Development of Industry-Specific Cost Metrics and Cost Impacts to Individuals for Standardized Regulatory Impact Assessment

Revised 9/18/2020

This document was prepared by California Air Resources Board (CARB) staff to document the methodology used in the development of industry-specific cost metrics and cost impacts to individuals that would result from the Draft Proposed Amendments to the Airborne Toxic Control Measure for Commercial Harbor Craft (hereinafter Proposed Amendments).

CARB staff is developing these cost metrics for the Standardized Regulatory Impact Assessment (SRIA), which, is required by Senate Bill (SB) 617 for proposed regulations that have an economic impact exceeding $50 million. This document is a preliminary discussion draft and is still under development. CARB staff is releasing this draft document in advance of the SRIA and Initial Statement of Reasons (ISOR) for the Proposed Amendments solely to request stakeholder input regarding these preliminary cost metrics.

Please submit comments or cost information to both Wei Liu (wei.liu@arb.ca.gov) and Ashley Arax (ashley.arax@arb.ca.gov) by October 30, 2020 to be considered for inclusion in the SRIA. Stakeholders can also continue to provide informal comments throughout the regulatory process, and formal comments during the 45-day public comment period that will occur prior to the Board's consideration of the Proposed Amendments.

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Table 1 summarizes the calculated cost metrics and impacts to individuals based on the projected annualized cost of the Draft Proposed Amendments in 2031.

Table 1. Calculated Cost Metrics and Cost Impacts to Individuals in 2031

Cost Metric	Cost in 2031*
Cost Per Passenger – Ferry Vessels, One-Way Trip	$3.28
Cost Per Passenger – Excursion Vessels	$1.13
Cost Increase Per Harbor Tug Ship Assist	$209 (+2.8%)
Cost Increase Per Harbor Tug Ship Escort	$381 (+2.8%)
Cost Increase Per Twenty-Foot-Equivalent Unit	$0.34
Cost Increase Per Gallon of Refinery Product	$0.0002

*Tug assist and escort costs, cost per Twenty-Foot-Equivalent Unit (TEU) and cost per gallon of refinery product based on year 2030 data

2. Calculation of One-Way Trip Cost Per Passenger for Ferry Vessels

CARB staff calculated the estimated increased cost per one-way trip per ferry vessel passenger that would occur due to the Draft Proposed Amendments in 2031. This estimate is based on information from three large operators: Golden Gate Bridge, Highway and Transportation District, San Francisco Bay Area Water Emergency Transportation Authority (WETA), and a confidential ferry operator that requested non-attribution.

This cost per passenger estimate is inclusive of different types of operation. In addition to considering the longer commuter routes operated by all three operators, WETA and Golden Gate both operate single trips to and from sporting events or concerts at Oracle Park and Chase Center. These shorter, single trips were considered in the cost per passenger estimate as well. CARB staff believes that the cost increase per passenger for smaller operators would likely be similar to the cost estimated using data from these three larger operators with varying run types and lengths.

CARB staff estimated total passenger count using data from ferry operators, when available. When actual passenger inventories were not available, CARB staff estimated passenger count using the number of trips, and an assumed 45 percent capacity of vessels. This capacity estimation was calculated from available passenger inventory information for 2019 and applied to operators for whom the passenger inventory was not available. Due to 2020 schedule changes caused by COVID-19, 2019 schedules were used when possible to reflect normal activity. For operators that provide services to Oracle Park and events at Chase Center, CARB staff used the 2019 game and event

schedules to estimate the number of trips. The total passenger counts are provided in Table 2.

Table 2. Total Passengers in Data Year (2019 or 2020)

Operator	Total Passengers 2019/2020
Confidential Source	1,171,266
Golden Gate[1]	1,416,663
WETA[2]	1,690,740
Total	4,278,669

These three operators currently have a combined fleet of 28 high-speed vessels, including both Catamaran and Monohull ferries. CARB staff's estimate of high speed vessel population in 2023 is 57 vessels.[3] These two vessel populations were used to scale the ridership calculations for these three operators to the projected total high-speed ferry passenger estimation of 8,710,148 in 2023 as shown in the calculation below:

57/28 * 4,278,669 = 8,710,148 passengers in 2023

This passenger estimation for 2023 was then scaled for the year 2031 by using a growth factor of 1.135[4], resulting in a passenger estimate of 9,886,018 passengers, as shown in the calculation below:

8,710,148 * 1.135 = 9,886,018 passengers in 2031

Finally, the total estimated compliance cost[3] in 2031 for high-speed ferry categories was divided by the total passenger estimation for 2031 to obtain the cost per passenger (per one-way trip):

$32,453,354 / 9,886,018 = **$3.28 per passenger per one-way trip in 2031**

[1] Golden Gate Bridge Highway & Transportation District Website: "Golden Gate Ferry Schedules" (accessed 8/14/20) https://www.goldengate.org/ferry/schedules-maps/
[2] WETA Website: "San Francisco Bay Ferry Schedule" (accessed 8/14/20) https://sanfranciscobayferry.com/route/all/all
[3] CARB Draft Cost Analysis for Standardized Regulatory Impact Assessment for the Draft Proposed Amendments to the Airborne Toxic Control Measure for Commercial Harbor Craft, September 2020 version, "Major Cost Inputs" tab, Table 20
[4] Calculated from annual growth factors in CARB Draft Cost Analysis Inputs and Assumptions for Standardized Regulatory Impact Assessment for the Draft Proposed Amendments to the Airborne Toxic Control Measure for Commercial Harbor Craft, September 2020 version, Table I-G-I, page 15

3. Calculation of Cost per Passenger for Excursion Vessels

CARB staff calculated the estimated increased cost per excursion passenger that would occur due to the Draft Proposed Amendments in 2031, the final implementation year before extensions, using the following methodology.

First, CARB staff calculated the average number of excursion vessel passengers per vessel trip or excursion for the four vessels in Table 3. Using vessel capacity data from excursion websites[5] and horsepower data available in CARB's commercial harbor craft database, CARB staff calculated an average vessel capacity per horsepower, which when multiplied with the statewide average excursion vessel horsepower (hp) of 869, gave an average vessel capacity of 103 passengers. Assuming excursion vessel ridership is 60 percent of vessel capacity, there are an average of 62 passengers per trip for excursion vessels.

Table 3: Excursion Vessel Total Passengers Per Trip

Vessel Name	Capacity	Horsepower	Capacity per hp
Safari Rose	50	760	0.065
Princess Monterey	150	1100	0.136
Atlantis Monterey	80	800	0.100
Condor Express	127	740	0.171
		Average capacity per hp:	0.118

869 = average excursion vessel hp statewide (CHC database)

869 hp x 0.118 capacity/hp = 103 average capacity for excursion vessel

103 average capacity x 60% ridership = 62 passengers per trip

CARB staff multiplied the average 62 passengers per vessel trip with the average number of vessel trips an excursion vessel makes per year to estimate the annual total number of passengers for a vessel. CARB staff calculated the number of annual excursion vessel trips, shown in Table 4, using data available on excursion websites[5] from multiple areas in the state. Then CARB staff multiplied the number of annual

[5] Excursion Websites Accessed September 3, 2020:
San Francisco Blue and Gold Fleet, https://freetoursbyfoot.com/blue-gold-fleet/
San Diego Whale Watch https://sdwhalewatch.com/our-trips/whale-watching/
Condor Express Whale Watching https://condorexpress.com/california-whale-watching-seasons-pricing/
Safari Rose Lake Tahoe, https://tahoecruises.com/
Monterey Whale Watching, https://montereywhalewatching.com/whale-watching-cruise/

excursion vessel trips by the projected number of excursion vessels in 2031 based on CARB's Draft Emission Inventory (footnote 4) to get the total estimated number of passengers taking excursions in 2031 on vessels that CARB staff expects would be subject to emission control requirements under the Proposed Amendments.

Table 4: Number of Excursion Vessel Trips per Year

Vessel	Trips per Year
Old Blue	469
The Privateer	730
Condor Express	508
Safari Rose	820
Princess Monterey	1,095
Average Excursion Vessel:	724.4

724.4 annual trips * 62 passengers per trip = 44,736 annual passengers per vessel

44,736 annual passengers per vessel * 408 vessels in 2031 = 18,252,465 passengers in 2031

Finally, CARB staff divided the estimated annualized cost of the Draft Proposed Amendments in 2031 by the estimated number of passengers in 2031 to calculate the estimated cost per passenger.

$20,652,241 / 18,252,465 passengers = **$1.13 per passenger in 2031**

4. **Harbor Tug Compliance Cost Increase Per Ship Assist/Escort, TEU, and Gallon of Refinery Product**

Table 5 summarizes the estimated compliance cost increase per average ship assist, per average ship escort, per container ship TEU, and price per gallon of refinery product in 2030 that CARB staff expect would result from increased compliance costs to harbor tug vessels due to the Draft Proposed Amendments to the Airborne Toxic Control Measure for Commercial Harbor Craft.

Table 5. Estimated 2030 Cost Increase per Ship Assist, Ship Escort, TEU, and Gallon of Refinery Product (Dollars)

Average Bay Area Cost Increase Per Ship Assist (2030)	Average Bay Area Cost Increase Per Ship Escort (2030)	Cost Increase Per Container TEU (2030)	Cost Increase Per Gallon of Refinery Product (2030)
$209 (+2.8%)	$381 (+2.8%)	$0.34	$0.0002

a. Methodology Summary

CARB staff calculated the estimates in Table 5 by first estimating total ocean-going vessel (OGV) visits to California ports in 2030 by scaling up the total vessel visits in 2016 to 2030 using projected industry growth factors. CARB staff then estimated the corresponding number of ship assists and tug escorts by assuming that each OGV visit would require a certain number of ship assist tugs and escort tugs based on OGV type, 2020 industry pilot service guidelines, and 2020 regulatory requirements related to oil spill prevention and response.

To determine the estimated compliance cost increases per ship assist or escort, CARB staff used the vessel visit counts and the average 2020 Bay Area cost-per-assist and cost-per-escort values to determine the ship assist, ship escort, and total ship assist + escort revenue in 2030. CARB staff then divided the fractions of the total ship assist + escort sector 2030 compliance cost attributed to ship assists and escorts, respectively, by the total number of ship assists and total number of escorts required in 2030.

To determine estimated cost increases per TEU and per gallon of refinery product, CARB staff divided the ship assist cost increase attributed to 2030 container ships by the total number of 2030 TEUs to obtain the per TEU cost increase.

To determine the estimated cost increase per gallon of refinery product, CARB staff divided the combined ship assist/escort cost increases attributed to seven types of 2030 OGV tanker subcategories, articulated tug barges (ATB), and tank barges (OTB) by the total 2030 statewide refinery product throughput (in gallons).

Further detail on each calculation is provided below.

b. Calculation of Number of OGV Ship Assists and Escorts in 2030

To obtain the estimated number of ship assists and escorts in 2030, CARB staff quantified the number of OGV visits from 2016 baseline data scaled up to 2030 using industry growth factors, then applied assumptions based on industry guidelines to quantify the ship assists and escorts required for each vessel visit as described below.

To obtain baseline vessel 2016 visit counts for all OGV types, CARB staff utilized data,[6] compiled from the updated 2016 IHS-Markit information and the 2016 South Coast Marine Exchange vessel visit counts according to port and vessel type. Note that for Port of Los Angeles (POLA) and Port of Long Beach (POLB), CARB staff utilized data from South Coast Marine Exchange, while IHS-Markit data was used for all other ports.

To scale up statewide tanker vessel berth visits from 2016 to 2030, CARB staff obtained San Francisco Marine Exchange (SFME) data for Port of Richmond for OGV visits in 2016.[7] This data included the total number of distinct tanker berth visits for articulated tug-barges (ATBs), towed tank barges (OTBs), and seven OGV tanker subcategories including crude oil tanker (TCR), chemical tanker (TCH), chemical/oil tanker (TCO), product tanker (TPD), asphalt tanker (TAS), acid tanker (TAC) and non-specific tanker (TTA) vessel types defined in SFME data.[8] The analysis by CARB staff found 918 distinct Port of Richmond berth visits for 2016. CARB staff scaled up the 400 Port of Richmond tanker visits listed in the 2016 IHS-Markit data by a tanker berth visit correction factor of 2.295 to reflect the combined total of ATBs, OTBs, and the seven OGV tanker types.

918 berth visits / 400 IHS-Markit Richmond tanker visits = 2.295 tanker berth visit correction factor

CARB staff applied the 2.295 tanker berth visit correction factor to the 1,628 California tanker visits that occurred in 2016 combined with the compounded tanker sector growth factor of 1.1172[9] for 2030 to obtain 4,174 distinct statewide tanker berth visits in 2030.

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[6] Staff Report: Initial Statement of Reasons (ISOR) Appendix H: 2019 Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results, Page H-15, https://ww3.arb.ca.gov/regact/2019/ogvatberth2019/apph.pdf

[7] 2016 Port of Richmond Data obtained from the San Francisco Marine Exchange https://www.sfmx.org/

[8] SFMX-Vessel-Type-Codes https://www.sfmx.org/wp-content/uploads/2017/10/Vessel-Type-Codes.pdf Last accessed September 9, 2020

[9] Proposed Control Measure for Ocean-Going Vessels At Berth, ISOR Appendix C-1: Standardized Regulatory Impact Assessment, Appendix D: Development of Cost Impacts to Individuals for Standardized Regulatory Impact Assessment, Page 4, https://ww3.arb.ca.gov/regact/2019/ogvatberth2019/appc-1.pdf

For container/refrigerated (reefer), roll-on-roll-off (ro-ro)/auto, cruise, and general/bulk vessel visits from 2016 to 2030, CARB staff scaled up the vessel visits according to the compounded 2030 growth factors determined for their respective sectors.[9] CARB staff scaled container/reefer ships up by 1.61, ro-ro/auto visits by 1.45, cruise ships by 1.66, and bulk/general cargo by 1.336. The scaled up vessel visit counts were added to the 2016 baseline of 7,830 CA vessel visits in the 2016 IHS-Markit data, including the 1,628 tanker visits that were scaled by both the combined 2.295 correction and 1.1172 growth factors. Based on this scaling, the total number of distinct OGV berth visits statewide for 2030 increased to 13,804 berth visits total for all OGV types.

Table 6. Quantification of 2030 OGV Visits Requiring Ship Assists and Escorts

Vessel Type	2016 Vessel Visits	Scaling Factor*	2030 Projected Vessel Visits
Container/Reefer	3,914	1.61	6,302
Cruise	483	1.66	802
Ro-Ro/Auto	1010	1.45	1465
Tanker/ATB/OTB	1,628	2.295 x 1.1172	4,174
Bulk/General	795	1.336	1062
Total	7,830	---	13,804

*Scaling factors include the correction factor for OGV tankers, ATBs, and OTBs to account for multiple berth visits per vessel and the industry growth factor.

CARB staff assumed that every OGV tanker type, ATB, or OTB underway would be carrying more than 5,000 long tons of either crude oil or refinery products, requiring a certified ship-escort tug to comply with the tanker escort requirements of the California Department of Fish and Wildlife (CDFW) Office of Spill Prevention and Response (OSPR) Regulation[10].

To calculate the number of tanker ship assists and ship escorts occurring in 2030, CARB staff assumed that due to shipping channel and tanker vessel size restrictions, each OGV tanker, ATB, or OTB would use only one escort tug per escort event and require only one tug per ship assist event. This assumption resulted in each tanker, ATB, or OTB berth visit requiring a total of two ship assists and two escorts per distinct berth visit.

[10] Title 14, California Code of Regulations, Subdivision 4. Office of Spill Prevention and Response, Chapter 4. Vessel Requirements, Subchapter 1. Tank Vessel Escort Regulations for the San Francisco Bay Region Sections 851.1 through 851.10.1, https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=22000&inline, Last accessed September 9, 2020.

CARB staff assumed that typical container ship berth visits to Port of Oakland would require an average of two assist tugs per docking event for a total of four ship assists per distinct berth visit (two for docking and two for undocking). CARB staff based this assumption on the average number of ship assist tugs required per container vessel according to the current harbor pilot guidelines for the Port of Oakland[11]. CARB staff assumed all other vessel types would require a single ship assist tug per ship assist event (a single assist tug for docking and a single assist tug for undocking) for a total of two ship assists per distinct berth visit.

Total 2030 ship assists and escorts are shown below in Table 7. To calculate total 2030 statewide ship assists, CARB staff applied four assist tugs per container ship visit and two ship assist tugs to every other OGV-type, ATB, or OTB berth visit in 2030. To calculate total 2030 escorts at two per tanker, ATB, and OTB berth visit (one escort to the berth and one exiting the berth), CARB staff multiplied the number of distinct statewide OGV tanker, ATBs, and OTB visits by two escorts. CARB staff assumed that escorts are not required for other OGV types.

Table 7. Quantification of 2030 Ship Assists and Escorts

Vessel Type	2030 Projected Vessel Visits	Tug Assists per Vessel Visit	Tug Escorts per Vessel Visit	Total Tug Assists 2030	Total Tug Escorts 2030
Container/Reefer	6,302	4	0	25,206	0
Cruise	802	2	0	1,604	0
Ro-Ro*	1,465	2	0	2,929	0
Tanker	4,174	2	2	8,348	8,348
Bulk/General	1,062	2	0	2,124	0
Total	13,804	---	---	40,211	8,348

*Includes auto carrier vessels

c. Calculation of Average Ship Assist and Escort Costs

CARB staff calculated the cost of an average Bay Area ship assist or ship escort using the advertised 2020 rate sheets of two large Bay Area tug fleet operators.[12] The rate sheets included cost detail on tanker escorts to/from Zone 1 outside of the Golden

[11] San Francisco Bar Pilots Operations Guidelines for the Movement of Vessels on San Francisco Bay and Tributaries, Page 10. http://sfbarpilots.com/wp-content/uploads/2016/04/GuidelinesHighlighted.pdf Last accessed September 9, 2020.

[12] Crowley Tug Rate Sheet 2018_SF https://www.crowley.com/wp-content/uploads/2018/10/2018_SF_SAE_Rate_Sheet.pdf, Last accessed September 9, 2020
Foss Tug SF Rate Sheet 2020 https://www.foss.com/wp-content/uploads/Foss-SF-Rate-Sheet-2020.pdf Last accessed September 9, 2020.

Gate Bridge boundary to San Francisco anchorages and refinery terminal locations in the Port of Richmond, Hercules, Rodeo/Crockett, Selby/ Zone 6 to Martinez and Benicia. The rate sheets provided cost detail on ship assists occurring in San Francisco, Port of Oakland Inner/Outer harbors, Alameda, Redwood City, Richmond, Hercules, Rodeo/Crockett, Martinez, Benicia, and Antioch/Pittsburg. Note that the costs of long-distance escorts/ship assists to Port of Stockton and Port of Sacramento were not factored into the average ship assist or escort costs used in this analysis due to lack of posted cost data for assist services in those locations or escorts to/from those locations. The average Bay Area 2020 ship assist cost calculated in this analysis from the two Bay Area tug fleet operators is $7,373.50. The average Bay Area 2020 tanker escort cost calculated is $13,473.75.

d. Calculation of 2030 Ship Assist Revenue, Escort Revenue, Total Revenue, Ship Assist and Escort Revenue Fractions

CARB Staff calculated the 2030 ship assist revenue, escort revenue, and total revenue using the 2020 average ship assist and escort costs multiplied by the total number of ship assists and ship escorts projected to occur Statewide in 2030 (detailed in Section b. above):[13]

$7,373.50 per ship assist * 40,211 ship assists = $296,497,721 ship assist 2030 revenue

$13,473.75 per ship escort * 8,348 ship escorts = $112,482,898 ship escort 2030 revenue

$296,497,721 + $112,482,898 = $408,980,619 total 2030 combined ship assist/escort revenue

CARB staff divided the 2030 ship assist revenue by the total 2030 revenue to calculate the ship assist revenue fraction:

$296,497,721 / $408,980,619 = 0.72 ship assist revenue fraction

CARB staff divided the 2030 escort revenue by the total 2030 revenue to calculate the ship escort revenue fraction:

$112,482,898 / $408,980,619 = 0.28 ship escort revenue fraction

[13] Exact values will vary due to rounding.

Table 8. Ship Assist and Escort Revenue (2030)

Ship Assist Revenue 2030 (Dollars)	Ship Escort Revenue 2030 (Dollars)	Total 2030 Revenue (Dollars)	Fraction of Revenue 2030 Ship Assists	Fraction of Revenue 2030 Escorts
$296,497,721	$112,482,898	$408,980,619	0.72	0.28

e. Calculation of Cost of Ship Assist/Escort Tug Compliance in 2030

CARB staff calculated the annualized 2030 ship assist/escort tug sector compliance cost to be $11,578,890 in the Draft Cost Analysis for the Proposed Amendments.

f. Calculation of 2030 Per-Ship Assist and Per-Escort Compliance Cost Increases

The ship assist/escort tug sector 2030 annualized compliance cost (see section e. above) was then multiplied by the 2030 ship assist revenue fraction and divided by the total number of 2030 statewide ship assists to obtain the 2030 cost increase per average ship assist.[13]

$11,578,890 * 0.72 / 40,211 = **$209 per ship assist cost increase in 2030**

The ship assist/escort tug sector 2030 annualized compliance cost was then multiplied by the 2030 ship-escort revenue fraction and divided by the total number of 2030 statewide escorts to obtain the 2030 cost increase per average ship escort.

($11,578,890*0.28) / (8,348 ship assists) = **$381/ship escort cost increase in 2030**

g. Calculation of 2030 Cost Increase Per TEU and Per Gallon of Refinery Product

To calculate the annualized cost increase per container TEU, CARB staff applied the average 2030 ship assist cost increase to the number of 2030 statewide ship assists allocated to container ships using the average of four ship assist tugs per container ship berth visit (two tugs assisting per docking event and per undocking event). CARB staff divided the 2030 ship assist cost allocated to container vessels by the total

number of statewide 2030 TEU throughput calculated by CARB staff[14] to estimate the cost increase per TEU.

25,206 container ship assists * $209 per ship assist / 15,590,200 TEUs in 2030 = **$0.34 per TEU cost increase in 2030**

To calculate the cost increase per gallon of refinery product as a result of increased regulatory costs on ship assist and escort tugs, CARB staff applied the annualized 2030 ship assist and escort average cost increases of $209 and $381, respectively, to the total statewide numbers of required 2030 ship assists and ship escorts required for the seven OGV tanker subcategories, ATBs, and OTBs in 2030. Each distinct OGV tanker or petrochemical tank barge berth visit consisted of two single-tug escorts and two single-tug ship assists. The 2030 refinery product throughput calculated by CARB staff[14] was used to determine the estimated cost increase per gallon.

((8,348 tanker escorts * $381 per escort) + (8,348 tanker assists * $209 per assist)) / 27,156,860,144 Gallons in 2030 = **$0.0002/Gallon cost increase in 2030**

[14] Proposed Control Measure for Ocean-Going Vessels At Berth, ISOR Appendix C-1: Standardized Regulatory Impact Assessment, Page 96, https://ww3.arb.ca.gov/regact/2019/ogvatberth2019/appc-1.pdf