 2013a). Staff assumed one redesign in 2021 and one redesign in 2024 (redesigns would occur at different periods for different manufacturers but are estimated to occur in two main batches in 2021 and 2024). Based on this, the annual reporting cost would be \$30,000<sup>4</sup> and would be borne in two years; 2021 and 2024 (calculated annual and total costs were rounded to nearest \$1,000).

2. Detailed A/C System Information Reporting Requirements

Staff is proposing to require manufacturers to report the following detailed A/C system information as part of A/C leakage standard certification: cover letter with summary table, A/C system schematics to show the topological layout of the system components, and Society of Automotive Engineers (SAE) J2727 spreadsheets that show the calculation of the A/C leak rates. The cover letter with summary table is similar to what manufacturers will be submitting to U.S. EPA under the federal Phase 2 rule. The federal Phase 2 rule requires manufacturers to evaluate the leak rate pursuant to SAE J2727 procedures, but not submit the actual spreadsheets. Therefore, the California Phase 2 proposal will impose additional costs on manufacturers to generate and submit the A/C system schematics, as well as the SAE J2727 spreadsheets.

EMA estimated that under an earlier version of our proposal, there would be 13 schematics and 87 SAE J2727 spreadsheets per EMA member company. To address some manufacturers' concerns about the certification workload, and based on stakeholder input, staff revised the proposal to somewhat relax the constraints on how a "worst-case" scenario A/C configuration may be selected to represent a group of configurations, and to exempt of low-volume A/C platforms from the detailed A/C system information requirements. An examination using one manufacturer's Phase 1 A/C leakage standard certification package suggests that the revisions could potentially reduce the necessary number of SAE J2727 spreadsheets by 78 percent, from 87 to 19 for an average manufacturer.

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<sup>4</sup> [(\$1,411/engine family) x (42 engine families)]/(2 redesign cycles) ~ \$30,000

Staff estimates that generating each schematic for the first applicable MY of California's Phase 2 rule would take an A/C engineer two hours, including the time for surveying all A/C configurations to assess the representative schematics, drawings, and/or graphical work. Therefore, generating the 13 schematics for the first year of compliance would take an A/C engineer 26 hours. Staff estimates that the time needed in subsequent years would be reduced by approximately half because A/C system platforms are usually carried over for several consecutive model years, and the basic topological layouts rarely change. Therefore, generating the schematics for any subsequent year is expected to take 13 hours.

According to input from PACCAR staff, the submission of each SAE J2727 spreadsheet would take about five minutes. For the purpose of this analysis, staff assumed that the submission of each system schematic takes the same amount of time. Thus, altogether, submitting the 13 schematics and the 19 SAE J2727 spreadsheets would take about three hours.

Hourly labor rates are estimated at \$44.33/hour (2016\$) (U.S. BLS, 2016) and multiplied by a factor of 2.1 (U.S. EPA, 2016a) to account for benefits and overhead. This gives an estimated hourly rate of \$93.11/hour in 2017 dollars. There are 27 large manufacturers that produce heavy-duty pickup trucks and vans, vocational vehicles, and tractors, and there are 19 small manufacturers that produce vocational vehicles. The implementation of the detailed A/C system information requirements for the small manufacturers will start with MY 2022, the second MY of the California Phase 2 regulation. For purposes of this analysis, staff assumed that each manufacturer, large or small, on average, would have the same number of system schematics (13) and SAE J2727 spreadsheets (19) as the large manufacturers.

Taking the above data estimates and assumptions into consideration, the following Table H-5 shows the annual industry costs to comply with these detailed A/C system information requirements.

**Table H-5: Projected Total Annual California Compliance Cost for Detailed A/C System Information Requirements for All Manufacturers (2017\$)**

<b>Calendar Year</b>	<b>Annual Cost (\$)</b>
2021	73,000
2022	92,000
2023	69,000
2024	69,000
2025	69,000
2026	69,000
2027	69,000
2028	69,000
<b>Total Cost from 2021 to 2028 (\$)</b>	<b>576,000</b>

### 3. Separate California Credit Tracking

CARB staff is proposing three differences that could affect manufacturers' Phase 2 compliance and credit reports (extra credit for low-GWP refrigerants, absence of transit bus custom chassis standards in CA, and additional requirements for PHEV credit multipliers -- subsection 4., below, provides more details on these California differences). Manufacturers that are affected by one or more of these California differences would be required to submit a CA-specific credit tracking spreadsheet to track compliance with the California differences. There would be a cost incurred to manufacturers, as compared to the federal Phase 2 baseline, due to this separate credit tracking effort.

The increased cost includes labor costs for a mechanical engineer's time to work on tracking the credits among vehicle families. Staff anticipates no additional system set-up costs to track these credits as they can be tracked via a simple Excel spreadsheet. Staff has previously provided, and thoroughly discussed, this tracking scheme with manufacturers.<sup>5</sup> Staff estimated it would take about an hour to track credit for each affected engine/vehicle family. Table H-6 summarizes total annual California compliance costs due to the CA-specific credit tracking for 2021 to 2028 calendar years (2017\$) (calculated costs were rounded to nearest \$1,000). Staff estimates one to 32 vehicle families would be equipped with low-GWP refrigerate systems in a given year. For the transit bus custom chassis difference, staff estimated two vehicle families would be affected in 2021 and three vehicle families would be affected in subsequent years.

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<sup>5</sup> See attached handout of the California Phase 2 Workshop on August 31, 2017.  
[https://www.arb.ca.gov/msprog/onroad/caphase2ghg/20170831\\_ca\\_proposed\\_credit\\_tracking\\_spreadsheet.pdf](https://www.arb.ca.gov/msprog/onroad/caphase2ghg/20170831_ca_proposed_credit_tracking_spreadsheet.pdf)

For PHEVs, staff estimates five to 30 vehicle families would be affected depending on the year being considered (assuming an increasing number of PHEV vehicle families over time). Staff uses the same \$93.11/hour (2017\$) labor rate as described previously.

**Table H-6: Total Annual California Compliance Cost for Separate Credit Tracking for All Manufacturers (2017\$)**

<b>Calendar Year</b>	<b>Annual Cost (\$)</b>
2021	<b>1,000</b>
2022	<b>2,000</b>
2023	<b>2,000</b>
2024	<b>4,000</b>
2025	<b>5,000</b>
2026	<b>5,000</b>
2027	<b>6,000</b>
2028	<b>6,000</b>
<b>Total Cost from 2021 to 2028 (\$)</b>	<b>31,000</b>

4. California Credit Provision Differences

a. Low -GWP Refrigerant Credits:

Staff is proposing an optional provision to provide additional credits to incentivize manufacturers to develop and implement A/C refrigerants that have low-GWPs. “Low-GWP” in this context refers to global warming potential equal to or less than 150, evaluated on a 100-year timeframe. Currently, the most common vehicle A/C refrigerant, hydrofluorocarbon-134a (HFC-134a, 1,1,1,2-tetrafluoroethane), has a 100-year GWP of 1,300. Manufacturers who wish to take advantage of these credits would need to make a capital investment to update their assembly facility in order to use an alternative refrigerant and also account for any price difference for each low-GWP refrigerant A/C system that they produce. The cost of the low-GWP provision is based on the cost information for hydrofluoroolefin-1234yf (HFO-1234yf, 2,3,3,3-tetrafluoropropene, GWP<1). This is the only low-GWP refrigerant currently being used in the light-duty vehicle fleet in the U.S. market, and appears to be the leading low-GWP refrigerant candidate for the medium- and heavy-duty vehicle fleet. It should be noted that a different low-GWP alternative would incur different costs.

Based on input from General Motors during CARB’s Low-Emission Vehicles (LEV III) rulemaking for the light-duty fleet, staff estimates the cost to update an assembly facility to use HFO-1234yf would be approximately \$2.77 million (2017\$).

A/C systems using HFO-1234yf differ little from conventional systems using HFC-134a. The main difference is the addition of an internal heat exchanger. Staff has estimated that the incremental hardware cost would be \$17.60 (2017\$) (CARB, 2011a). In addition, it is estimated that the bulk price of HFO-1234yf for vehicle manufacturers would be \$75-80 per kilogram (/kg) compared to \$6-8 per kg for HFC-134a or \$70.50 per kg more on average (2017\$) (Sherry et al., 2017). The average A/C refrigerant capacity of on-road heavy-duty vehicles is estimated to be 1.36 kg (Baker & Burnette, 2010). There are anticipated to be additional costs for production, corporate operation, and selling the low-GWP system which are estimated to add 20 percent to the total cost based on the LEV III rulemaking (CARB, 2011a). Therefore, each HFO-1234yf A/C system would cost \$136 (\$2017) more than a HFC-134a system.

The cost for using low-GWP refrigerants consists of the cost for a one-time assembly facility update (\$2,772,000 per manufacturer) plus the incremental hardware and refrigerant cost to use low-GWP refrigerants (\$136 per unit). Because this provision is optional, manufacturers would only choose to participate if it is in their best financial interest. Staff assumed four heavy heavy-duty tractor manufacturers would participate in the low-GWP credit program to earn California extra emission credits that they could use for compliance with other proposed California Phase 2 provisions and to avoid additional A/C reporting required under the proposed California Phase 2. Staff assumed one manufacturer would update its assembly facility each year in 2021 through 2024. Once each manufacturer's assembly facility is updated, that manufacturer would change its new vehicle fleet to use a low-GWP refrigerant the following year. The new vehicle fleet population was estimated based on CARB's emission inventory model, EMFAC2014 (CARB, 2017a). The annual estimated compliance costs are summarized in Table H-7 (calculated annual and total costs were rounded to nearest \$1,000).

**Table H-7: Projected Total Annual California Compliance Cost for Using Low-GWP Refrigerants for All Manufacturers (2017\$)**

<b>Calendar Year</b>	<b>New Heavy Heavy-Duty Tractor Population (from EMFAC2014)</b>	<b>Annual Cost (2017\$)</b>
2021	6,169	2,772,000
2022	6,357	2,988,000
2023	7,006	3,248,000
2024	6,200	3,404,000
2025	6,288	854,000
2026	6,386	868,000
2027	6,491	882,000
2028	6,605	897,000
<b>Total Cost from 2021 to 2028 (\$)</b>		<b>15,913,000</b>

It should also be noted, again, that the use of low-GWP refrigerants is optional, so manufacturers may choose not to incur these costs.

b. PHEV Credits:

In the federal Phase 2 GHG regulation, U.S. EPA and NHTSA allow an ATC multiplier of 3.5 for PHEVs, 4.5 for electric vehicles, and 5.5 for fuel cell vehicles. The federal ATC multiplier provision (40 CFR 1037.150(p)) applies to MY 2027 and earlier vehicles. CARB staff is proposing additional requirements for PHEVs in order for manufacturers to receive the PHEV's ATC multiplier of 3.5 in CA. Manufacturers would have to demonstrate that their PHEVs do not have higher NOx emissions compared to a similar conventional vehicle and are capable of meeting a minimum drive distance of AER in order to qualify for the ATC multiplier of 3.5. These additional requirements are consistent with CARB's requirements for PHEV funding under its HVIP [protocol](#) (CA HVIP, 2017). There would be an increased California compliance cost due to additional demonstration testing as compared to the federal Phase 2 requirement.

Staff estimated a demonstration testing cost of \$57,502 (2017\$) per engine family (CARB, 2016b). Staff assumed five to 10 manufacturers (one engine family per model year per manufacturer) would perform demonstration testing on their PHEVs per the proposed ATC multiplier provision in the early years, 2021-2023. As PHEV technology develops and becomes more mature, staff anticipates that reduced costs and increased

demands for PHEVs would result in more manufacturers offering these vehicles. Hence, staff assumes that the number of manufacturers offering PHEVs for sales in California would increase to 15-20 in 2024-2026, and 25-30 in 2027-2028, with the upper range based on the number of manufacturers having a presence in the hybrid market. Table H-8, below, lists the estimated average demonstration testing cost from 2021 to 2028(2017\$).<sup>6</sup>

**Table H-8: Estimated Average Demonstration Testing Costs for PHEV’s ATC Multiplier (Total Cost for All Manufacturers) (2017\$)**

<b>Calendar Year</b>	<b>Annual Cost (\$)</b>
2021	431,000
2022	431,000
2023	431,000
2024	1,006,000
2025	1,006,000
2026	1,006,000
2027	1,581,000
2028	1,581,000
<b>Total Cost from 2021 to 2028 (\$)</b>	<b>7,475,000</b>

c. Transit Bus Custom Chassis Provisions:

In the federal Phase 2 GHG regulation, custom chassis manufacturers of motor homes, coach buses, transit buses, school buses, refuse trucks, cement mixers, and emergency vehicles have an option to certify those vehicles to less stringent standards than the primary vocational standards through a simplified GEM process (U.S. EPA, 2016). For the California Phase 2 rule, transit bus manufacturers would still have the option of California certifying their vehicles to the custom chassis standards using simplified GEM. However, if they do, they would also be required to perform emission modelling using full-GEM to determine the family emission level of these vehicles, and demonstrate how these vehicles would comply with the primary vocational standards. The manufacturer would then be required to retire any emission credits that were used to demonstrate compliance. There would be additional California compliance costs due to a more complex certification pathway through full GEM for California transit buses as compared to the federal Phase 2 requirement. As discussed earlier, these cost impacts on Phase 2 transit bus manufacturers would be passed on to transit bus “customers”,

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<sup>6</sup> The estimated testing cost were calculated using the following equation: Annual Cost (\$) = (number of emission test per year for all manufacturers) x (cost per emission test)



which are local transit agencies. Therefore, these costs are considered local government costs in the Fiscal Impact Statement section of this document.

Transit bus manufacturers have several options for meeting the proposed California Phase 2 regulation requirements (which do not allow use of the federal custom chassis provisions). First, transit bus manufacturers could meet the proposed California Phase 2 regulation through hybridization or electrification, both of which have been well commercialized in the transit bus sector. Second, since Phase 2 includes advanced technology credit multipliers of 4.5, and 5.5 for all-electric vehicles and fuel cell vehicles, respectively (U.S. EPA, 2016), manufacturers could produce a small portion of advanced zero emission transit buses and take advantage of the advanced technology credits to compensate for other transit buses that are certified with the federal Phase 2 custom chassis provisions. Battery electric technology has been widely commercialized in the transit bus sector and encouraged by federal, state, and local incentive funding in many areas of CA. Fuel cell electric buses are being demonstrated with some in the early commercialization stage (CARB, 2015; CARB, 2015a). Nearly all transit bus manufacturers are offering fuel cell and battery electric transit buses (CARB 2016c), and there are currently more than 100 fuel cell and battery electric buses in operation with more than 300 fuel cell and battery electric buses on order in California (CARB, 2017). With the advanced multiplier of 4.5 for battery electric vehicles, staff estimated that manufacturers would only need to produce up to two percent of their total California transit bus production with battery electric buses (equivalent to four to 16 battery transit buses per year statewide) to have enough credits to compensate for the rest of the California transit bus fleet only meeting the custom chassis stringency. Staff expects transit bus manufacturers would meet the proposed California Phase 2 transit bus standards without any additional capital investment in vehicle technology by utilizing Phase 2 advanced technology credits for fuel cell and battery electric vehicles. As a result, the proposed California Phase 2 transit bus custom chassis provisions would not impose any additional technology cost on transit bus manufacturers.

The proposed California Phase 2 transit bus custom chassis provisions would impose some additional reporting costs. There would be increased reporting costs due to the full-GEM run for these California custom chassis transit buses due to additional GEM-input requirements. Staff estimated the increased reporting cost using U.S. EPA and NHTSA's respondent burden and cost estimate (U.S. EPA, 2016a). U.S. EPA and NHTSA estimated the annual data collection and GEM run cost for the vocational program of \$1,854 per application (2017\$) (U.S. EPA, 2016a). Currently, the national transit bus market is dominated by three transit bus manufacturers (CARB, 2016c). Since one of the major bus manufacturers is a small business, that one bus

manufacturer would not be affected by the California Phase 2 GHG regulation until 2022 (one-year compliance delay for small businesses). Therefore, staff expects there would be two transit bus manufacturers affected by this California difference in 2021 and three transit bus manufacturers affected in subsequent years. As a result, staff computed an annual increased reporting cost of \$4,000 in 2021 and \$6,000 in subsequent years in total for all affected manufacturers (2017\$).<sup>7</sup>

#### 5. Consumer label requirements for Class 2b/3 pick-ups and vans

Consumer window labels are paper information sheets in the windows of new vehicles for sale at dealerships. Staff is proposing to require consumer window labels for new Class 2b/3 pickups and vans sold in California with gross vehicle weight ratings of 8,501 to 14,000 pounds beginning with MY 2021. The new labels would help consumers compare vehicle choices based on the provided GHG and smog ratings and potentially choose lower-emitting vehicles.

The cost of the proposed consumer labels includes labor to develop the labels and materials to print the labels. Six manufacturers are anticipated to be affected. Since these manufacturers also produce light-duty trucks and passenger cars and already are required to produce consumer window labels for their light-duty vehicles, staff assumed no new printers were needed. To estimate labor cost, staff used Bureau of Labor Statistics' wage estimates for a full-time mechanical engineering occupation of \$92,209 per year (2017\$) (U.S. BLS, 2016). This rate was increased by a factor of 2.1 to account for benefits and overhead, resulting in a full-time mechanical engineer's salary and benefits of \$193,639 per year (2017\$). Staff estimated it would take about a quarter of an engineer's work time to comply with these proposed label requirements in the first year and about 10 percent of his/her work time to comply in succeeding years. Staff used CARB's EMFAC2014 web database (CARB, 2017a) and CARB's certification data to estimate the number of affected Class 2b/3 vehicles. Staff estimated the total cost of label stock and printing to be approximately \$7,650-\$8,250 per year (2017\$) from 2021 to 2028 (Label, 2017; CARB, 2007). Staff did not take into account the printer cost as most of these affected manufacturers could use the same printers that are used for the current light-duty label requirement. The actual cost for each manufacturer would depend on the vehicle production volumes per model year. Table H-9 below summarizes manufacturers' annual cost to comply with the consumer label requirement from 2021 to 2018 (2017\$).

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<sup>7</sup> Annual reporting cost = (reporting cost per transit bus application) x (number of transit bus applications)

**Table H-9: Total Estimated Annual California Compliance Cost for Consumer Label Provision for Major Manufacturers (2017\$)**

Calendar Year	Annual Cost (\$)
2021	298,000
2022	124,000
2023	124,000
2024	124,000
2025	124,000
2026	124,000
2027	124,000
2028	124,000
<b>Total Cost from 2021 to 2028 (\$)</b>	<b>1,167,000</b>

## II. Affected Businesses

Medium- and heavy-duty engine/vehicle/trailer manufacturers would be the regulated entities under the proposed California Phase 2 regulation. Since most of the affected manufacturers are located outside of CA, staff assumed the direct costs imposed on these manufacturers would be passed on to heavy-duty vehicle fleets who purchase the California Phase 2-certified vehicles and trailers. Therefore, businesses impacted by the proposed California Phase 2 regulation would also include the California heavy-duty vehicle fleets in addition to the regulated manufacturers. Staff estimated the number of impacted manufacturers using U.S. EPA and NHTSA's estimate (U.S. EPA, 2016a; U.S. EPA, 2016). Staff estimated the number of impacted California vehicle fleets using California DMV 2015 registration data and CARB's emission inventory model, EMFAC2014 (CARB, 2017a). There would be approximately 158,079 businesses impacted by the proposed California Phase 2 regulation; Table H-10 breaks down the number of small and large businesses affected by the proposed California Phase 2 regulation.

**Table H-10: Number of Businesses Impacted by California Phase 2, Including Directly Impacted Manufacturers and Indirectly Impacted California Fleets (U.S. EPA, 2016a; U.S. EPA, 2016)**

<b>Category</b>	<b>Industry NAICS Code</b>	<b>Number of Large Businesses</b>	<b>Number of Small Businesses</b>	<b>Total</b>
<i>Impacted Medium- and Heavy-Duty Manufacturers</i>				
Engine	3363	12	6	18
Class 2b/3 Pickups and Vans	3361	3	0	3
Vocational	3361	20	19	39
Tractor	3361	4	0	4
Trailer	3362	25	75	100
<i>Total</i>		<i>64</i>	<i>100</i>	<i>164</i>
<i>Impacted California Heavy-Duty Vehicle Fleets</i>				
California Heavy-Duty Vehicle Fleets <sup>8</sup>	484	20,529	137,386	157,915
<i>Total</i>		<i>20,529</i>	<i>137,386</i>	<i>157,915</i>
<b>Total Impacted Businesses</b>		<b>20,593</b>	<b>137,486</b>	<b>158,079</b>

As shown in Table H-10, the total number of impacted manufacturers was estimated at 164, among which there are 100 small businesses<sup>9</sup> (~61 percent). The total number of impacted fleets was estimated at 157,915, among which there are 137,386 small businesses<sup>10</sup> (~87 percent).

<sup>8</sup> When estimating the number of California heavy-duty fleets that would face slightly higher vehicle costs due to California Phase 2, staff quantified the number of California heavy-duty fleets that purchase Class 4 to 8 vehicles. Although Phase 2 applies to Class 2b/3 vehicles as well, staff believes it is appropriate to exclude fleets of Class 2b/3 vehicles, because the additional California Phase 2 cost for such vehicles is very low compared to other higher class vehicles (approximately \$22 per Class 2b/3 vehicle vs. \$231 per Class 4-8 vehicle). Including Class 2b/3 fleets would inappropriately overestimate the number of California businesses impacted and underestimate the cost impact per typical business. Because 2b/3 fleets were excluded, the per business cost estimates represent a conservative (high) estimate of cost per heavy-duty fleet.

<sup>9</sup> Use federal “small business” definition. “Small business” is defined in 40 CFR 1068.30 – Definitions. See also 40 CFR 1037.150 (c) – Interim Provisions and Table XIV-2 of the federal Phase 2 Greenhouse Gas Rules.

<sup>10</sup> Vehicle fleet of 3 vehicles or less is defined as small business

### III. Costs per Affected Business

As discussed above, staff assumed the increased cost on regulated manufacturers due to the proposed California Phase 2 GHG regulation to be passed on to California heavy-duty vehicle fleets who purchase the California Phase 2-certified vehicles and trailers, thus costs per impacted business were estimated based on costs per California heavy-duty vehicle fleet.<sup>11</sup> For the average annual cost per impacted small business, staff divided the annual statewide costs on private businesses by the number of impacted private California heavy-duty vehicle fleets (the economic impact on a small business and a typical business was assumed to be the same). Table H-11 summarizes average annual cost per impacted private business from 2018 (initial cost) to 2028. The initial costs for an impacted business in 2018 are zero, and the average annual ongoing costs for an impacted private business range from zero to \$53.05 within the considered regulation's lifetime of 11 years.

**Table H-11: Average Annual Compliance Cost per Impacted Business from 2018 to 2028 (2017\$)**

Calendar Year	Annual Statewide Costs on Private California Businesses (\$)	Number of Private Businesses <sup>12</sup>	Annual Statewide Costs per Private Business (\$/business)
2018	-	-	-
2019	-	-	-
2020	780,000	138,176	<b>5.64</b>
2021	5,874,000	138,176	<b>42.51</b>
2022	6,455,000	138,176	<b>46.71</b>
2023	6,663,000	138,176	<b>48.22</b>
2024	7,330,000	138,176	<b>53.05</b>
2025	5,074,000	138,176	<b>36.72</b>
2026	5,085,000	138,176	<b>36.80</b>
2027	5,623,000	138,176	<b>40.70</b>
2028	5,637,000	138,176	<b>40.79</b>

<sup>11</sup> Again, since 2b/3 fleets were excluded, the per business cost estimates here represent a conservative (high) estimate of cost per heavy-duty fleet.

<sup>12</sup> Staff estimated 12.5% of California heavy-duty vehicle fleets to be local and state government fleets (using EMFAC data), thus number of private California heavy-duty vehicle fleets = 157,915 x (100%-12.5%) = 138,176 fleets

#### **IV. Fiscal Impact to Local and State Agency**

##### **1. Cost to Local Government**

The costs from the proposed California Phase 2 transit bus custom chassis provisions would be completely passed on via increased bus prices to local transit agencies; thus, this increased cost on transit bus manufacturers would impose fiscal impacts on local government. The increased transit bus costs were estimated at \$43,000 over an 11-year timeframe (see Table H-1). In addition to the increased transit bus costs, local government fleets who purchase California Phase 2-certified heavy-duty vehicles other than transit buses would also have cost impacts from the rest of other costs listed in Table H-1. Staff estimated the local government heavy-duty vehicle population to be about 9.4 percent of total heavy-duty vehicles using CARB's EMFAC data. The estimated costs to local governments impacted by the proposed California Phase 2 regulation are \$5,255,000 over an 11-year period from 2018 to 2028.

The impact to local government in 2017/2018 and 2018/2019 fiscal years is zero as the proposed regulation's costs would not be incurred until 2020. In 2019/2020 fiscal year, the cost impacts are estimated at \$84,000.

##### **2. Cost to State Government**

###### **a. State Government Fleet**

There would be cost impacts on state government fleets who purchase California Phase 2-certified heavy-duty vehicles. Staff estimated the state government heavy-duty vehicle population to be about 3.1 percent of total heavy-duty vehicles using CARB's EMFAC data. The estimated costs to local governments impacted by the proposed California Phase 2 regulation are \$1,719,000 over an 11-year period from 2018 to 2028.

The impact to state government in 2017/2018 and 2018/2019 fiscal years is zero as the proposed regulation's costs would not be incurred until 2020. In 2019/2020 fiscal year, the cost impacts were estimated at \$28,000.

###### **b. CARB**

Under the federal Phase 1 rule, GHG standards for medium- and heavy-duty engines and vehicles were premised on a simple set of off-the-shelf technologies (e.g., low-rolling resistance tires, aerodynamic devices, weight reduction, and idle reduction), and there was no GHG standards for trailers. For federal Phase 1 vehicle certification

through GEM, most of the GEM inputs are by default, and manufacturers only need to submit a minimal amount of certification data, mostly related to low-rolling resistance tires and aerodynamic devices. Under the federal Phase 2 rule, however, GHG standards are predicated on a much more complex technology suite, and more input data are required for submission. In addition, for federal Phase 2 vehicle certification through GEM, vehicle-specific inputs (as opposed to default GEM inputs) such as engine fuel maps and powertrain testing data are required. The federal Phase 2 rule also includes GHG standards for trailers for the first time. As a result, the amount of federal Phase 2 certification documentation required for submission is substantially higher than what was required under federal Phase 1. Under California's Phase 1 program, with deemed to comply provisions, manufacturers are deemed to comply with California if they comply with federal Phase 1, and CARB issues California EOs contingent on U.S. EPA's Phase 1 approval. Unlike California's Phase 1 program, the proposed California Phase 2 regulation would exclude "deemed to comply" provisions, requiring manufacturers to submit certification documents to CARB for an independent review before an EO would be issued.

The larger amount of Phase 2 data submission for review along with no "deemed to comply" provisions in the proposed California Phase 2 regulation would require additional CARB resources. It would be impossible to absorb this regulation implementation effort with existing staff since staff time is already being consumed by the current rule implementation efforts. Staff estimated an addition of 15 CARB positions (two APSs, 11 AREs, one SAPS, and one ARS I) would be needed for the proposed California Phase 2 regulation implementation. The cost for an ARS I position (salary + benefit + overhead) is \$202,000 for the first year with an annual cost in subsequent years of \$201,000. The cost for a SAPS position (salary + benefit + overhead) is \$187,000 for the first year with an annual cost in subsequent years of \$186,000. The cost for an ARE position (salary + benefit + overhead) is \$175,000 for the first year with an annual cost in subsequent years of \$174,000. The cost for an APS position (salary + benefit + overhead) is \$165,000 for the first year with an annual cost in subsequent years of \$164,000. The hiring of those 15 requested positions would be spread out from 2018 to 2022; specifically: one APS and two AREs starting in 2018-2019, two additional AREs and one ARS I starting in 2019-2020, five additional AREs starting in 2020-2021, one additional APS and one additional ARE starting in 2021-2022, and lastly one SAPS and one additional ARE starting in 2022-2023. Table H-12 below lists estimated annual cost to CARB from 2018 to 2028 (2027\$).

**Table H-12: Annual Costs to CARB due to the Proposed Phase 2 California GHG Regulation from 2018 to 2028 (2017\$)**

Fiscal Year	Annual Cost to State Agency (\$)
2018-2019	515,000
2019-2020	1,064,000
2020-2021	1,936,000
2021-2022	2,271,000
2022-2023	2,631,000
2023-2024	2,629,000
2024-2025	2,629,000
2025-2026	2,629,000
2026-2027	2,629,000
2027-2028	2,629,000

## V. Regulatory Alternatives

In developing the preferred California Phase 2 regulatory proposal, staff also considered two alternative proposals.

1. Alternative 1: Align with the federal Phase 2 GHG standards but at accelerated timeline (with no minor California differences)

One alternative staff considered was to phase in emission requirements faster than required by the federal Phase 2 GHG rule and require manufacturers to certify their engines, vehicles, and trailers with CARB (i.e., no “deemed to comply” provision). Alternative 1 would set the same standard stringency levels as the federal Phase 2 regulation, but would phase in 3 years sooner (fully phase in by 2024 instead 2027). Given the faster phase-in schedule, Alternative 1 could yield GHG emissions benefits faster than the proposed regulation.

Staff rejected this alternative for the reasons described below. First, imposing a faster CA-only phase-in of the GHG standards would likely impose a significant financial burden on manufacturers, and significantly disrupt engine and vehicle manufacturers’ federal compliance strategies that are already underway. Second, as discussed in the federal Phase 2 document, given the insufficient lead time, there are concerns it could be technologically infeasible to have the Phase 2 regulation fully phased in in 2024 (U.S. EPA, 2016). U.S. EPA and NHTSA projected that only engine improvements and some tire improvement technologies would be achievable by 2024. U.S. EPA and



NHTSA stated that pulling the program ahead too fast would significantly compromise the technologies' reliability and durability. Third, staff rejected this alternative because it would not establish requirements necessary to align with existing California programs and provide incentives to bring advanced technologies to market.

The cost of Alternative 1 includes costs due to a faster phase-in schedule than the federal regulation and costs due to separate manufacturers' reporting to CARB (no "deemed to comply"). The cost due to faster phase-in schedule was estimated based on U.S. EPA and NHTSA's federal Phase 2 GHG regulation analysis (U.S. EPA, 2016d). In the federal Phase 2 document, U.S. EPA and NHTSA estimated annual cost for the final federal Phase 2 regulation based on national sales. California sales are usually about 10 percent of the national sales, thus staff scaled federal cost estimates down to 10 percent to reflect the California cost for each calendar year (this would be an underestimated value since in reality, the increased cost per vehicle would be much higher if manufacturers were to produce fewer vehicles than their national production volume to comply with the significantly more stringent California standards – higher capital investment cost for a smaller production volume). In addition, since Alternative 1 would phase in by 2024 (3-years sooner than the federal Phase 2 regulation), the scaled federal cost estimate in 2027 and thereafter would become California Alternative 1's cost in 2024 and thereafter. The cost due to separate manufacturers' reporting to CARB was detailed in Section I., above (i.e., no "deemed to comply" cost). Table H-13 summarizes annual Alternative 1 costs to businesses and individuals relative to the federal Phase 2 compliance cost baseline from 2018 to 2025.

**Table H-13: Total Statewide Dollar Cost to Comply with California Alternative 1 (2017\$)**

Calendar Year	California Cost due to Faster Phase-in than the Federal Program (\$)	California Cost due to Separate Reporting to CARB (\$)	Total Alternative 1 Cost (\$)
2018	-	-	-
2019	-	-	-
2020	-	780,000	780,000
2021	-	2,524,000	2,524,000
2022	-	2,991,000	2,991,000
2023	-	2,991,000	2,991,000
2024	95,097,000	3,017,000	98,115,000
2025	94,975,000	2,991,000	97,967,000
<b>Total Cost over 8 Years (\$)</b>	<b>190,073,000</b>	<b>15,295,000</b>	<b>205,368,000</b>

2. Alternative 2: Adopt the federal Phase 2 GHG standards but at accelerated timeline with minor California differences

Another alternative considered was to phase in emission requirements faster than required by the federal Phase 2 GHG rule, require manufacturers to certify their engines, vehicles, and trailers with CARB (i.e., no “deemed to comply” provision), and include the same minor California differences as in staff’s proposal. This alternative, Alternative 2, would be identical to Alternative 1, except that it would include the minor California differences (described above in Section I.). Alternative 2 would set the same standard stringency levels as the federal Phase 2 regulation, but with an accelerated timeline (3 years sooner, fully phase in by 2024 instead of 2027). Given the faster phase-in schedule, Alternative 2 could yield GHG emissions benefits faster than the proposed regulation; however, in the long-term, the proposed regulation and Alternative 2 would achieve similar GHG emissions benefits. Although Alternative 2 was more attractive than Alternative 1 because unlike Alternative 1, it would achieve the benefits of the California differences, staff rejected Alternative 2 for two reasons. First, imposing a faster CA-only phase-in of the standards in addition to the proposed California differences would impose a significant financial burden on manufacturers. Second, pulling the regulation phase-in schedule too fast could be technologically infeasible and compromise technologies’ reliability and durability.

The cost of Alternative 2 includes cost due to faster phase-in schedule than the federal regulation, cost due California differences, as well as cost due to no “deemed to comply” provision. Similar to Alternative 1, the cost due to faster phase-in schedule was estimated based on U.S. EPA and NHTSA’s federal Phase 2 GHG regulation analysis (U.S. EPA, 2016d). The cost due to the California differences and no “deemed to comply” provision was estimated using data discussed in section I, above. Table H-14 shows estimated total incremental costs for Alternative 2 relative to the federal Phase 2 regulation baseline.

**Table H-14: Estimated California Costs due to California Phase 2 Alternative 2 from 2018 to 2025 (2017\$)**

Calendar Year	California Costs due to Faster Phase-in than the Federal Program (\$)	California Costs due to Minor California Differences and no “Deemed to Comply” Provisions (\$)	Total Alternative 2 Costs (\$)
2018	-	-	-
2019	-	-	-
2020	-	780,000	780,000
2021	-	5,874,000	5,874,000
2022	-	6,455,000	6,455,000
2023	-	6,663,000	6,663,000
2024	95,097,000	7,351,000	102,448,000
2025	94,975,000	5,095,000	100,070,000
<b>Total Costs over 8 Years (\$)</b>	<b>190,073,000</b>	<b>32,216,000</b>	<b>222,289,000</b>