Appendix D

Methodology of Estimating Economic Impacts

(this page left intentionally blank)

Appendix D

ECONOMIC IMPACTS METHODOLOGY

This chapter discusses the estimated costs and economic impacts associated with implementation of the proposed amendments to the Commercial Harbor Craft Regulation (CHC Regulation). The expected capital and recurring costs for potential compliance options, the cost and associated economic impacts on businesses, as well as an analysis of the cost-effectiveness of proposed CHC amendments to the regulation are presented. ARB staff calculated the economic impacts associated with the proposed amended CHC regulation using the same methodology as was done for the 2007 CHC regulation. Generally, costs discussed in this section are presented in 2009 dollars, but the tables also contain the values adjusted for net present value (NPV) to estimate "today's dollars" of future net cash. The equations and calculation method can be found in the Air Resources Board, Technical Support Document: Proposed Regulation for Commercial Harbor Craft, September 2007.

A. Summary of the Economic Impacts

In assessing the costs associated with the proposed amendments to the CHC Regulation, ARB staff developed two different estimates, one for "regulatory costs" and another for "new equipment costs." Regulatory costs are the estimated costs resulting from the proposed amendments taking into consideration the residual value of the in-use engine being replaced, the residual value of the most recent engine rebuild work, recordkeeping and reporting costs, and the time value of money associated with the early engine replacement. New equipment costs are the estimated total out-of-pocket costs for purchasing and installing a new engine (engine replacement cost) in crew and supply, barge, and dredge vessels. The new equipment costs for purchasing and installing a new engine are costs that the vessel owner would eventually pay, but the proposed amendments to the CHC regulation requires this service to be performed earlier than normal.

Staff estimates the lifetime regulatory cost for compliance with the proposed amendments to the regulation to be approximately $15 million (2009 dollars or adjusted to $9.9 million NPV) from 2011 through 2022. New equipment costs are estimated at approximately $46 million dollars (2009 dollars or adjusted to $31 million NPV) over the lifetime of the proposed amendments (2011 to 2022).

Staff evaluated the economic impacts the proposed amendments had on crew and supply, barge and dredge businesses by estimating the effect of the regulatory cost on typical business's "return on owner's equity" (ROE). The ROE approach, found that the overall change in ROE would range from a negligible decline of about 0.45 percent for a typical barge and dredge company, to a decline of 1.44 percent for a crew and supply company. Overall, most affected businesses will be able to absorb the costs of the proposed amendments to the CHC regulation with no significant adverse impacts on

their profitability. Generally, the ARB considers a 10 percent change in ROE to be the threshold at which businesses experience a significant adverse impact.

A few federal, State, and local agencies will be impacted by the proposed amendments to the CHC regulation. One federal agency, U.S. Army Corps of Engineers, one state agency, State of California – the Department of Parks and Recreation, and two local agencies (Monterey Regional Water Pollution Control Agency (RWPCA) and Santa Cruz Port District) would be impacted by the in-use engine requirements. Estimated regulatory costs to all of these agencies range from $1,900 to $60,000. Additional details are presented in Table D-13.

Cost-effectiveness is expressed in terms of costs in dollars per unit of emissions reduced (pounds or tons). Low cost-effectiveness results from efficient regulation reductions. The cost-effectiveness for the proposed amendments to the CHC regulation is determined by dividing the regulatory costs by the total pounds of diesel PM reduced during the years 2011 to 2022. Costs are presented in 2009 equivalent expenditure dollars and also shown adjusted for net present value. Table D-1 shows the cost-effectiveness estimate for the proposed amendments expressed three ways. First, all costs assigned to PM, second, cost divided equally between PM and NOx, and third, PM and NOx emissions are combined. The cost-effectiveness values are within the range of cost effectiveness for other diesel engine regulations adopted by the ARB. See Table D-19 for other ARB regulation cost-effectiveness totals.

Table D-1: Summary of Average Amended Proposed Regulation Cost-Effectiveness for the Period 2011-2022

	Total Regulatory Cost		Total Emissions	Total Cost Effectiveness	
Emissions	2009 Dollars ($ millions)	NPV ($ millions)	Total Emissions Reduced	2009 Dollars	NPV
All costs assigned to PM					
PM	$15	$9.9	435,000 lbs	$35/lb	$23/lb
Divide Costs Equally Between PM and NOx					
PM	$7.5	$5.0	435,000 lbs	$17/lb	$11/lb
NOx	$7.5	$5.0	2,800 tons	$2,690/ton	$1,780/ton
Combine PM and NOx Emissions					
PM + NOx	$15	$9.9	6,030,000 lbs	$2.50/lb	$1.65/lb

All values rounded

B. Legal Requirements

In this section we explain the legal requirements that must be satisfied in analyzing the economic impacts of the proposed amendments to the CHC regulation.

Section 11346.3 of the Government Code requires State agencies assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed amended regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states. Also, California state agencies are required to estimate the cost or savings to any State or local agency in accordance with instructions adopted by the Department of Finance (DOF). The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

In addition, Health and Safety Code section 57005 requires the ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year. Because the estimated cost of the amendments to the CHC Regulation does not exceed 10 million dollars in any single year, the proposed amendments to the CHC Regulation do not constitute a major regulation. However, two alternatives were considered.

The following is a description of the methodology used to estimate costs as well as ARB staff's analysis of the economic impacts on California businesses, as well as, federal, State, and local agencies.

C. Methodology for Estimating Costs Associated with Proposed Regulation

In this section, the estimated costs associated with the proposed amendments are discussed.

Briefly, the methodology entailed:

- Two different estimates of costs were developed, regulatory costs and new equipment costs.
    - The regulatory costs are the estimated costs resulting from the proposed amendments taking into consideration the residual value of the in-use engine being replaced, the residual value of the most recent engine rebuild work, recordkeeping and reporting costs, and the time value of money associated with the early engine replacement.
    - New equipment costs are the estimated total out-of-pocket costs for purchasing and installing a new engine (engine replacement cost), and recordkeeping and reporting costs. The portion of new equipment out-of-pocket costs for purchasing and installing a new engine are costs

that the vessel owner would eventually pay, but the proposed amendments require this service to be performed earlier than normal.

- Engine replacement (repowering) was the assumed in-use engine compliance option.
- Operating and maintenance costs for replacement engines were assumed to be the same as for an existing engine.
- No new reporting costs are involved. No additional reporting costs included pertaining to the amended proposed CHC regulation. The owners of the effected vessel engines are currently required to report to the CHC regulation, the PERP, or districts.
- Costs were estimated in 2009 dollars and also adjusted to NPV using a 5 percent discount rate.

1. Costs

a. Engine Replacement (Repower) Costs:

The estimated costs for purchasing and installing a new diesel-fueled engine in an in-use vessel were determined using actual cost data from the Port of Los Angeles Community Advisory Committee China Shipping Settlement Funding submittals and cost information provided by industry and vessel owners. Staff's estimate of the average costs per engine horsepower for purchase and installation of a new main and auxiliary diesel-fueled engine are shown in Table D-2. The marine auxiliary engines are typically smaller horsepower than the propulsion engines, but the prices of some marine auxiliary engines are more expensive on a per horsepower comparison. In addition, repowering auxiliary engines in crew and supply vessels may be more difficult, requiring more installation time and costs compared to most barge and dredge vessels. Thus, the average cost for crew and supply auxiliary engine is higher than propulsion engines and barge and dredge auxiliary engines.

Table D-2: Estimated Vessel Engine Replacement Costs

Engine Category	Average Cost ($/hp)[A]	
	Crew and Supply	Barge and Dredge
Propulsion Engine	$ 214	$ 270
Auxiliary Engine	$ 508	$285

[A] Includes engine, labor, and ancillary equipment costs.

b. Early Replacement Costs

(i) Residual Value of Engine

Staff anticipates that most operators of crew and supply, barge, and dredge vessels will comply with the proposed amendments by replacing existing engines with new engines. There will be situations where engines have to be replaced before the end of the engine's useful service life. In these situations, the costs associated with the loss of the residual or remaining value of the engine being replaced is assigned to this regulatory action. In situations where the engine is being replaced after the end of the useful service life, costs associated with the engine replacement are not assigned to the regulation. (The equations and calculation method can be found in the Air Resources Board, Technical Support Document: Proposed Regulation for Commercial Harbor Craft, September 2007.)
Table D-3 presents ARB estimates of the useful service life and total life for main and auxiliary engine on crew and supply, barge, and dredge vessels. (See Appendix C)

Table D-3: Estimated Useful Service and Total Life of Selected Vessel Engines

Vessel Engine Type	Useful Service Life	Total Life
Crew and Supply Main	28	56
Crew and Supply Auxiliary	28	56
Barge and Dredge Main	17	34
Barge and Dredge Auxiliary	Varies depends on the type	Varies

(ii) Residual Value of Engine Rebuild Work

As with the previous section and discussion of the residual value of the engine, there is also a residual value to the most recent engine rebuilds or overhauls. The engine overhauls are categorized as either a "major" or "top end" overhaul. The frequency of these overhauls can depend on the engine application and the amount of annual use. Engines used under high loads and long hours may need to be overhauled more often. (See Air Resources Board, Technical Support Document: Proposed Regulation for Commercial Harbor Craft, September 2007 as reference for more details.)

c. Operation and Maintenance Costs – Replacement Engines

Based on discussion with engine manufacturers, we do not anticipate that there will be any change in the operating and maintenance costs for new engines compared to the engines that are being replaced.

d. Monitoring, Recordkeeping, and Reporting Costs

The proposed amendments to the CHC regulation require no additional monitoring, reporting, and recordkeeping costs. Monitoring and reporting costs for crew and supply vessels were included in the 2007 CHC Regulation. Barge and dredge vessel owner/operators previously reported and kept records as a requirement of the 2007 CHC regulation, the PERP, or local air district permit requirements. Additional annual reporting is not required, however there are occasions specified in the proposed amendments when reporting would be required. These occasions include the purchase of a new engine or vessel, a change in engine or vessel ownership, a change in engine operating hours, submitting a compliance plan for engines subject to replacing the engine, and compliance demonstration.

2. Future Year Equipment Populations Subject to the Proposed Amendments

Staff estimated the engine inventory for future years to determine the number of in-use engines required to come into compliance in each year. Staff used the vessel and engine inventory and emissions model to calculate equipment growth, annual use, age distribution, and attrition for the vessel categories. Future year equipment populations for each compliance year were evaluated by the inventory model to determine the number of engines to be replaced for each compliance year.

Table D-4 presents the expected number of in-use crew and supply vessel engines per year required to comply with the requirements of the amendments. The total estimated number of crew and supply vessel engines replaced is expected to be 150 over the compliance years 2011 to 2022.

Table D-4: Estimated Population of In-Use Crew and Supply Vessel Engines Subject to Amendments to CHC Regulation Emission Limits

Year	Main	Auxiliary	Total
2011	21	12	33
2012	5	1	6
2013	3	0	3
2014	3	0	3
2015	6	4	10
2016	2	1	3
2017	14	0	14
2018	8	4	12
2019	9	5	14
2020	8	11	19
2021	3	5	8
2022	22	3	25
Total	**104**	**46**	**150**

Table D-5 presents the expected number of in-use barge and dredge vessel engines per year required to comply with the requirements of the amendments. The estimated number of engines replaced is expected to be 129 over the compliance years 2011 to 2022.

Table D-5: Estimated Population on In-Use Barge and Dredge Vessel Engines Subject to Amendments to CHC Regulation

Year	Main	Auxiliary	Total
2011	0	5	5
2012	0	3	3
2013	0	7	7
2014	0	6	6
2015	0	5	5
2016	0	43	43
2017	1	44	45
2018	0	6	6
2019	0	4	4
2020	0	3	3
2021	0	1	1
2022	0	2	2
Total	**1**	**128**	**129**

D. Total Regulatory and New Equipment Costs

Table D-6 and Table D-7 provide the regulatory costs attributed to the in-use engine requirements of the proposed amendments. The in-use engine regulatory costs are derived from the residual value of the replaced engine, the residual value of the most recent overhaul, the time value of money for the earlier than anticipated repower cost, and the reporting cost. Reporting costs include the cost of updating the initial information as engines are replaced. The in-use crew and supply vessel total regulatory costs for the amendments over the years 2011 to 2022 are estimated to be about $9.5 million (2009 dollars). The in-use barge and dredge vessel total regulatory costs are estimated to be about $5.6 million (2009 dollars). Values adjusted to NPV are also shown in the Tables.

Table D-6: Estimated Regulatory Costs for Crew and Supply Vessel In-Use Engine Replacement

Year	Regulatory Cost					
	Main (2009 $)	Main (NPV)	Auxiliary (2009 $)	Auxiliary (NPV)	Total (2009 $)	Total (NPV)
2011	$671,000	$611,000	$179,000	$164,000	$850,000	$775,000
2012	$102,000	$89,000	$6,000	$6,000	$108,000	$95,000
2013	$246,000	$200,000	$0	$0	$246,000	$200,000
2014	$83,000	$65,000	$0	$0	$83,000	$65,000
2015	$922,000	$682,000	$159,000	$118,000	$1,081,000	$800,000
2016	$129,000	$91,000	$99,000	$69,000	$228,000	$160,000
2017	$858,000	$576,000	$0	$0	$858,000	$576,000
2018	$676,000	$432,000	$85,000	$55,000	$761,000	$487,000
2019	$1,258,000	$764,000	$238,000	$145,000	$1,496,000	$909,000
2020	$695,000	$403,000	$386,000	$224,000	$1,081,000	$627,000
2021	$278,000	$153,000	$194,000	$108,000	$472,000	$261,000
2022	$2,126,000	$1,117,000	$63,000	$33,000	$2,189,000	$1,150,000
Total	**$8,044,000**	**$5,183,000**	**$1,409,000**	**$922,000**	**$9,453,000**	**$6,105,000**

All values rounded

Table D-7: Estimated Regulatory Costs for Barge and Dredge Vessel In-Use Engine Replacement

Year	Regulatory Cost					
	Main (2009 $)	Main (NPV)	Auxiliary (2009 $)	Auxiliary (NPV)	Total (2009 $)	Total (NPV)
2011	$0	$0	$82,000	$75,000	$82,000	$75,000
2012	$6,000	$6,000	$64,000	$55,000	$70,000	$61,000
2013	$0	$0	$137,000	$113,000	$137,000	$113,000
2014	$0	$0	$344,000	$269,000	$344,000	$269,000
2015	$0	$0	$150,000	$112,000	$150,000	$112,000
2016	$0	$0	$1,958,000	$1,382,000	$1,958,000	$1,382,000
2017	$0	$0	$1,825,000	$1,224,000	$1,825,000	$1,224,000
2018	$0	$0	$173,000	$111,000	$173,000	$111,000
2019	$0	$0	$26,000	$16,000	$26,000	$16,000
2020	$0	$0	$304,000	$176,000	$304,000	$176,000
2021	$0	$0	$252,000	$138,000	$252,000	$138,000
2022	$0	$0	$283,000	$148,000	$283,000	$148,000
Total	**$6,000**	**$6,000**	**$5,598,000**	**$3,819,000**	**$5,604,000**	**$3,825,000**

All values rounded

Table D-8 and Table D-9 provide summaries of the new equipment compliance costs for the replacement of in-use engines with new engines. The in-use engine new equipment costs are derived from the capital and installation repowers costs and the reporting cost. The new equipment costs for repowering an in-use engine are costs that the vessel owner would eventually pay, but the proposed amendments requires this service to be performed earlier than normal. The initial reporting costs were not included in this analysis because those requirements are already in the CHC Regulation and not part of the proposed amendments. Subsequent year reporting costs include the cost of updating the initial information as engines are replaced. The total in-use engine replacement new equipment costs associated with the amendments over the years 2011 to 2022 are estimated to be about $20 million for crew and supply vessel engines and $27 million for barge and dredge vessel engines.

Table D-8: Estimated New Equipment Costs for In-Use Crew and Supply Vessel Engine Replacement

Year	New Equipment Costs					
	Main (2009 $)	Main (NPV)	Auxiliary (2009 $)	Auxiliary (NPV)	Total (2009 $)	Total (NPV)
2011	$2,486,000	$2,213,000	$754,000	$671,000	$3,240,000	$2,884,000
2012	$367,000	$311,000	$61,000	$52,000	$428,000	$363,000
2013	$856,000	$691,000	$0	$0	$856,000	$691,000
2014	$201,000	$155,000	$0	$0	$201,000	$155,000
2015	$1,656,000	$1,212,000	$353,000	$259,000	$2,009,000	$1,471,000
2016	$202,000	$141,000	$393,000	$274,000	$595,000	$415,000
2017	$1,407,000	$935,000	$0	$0	$1,407,000	$935,000
2018	$1,218,000	$770,000	$83,000	$53,000	$1,301,000	$823,000
2019	$2,483,000	$1,496,000	$424,000	$256,000	$2,907,000	$1,752,000
2020	$1,281,000	$735,000	$614,000	$353,000	$1,895,000	$1,088,000
2021	$535,000	$292,000	$314,000	$172,000	$849,000	$464,000
2022	$4,051,000	$2,108,000	$64,000	$34,000	$4,115,000	$2,142,000
Total	**$16,743,000**	**$11,059,000**	**$3,060,000**	**$2,124,000**	**$19,803,000**	**$13,183,000**

Table D-9: Estimated New Equipment Costs for In-Use Barge and Dredge Vessel Engine Replacement

Year	New Equipment Costs					
	Main (2009 $)	Main (NPV)	Auxiliary (2009 $)	Auxiliary (NPV)	Total (2009 $)	Total (NPV)
2011	$0	$0	$418,000	$372,000	$418,000	$372,000
2012	$41,000	$35,000	$266,000	$226,000	$307,000	$261,000
2013	$0	$0	$926,000	$748,000	$926,000	$748,000
2014	$0	$0	$1,181,000	$908,000	$1,181,000	$908,000
2015	$0	$0	$603,000	$442,000	$603,000	$442,000
2016	$0	$0	$10,881,000	$7,586,000	$10,881,000	$7,586,000
2017	$55,000	$37,000	$7,892,000	$5,241,000	$7,947,000	$5,278,000
2018	$0	$0	$452,000	$286,000	$452,000	$286,000
2019	$0	$0	$104,000	$63,000	$104,000	$63,000
2020	$0	$0	$1,419,000	$813,000	$1,419,000	$813,000
2021	$0	$0	$999,000	$546,000	$999,000	$546,000
2022	$0	$0	$1,395,000	$726,000	$1,395,000	$726,000
Total	**$96,000**	**$72,000**	**$26,536,000**	**$17,957,000**	**$26,632,000**	**$18,029,000**

E. Estimated Costs to Businesses

The costs and economic impacts on businesses are presented in this section. The overall impact on business competitiveness, employment, and other impacts on business are also presented.

1. Potential Business Impacts Based on Change to Return on Owners' Equity (ROE)

In this section, we analyze the estimated cost and potential impacts created by the proposed amendments to CHC Regulation on businesses in California. This analysis is based on a comparison of the ROE for affected businesses before and after the inclusion of the regulatory costs. The analysis used publicly available information to assess the impacts on competitiveness, jobs, and business expansion, elimination, or creation. From the limited financial data staff obtained on crew and supply, barge, and dredge owner/operators, approximately 56 percent of these companies would be considered a small business.

Based on 2009 CHC Regulation initial reporting data, staff estimates that there are about 20 crew and supply vessel businesses. Based on the 2007 CHC regulation initial reporting, air district permits, the PERP database, and the 2009 barge and dredge vessel survey about 25 barge and dredge vessel businesses that will be affected by the amendments.

The ROE approach used in evaluating the potential economic impact of the proposed amendments on California businesses is as follows:

(1) Affected businesses were identified from responses to the 2007 CHC Regulation initial reporting requirements, air district permits, the PERP database, and 2009 barge and dredge vessel survey.

(2) The cost for compliance was estimated and averaged over the years a particular company was affected.

(3) The total annual cost for each business was adjusted for both federal and state taxes.

(4) These adjusted costs were subtracted from net profit data, either actual net profit from Dun and Bradstreet or industry averages applied to the number of employees, and the results used to calculate the Return on Owners' Equity (ROE). The resulting ROE was then compared with the ROE before the subtraction of the adjusted costs to determine the impact on the profitability of the businesses.

Using Dun and Bradstreet financial data when data were available, staff calculated the ROEs, both before and after the subtraction of the adjusted annual costs, for the typical businesses from each industry category. These calculations were based on the following assumptions.

- All affected businesses are subject to federal and state tax rates of 35 percent and 9.3 percent, respectively.

- Affected businesses are neither able to increase the prices of their services nor lower their costs of doing business through cost-cutting measures.

These assumptions, though reasonable, might not be applicable to all affected businesses.

As shown in Table D-10, the average ROE of the businesses in the categories listed changed by about 0.95 percent. The decline in profitability was 1.44 percent for crew and supply vessels, and 0.45 percent for barge and dredge vessels. Generally, the ARB considers a 10 percent change in ROE to be the threshold at which businesses experience a significant adverse impact. These businesses, however, are unlikely to have to absorb the entire cost of this proposed amended regulation. To the extent that they are able to pass on the cost of the regulation, the impact on their profitability would be less than estimated here. Thus, staff expects most affected businesses to be able to absorb the cost of the regulation with no significant impact on their profitability.

Table D-10: Affected Businesses with Change in ROE

Category	ROE % Change
Crew and Supply	-1.44%
Barge and Dredge	-0.45%
Average	-0.95%

These businesses may be able to reduce the impact of the proposed amendments on their businesses by taking advantage of available public funding. The costs impacts presented here do not take into consideration the impact of incentive or grant funding. The Carl Moyer Program funding is a potential funding source for companies that comply early or achieve emission reductions beyond the amendments. However, most barges and dredges are not self-propelled and would not be eligible for Moyer funding.

2. Potential Impact on Employment, Business Creation, Elimination or Expansion

a. Potential Impact on Employment

The proposed amendments are not expected to cause a measurable change in California employment and payroll. The staff's profitability analysis shows that the impact on business profitability is minor. The proposed amendments, however, are likely to result in a small increase in employment in businesses that make, sell, install, maintain, and retrofit marine engines. Staff believes jobs will not be eliminated as a result of the amendments, but it may lead to the augmentation or alteration of job duties, leading to a net expansion of boat building, repair, and yard businesses, resulting in an increase in the number of jobs.

b. Potential Impact on Business Creation, Elimination or Expansion

The proposed amendments would have no measurable impact on the status of California businesses. This is because the regulation costs are not expected to impose a significant impact on the profitability of businesses in California. However, some small businesses with little or no margin of profitability may lack the financial resources to comply in a timely manner. These businesses may be able to take advantage of available public funding such as the Carl Moyer program or Proposition 1B funds to lessen the economic impact of the proposed amendments.

While some individual businesses may be affected adversely, the proposed amendments may provide some business opportunities for existing California businesses or result in the creation of new businesses or expansion of current businesses. California businesses that make, install, retrofit, and maintain marine engines may benefit from increased crew and supply, barge, and dredge businesses spending on compliance.

c. Potential Impact on Business Competitiveness

The proposed amendments would have no significant impact on the ability of California businesses to compete with businesses in other states. Non-California vessels operating in California will be required to meet the same regulatory requirements as California-based vessels.

3. Estimated Regulatory Cost for Small and Typical Business

About 60 percent of the companies that own crew and supply vessels are considered small businesses, having less than 100 employees. Approximately 50 percent of the companies operating barge and dredge vessels are considered to be typical businesses, having more than 100 employees. The estimated regulatory cost for small and typical business is presented in Table D-11 and Table D-12. The estimated regulatory cost for a small business ranges from $18,000 to $629,000 for crew and supply business and from $14,000 to $84,000 for barge and dredge business. The estimated regulatory cost for a typical business ranges from $5,000 to $537,000 for crew and supply business and from $27,000 to $584,000 for barge and dredge business.

Table D- 11: Estimated Regulatory Cost for Crew and Supply Small and Typical Business (adjusted to 2009 NPV)

Year	Cost to Small Business			Cost to Typical Business		
	Total Cost	No. of Small Business	Average Cost	Total Cost	No. of Typical Business	Average Cost
2011	$629,000	1	$629,000	$142,000	3	$47,000
2012	$84,000	2	$42,000	$10,000	2	$5,000
2013	$40,000	1	$40,000	$160,000	1	$160,000
2014	$18,000	1	$18,000	$0	0	$0
2015	$30,000	1	$30,000	$768,000	2	$384,000
2016	$91,000	1	$91,000	$69,000	1	$69,000
2017	$338,000	3	$113,000	$236,000	1	$236,000
2018	$485,000	2	$243,000	$0	0	$0
2019	$370,000	4	$93,000	$537,000	1	$537,000
2020	$625,000	3	$208,000	$0	0	$0
2021	$260,000	3	$87,000	$0	0	$0
2022	$1,136,000	4	$284,000	$11,000	1	$11,000

All values rounded

Table D-12: Estimated Regulatory Cost for Barge and Dredge Small and Typical Business (adjusted to 2009 NPV)

Year	Cost to Small Business			Cost to Typical Business		
	Total Cost	No. of Small Business	Average Cost	Total Cost	No. of Typical Business	Average Cost
2011	$15,000	1	$15,000	$59,000	1	$59,000
2012	$0	0	$0	$55,000	2	$28,000
2013	$0	0	$0	$108,000	4	$27,000
2014	$169,000	2	$84,000	$100,000	2	$50,000
2015	$0	0	$0	$112,000	4	$28,000
2016	$269,000	10	$27,000	$1,049,000	8	$131,000
2017	$42,000	3	$14,000	$1,167,000	2	$584,000
2018	$70,000	1	$70,000	$40,000	1	$40,000
2019	$16,000	1	$16,000	$0	0	$0
2020	$0	0	$0	$176,000	1	$176,000
2021	$0	0	$0	$138,000	1	$138,000
2022	$0	0	$0	$148,000	1	$148,000

All values rounded

F. Potential Costs to Local, State, and Federal Agencies

The proposed amendments directly affect a few local, State and Federal agencies. Those public agencies will have an insignificant cost impact to comply with the proposed amendments. The calculated costs are shown in Table D-13. The estimated regulatory costs range from $1,900 to $60,000 (2009 dollars). The estimated new equipment costs range from $24,700 to $393,000 (2009 dollars). These costs will be incurred between 2014 and 2016, because the owners and operators of these engines would not have to comply in the first compliance years because of the original engine model year. Staff estimated the amendments would have no significant impact on these public agencies.

Table D-13: Costs to Local, State, and Federal Agencies

Area	Agency	Compliance Year	Regulatory Costs	Regulatory Costs (2009 NPV)	New Equipment Costs	New Equipment Costs (2009 NPV)
Local	Monterey RWPCA	2016	$1,900	$1,300	$24,700	$17,000
	Santa Cruz Port District	2016	$44,800	$31,600	$393,000	$274,000
	Total		$46,700	$32,900	$417,700	$291,000
Federal	U.S. Army Corps of Engineers	2012 & 2013	$9,100	$7,800	$302,000	$246,000
State	State of California - Parks	2014	$60,000	$47,000	$143,000	$110,000

All values rounded

G. Cost-Effectiveness

In this section, the cost-effectiveness of the proposed amendments to the CHC regulation is estimated. Cost-effectiveness is expressed in terms of control costs (dollars) per unit of air emissions reduced (tons or pounds). As described below, for example, the cost-effectiveness for the proposed amendments is determined by dividing the total cost of the proposed amendments by the total pounds of diesel PM emissions reduced during the years 2011 to 2022. All costs are in 2009 equivalent expenditure dollars. The net present value estimates "today's dollars" of future net cash are also presented.

1. Expected Emission Reductions

Staff estimated the projected total emission reductions under the proposed amendments using the statewide harbor craft inventory. The following Table D-14 and Table D-15 provide a summary of the annual statewide diesel PM and NOx reductions that will result from the amendments. The amendments are expected to reduce almost 293,000 pounds of diesel PM and 1,622 tons of NOx by 2022 for crew and supply vessels, 142,000 pounds of diesel PM and 1,175 tons of NOx for barge and dredge vessels.

Table D-14: Statewide Diesel PM and NOx Annual Emission Reductions from 2011 to 2022 for Crew and Supply Vessels

	PM Reduction (pounds/year)			NOx Reduction (tons/year)		
Year	**Main**	**Aux**	**Total**	**Main**	**Aux**	**Total**
2011	15,999	1,471	17,470	119	13	132
2012	15,370	1,381	16,751	114	12	126
2013	18,657	1,284	19,941	115	11	126
2014	17,433	1,198	18,631	106	11	117
2015	23,207	1,485	24,692	122	13	135
2016	22,247	1,515	23,762	113	13	126
2017	22,852	1,426	24,278	114	12	126
2018	24,010	1,369	25,379	119	12	131
2019	28,502	1,395	29,897	143	11	154
2020	29,036	1,440	30,476	141	11	152
2021	29,161	1,455	30,616	137	10	147
2022	29,429	1,388	30,817	140	10	150
Total	**275,903**	**16,807**	**292,710**	**1,483**	**139**	**1,622**

Values are rounded.

Table D-15: Statewide Diesel PM and NOx Annual Emission Reductions from 2011 to 2022 for Barge and Dredge Vessels

Year	PM Reduction (pounds/year)			NOx Reduction (tons/year)		
	Main	Aux	Total	Main	Aux	Total
2011	0	336	336	0	3	3
2012	132	430	562	1	4	5
2013	0	2,753	2,753	0	23	23
2014	0	1,771	1,771	0	15	15
2015	0	2,454	2,454	0	21	21
2016	0	18,217	18,217	0	149	149
2017	85	22,246	22,331	1	184	185
2018	47	20,760	20,807	0	171	171
2019	39	19,573	19,612	0	160	160
2020	34	20,865	20,899	0	169	169
2021	31	17,123	17,154	0	141	141
2022	29	15,437	15,466	0	133	133
Total	**397**	**141,965**	**142,362**	**2**	**1,173**	**1,175**

Values are rounded.

2. Cost-Effectiveness

To determine the cost-effectiveness of the amendments, we divided the sum of the annual regulatory costs (2011 to 2022) for the amendments by the diesel PM emission reductions over the same time period attributable to the amendments. The regulatory costs include the remaining value of the engine being replaced (engine, supporting equipment, and installation labor), the residual value of the most recent maintenance, and recordkeeping and reporting costs. The estimated overall cost-effectiveness (total PM reduced divided by total regulatory costs) is $32 per pound of diesel PM reduced for crew and supply vessels and $39 per pound of diesel PM reduced for barge and dredge vessels, if all the costs of compliance are allocated to diesel PM reduction, or $35 per pound of diesel PM reduced for both vessel categories.

Since the amendments will also result in reductions in oxides of nitrogen (NOx) emissions, staff conducted a second cost-effectiveness analysis in which half of the cost of compliance was allocated to PM benefits and half the cost was allocated to NOx benefits. This results in cost-effectiveness values of $16/lb for diesel PM and $2,915/ton for NOx for crew and supply vessels, $20/lb for diesel PM and $2,384/ton for NOx for barges and dredges, or $17.30 for diesel PM and $2,600/ton for NOx both vessel categories

A third method to express cost effectiveness is to use the sum of the combined PM and NOx reductions (approximately 3.5 million pounds for crew and supply vessels, 2.5 million pounds for barge and dredge vessels). Using this approach, the resulting cost effectiveness for the proposed amendments is about $2.70 per pound of PM and NOx reduced for crew and supply vessels, $2.25 per pound of PM and NOx reduced for

barge and dredge vessels, or $2.50 per pound of PM and NOx for both vessel categories (2009 dollars). These cost-effectiveness values are presented in 2009 expenditure dollars and adjusted for NPV in Table D-16, Table D-17, and Table D-18 below.

Table D-16: Summary of Average Cost Effectiveness for Crew and Supply Vessels for the period 2011 to 2022

Emissions	Total Emissions Reduced 2011-2022	Total Regulatory Cost 2011-2022	Total Cost-Effectiveness	Total Regulatory Cost 2011-2022 (2009 NPV)	Total Cost-Effectiveness (2009 NPV)
All costs assigned to PM					
PM	293,000 lbs	$9,453,000	$32/lb	$6,105,000	$21/lb
Divide Costs Equally Between PM and NOx					
PM	293,000 lbs	$4,726,000	$16/lb	$3,053,000	$10/lb
NOx	1,600 tons	$4,726,000	$2,915/ton	$3,053,000	$1,882/ton
Combine PM and NOx Emissions					
PM + NOx	3,536,000 lbs	$9,453,000	$2.70/lb	$6,105,000	$1.70/lb

All values rounded

Table D-17: Summary of the Average Cost Effectiveness for Barge and Dredge Vessels for the Period 2011 – 2022

Emissions	Total Emissions Reduced 2011-2022	Total Regulatory Cost 2011-2022	Total Cost-Effectiveness	Total Regulatory Cost 2011-2022 (2009 NPV)	Total Cost-Effectiveness (2009 NPV)
All costs assigned to PM					
PM	142,000 lbs	$5,604,000	$39/lb	$3,825,000	$27/lb
Divide Costs Equally Between PM and NOx					
PM	142,000 lbs	$2,802,000	$20/lb	$1,913,000	$13/lb
NOx	1,200 tons	$2,802,000	$2,384/ton	$1,913,000	$1,628/ton
Combine PM and NOx Emissions					
PM + NOx	2,493,000 lbs	$5,604,000	$2.25/lb	$3,825,000	$1.50/lb

All values rounded

Table D-18: Summary of Average Amended Proposed Regulation Cost-Effectiveness for the Period 2011-2022

Emissions	Total Regulatory Cost		Total Emissions	Total Cost Effectiveness	
	2009 Dollars ($ millions)	NPV ($ millions)	Total Emissions Reduced	2009 Dollars	NPV
All costs assigned to PM					
PM	$15	$9.9	435,000 lbs	$35/lb	$23/lb
Divide Costs Equally Between PM and NOx					
PM	$7.5	$5.0	435,000 lbs	$17/lb	$11/lb
NOx	$7.5	$5.0	2,800 tons	$2,690/ton	$1,780/ton
Combine PM and NOx Emissions					
PM + NOx	$15	$9.9	6,030,000 lbs	$2.50/lb	$1.65/lb

All values rounded

As shown Table D-19, the cost-effectiveness of the proposed amendments is in the range of other regulations recently adopted by the ARB. For example, the diesel PM cost-effectiveness of the solid waste collection vehicle rule was estimated at $28 per pound, excluding the benefits of NOx and hydrocarbon reductions (ARB, 2003a). The cost-effectiveness of the stationary diesel engine airborne toxic control measure (ATCM) was estimated to range from $4 to $26 per pound of diesel PM reduced (ARB,2003b). Finally, the transport refrigeration unit ATCM was estimated to have a cost-effectiveness of $10 to $20 per pound of diesel PM reduced (ARB, 2003c).

Table D-19: Diesel PM Cost Effectiveness of the Proposal and Other Regulations/Measures (Attributes All Costs to Each Pollutant Individually)

Regulation or Airborne Toxic Control Measure	Diesel PM Cost- Effectiveness
	Dollars/ Pound PM
Commercial Harbor Craft (2007)	$29
Commercial Harbor Craft (2010 amendments)	**$35***
In-Use Off-Road Diesel Vehicles	$40
Cargo Handling Equipment Proposal	$41
Solid Waste Collection Vehicle Rule	$28
Stationary Diesel Engine ATCM	$4 - $26
Transport Refrigeration Unit ATCM	$10 - $20

*$23 for Net Present Value

H. Availability of Incentive Funding

Incentive programs have the ability to achieve emissions reductions early or beyond those required by regulations. California has one of the largest clean air incentive programs in the nation – the Carl Moyer Program – with up to $140 million available each year through State and local funds. This level of funding is far from sufficient to pay for all the reductions needed to provide clean air. Incentive programs, such as the Carl Moyer Program, fund the incremental cost of cleaner-than-required engines, equipment, and other sources of pollution providing early or extra emission reductions. Carl Moyer Program emission reductions are credited in California's State Implementation Plan and must be real, surplus to regulatory requirements, quantifiable, and enforceable. To be eligible for Carl Moyer funds, marine vessels must be self-propelled. Most barges and dredges would not be eligible because few have propulsion engines.

The Carl Moyer Program is implemented as a partnership between ARB and the districts. ARB provides program oversight and minimum program requirements and the districts select and fund projects. Statewide, the Carl Moyer Program has been oversubscribed every year, and this continues to be the case today. Eligible marine vessel projects compete with on-road, off-road, agricultural pump, locomotive, and other projects for funding.

In November 2006, California voters approved $1 billion in incentive funding to reduce emissions from goods movement activities. Proposition 1B funds will also be available to eligible commercial harbor craft operators for repowering engines, retrofitting vessels with hybrid systems, and replacing vessels with cleaner models. At the Board meeting held on March 25, 2010, the *Proposed Update to the Proposition 1B Program Guidelines* were approved, which included project options that would fund up to 80% of the cost for non-regulated vessels and up to 50% for the early compliance of regulated vessels. The Board will award the next Proposition 1B funding allocations to local agencies in June 2010 with additional funding to be made available as bond monies are received by ARB.

I. Analysis of Alternatives

In this section, the cost-effectiveness of the proposed amendments is compared to two alternative control options. The first alternative would accelerate the barge and dredge compliance schedule but the crew and supply vessels would follow the proposed compliance schedule. The other alternative is to slow down the compliance timeline for both crew and supply vessels and barge dredge vessels. The first alternative would achieve greater emission reductions, but with higher regulatory cost. The second alternative analyzed results in lower regulatory cost, but emissions are reduced less.

<u>Alternative 1: Accelerate Barge and Dredge Vessels Compliance Schedule and Require the Crew and Supply Vessels to Follow the Proposed Compliance Schedule</u>

For Alternative 1, barge and dredge vessels throughout the State would be subject to a 2011 to 2020 accelerated compliance schedule. Crew and supply vessels would still be subject to the 2011 to 2022 regular compliance schedule. This alternative would speed up the engine replacements in the first five years. The engine replacement comparison for both alternatives is shown in Table 20. The estimated new equipment cost of this alternative is $52 million which is about $6 million higher than the proposed amendments new equipment compliance cost, as shown in Table D-21, and the regulatory cost is $19 million which is about $4 million higher than the proposed amendments regulatory cost, shown in Table D-22. The total diesel PM emissions reduced with this alternative would be greater than with the proposed schedule, 82,000 pounds during the 12 years from 2011 to 2022 as shown in Table D-23. The total NOx reduction of this same time period would be 3,400 tons which is about 600 tons greater than the proposed schedule. The resulting cost-effectiveness for this alternative is higher than the proposed schedule, $37 per pound of diesel PM reduced. The resulting cost effectiveness, dividing the cost equally between diesel PM and NOx, would be $19 per pound of diesel PM reduced and $2,850 per ton of NOx reduced. The cost effectiveness comparison is shown in Table D-24. This alternative has greater emission reductions benefits but with higher regulatory cost.

This alternative further increases the number of vessels complying early and restricts the amount of time and money from funding sources. Also, the additional early expenses for businesses reduce their ability to spread the compliance cost over the proposed time. Based on these reasons, staff does not recommend this alternative.

Table D-20: Statewide Annual In-Use Engine Replacements

Year	Number of Propulsion Engines			Number of Auxiliary Engines		
	Reg	Alt 1	Alt 2	Reg	Alt 1	Alt 2
2011	21	22	10	17	47	2
2012	5	5	2	4	10	5
2013	3	3	10	7	62	8
2014	3	4	2	6	11	7
2015	6	6	2	8	39	1
2016	2	2	2	44	7	7
2017	15	14	7	44	5	3
2018	8	8	0	10	6	37
2019	9	9	4	10	6	43
2020	8	8	20	13	13	12
2021	3	3	17	6	5	19
2022	22	22	25	4	3	10
Total	**105**	**106**	**101**	**173**	**214**	**154**

Table D-21: Statewide Annual New Equipment Compliance Costs for Crew and Supply Vessels and Barge and Dredge Vessels

Year	New Equipment Compliance Costs			New Equipment Compliance Costs (2009 NPV)		
	Reg	Alt 1	Alt 2	Reg	Alt 1	Alt 2
2011	$3,657,000	$7,427,000	$1,152,000	$3,256,000	$6,612,000	$1,026,000
2012	$735,000	$951,000	$611,000	$624,000	$807,000	$518,000
2013	$1,782,000	$15,909,000	$2,229,000	$1,439,000	$12,839,000	$1,801,000
2014	$1,382,000	$2,989,000	$1,046,000	$1,063,000	$2,298,000	$804,000
2015	$2,612,000	$7,501,000	$929,000	$1,913,000	$5,492,000	$680,000
2016	$11,476,000	$1,058,000	$1,392,000	$8,001,000	$738,000	$971,000
2017	$9,354,000	$1,521,000	$2,409,000	$6,213,000	$1,011,000	$1,600,000
2018	$1,753,000	$2,721,000	$10,064,000	$1,109,000	$1,720,000	$6,364,000
2019	$3,011,000	$3,908,000	$7,792,000	$1,815,000	$2,355,000	$4,694,000
2020	$3,314,000	$3,291,000	$3,062,000	$1,901,000	$1,888,000	$1,758,000
2021	$1,848,000	$849,000	$7,250,000	$1,010,000	$464,000	$3,962,000
2022	$5,510,000	$4,115,000	$6,362,000	$2,868,000	$2,142,000	$3,312,000
Total	**$46,437,000**	**$52,240,000**	**$44,298,000**	**$31,212,000**	**$38,366,000**	**$27,490,000**

Values are rounded

Table D-22: Statewide Annual Regulatory Costs for Crew and Supply Vessels and Barge and Dredge Vessels

Year	Regulatory Cost			Regulatory Cost (2009 NPV)		
	Reg	Alt 1	Alt 2	Reg	Alt 1	Alt 2
2011	$932,000	$1,852,000	$410,000	$850,000	$1,684,000	$373,000
2012	$178,000	$466,000	$65,000	$156,000	$403,000	$56,000
2013	$383,000	$4,621,000	$446,000	$313,000	$3,776,000	$368,000
2014	$427,000	$1,331,000	$210,000	$334,000	$1,031,000	$166,000
2015	$1,231,000	$2,790,000	$236,000	$912,000	$2,066,000	$174,000
2016	$2,186,000	$388,000	$262,000	$1,542,000	$273,000	$188,000
2017	$2,683,000	$964,000	$648,000	$1,800,000	$648,000	$432,000
2018	$934,000	$1,136,000	$2,132,000	$598,000	$726,000	$1,369,000
2019	$1,521,000	$1,749,000	$2,113,000	$925,000	$1,063,000	$1,291,000
2020	$1,385,000	$1,441,000	$1,330,000	$803,000	$835,000	$772,000
2021	$725,000	$473,000	$3,316,000	$399,000	$261,000	$1,833,000
2022	$2,472,000	$2,189,000	$2,973,000	$1,298,000	$1,150,000	$1,561,000
Total	**$15,057,000**	**$19,400,000**	**$14,141,000**	**$9,930,000**	**$13,916,000**	**$8,583,000**

Values are rounded

Table D-23: Statewide Annual Diesel PM and NOx Emission Reductions

Year	PM Reductions (pounds)			NOx Reductions (tons)		
	Reg	Alt 1	Alt 2	Reg	Alt 1	Alt 2
2011	17,806	25,552	7,517	135	202	56
2012	17,314	23,051	7,689	132	182	58
2013	22,694	46,574	17,238	149	337	130
2014	20,401	43,420	16,734	131	309	126
2015	27,145	51,578	19,771	156	348	126
2016	41,978	46,068	19,242	275	302	123
2017	46,609	44,695	25,831	311	285	144
2018	46,186	46,781	38,354	301	297	242
2019	49,509	50,293	40,934	314	315	264
2020	51,375	49,714	42,544	321	309	267
2021	47,771	45,730	48,103	288	269	297
2022	46,282	43,544	47,957	282	252	295
Total	**435,071**	**516,999**	**331,913**	**2,796**	**3,409**	**2,128**

Table D-24: Summary of Average Cost-Effectiveness for the Period 2011- 2022

Emissions	Proposed Regulation		Regulation Alternative 1		Regulation Alternative 2	
	Cost in 2009 Dollars	Cost in NPV	Cost in 2009 Dollars	Cost in NPV	Cost in 2009 Dollars	Cost in NPV
All costs assigned to PM						
PM ($/lb)	35	23	38	27	43	26
Divide Costs Equally Between PM and NOx						
PM ($/lb)	17	11	19	14	21	13
NOx ($/ton)	2,690	1,780	2,850	2,040	3,320	2,020
Combine PM and NOx Emissions						
PM + NOx ($/lb)	2.50	1.65	2.65	1.90	3.00	1.90

Values are rounded

Alternative 2: Decelerate the compliance schedule for both crew and supply vessels and barge and dredge vessels

For Alternative 2, the compliance schedule for both crew supply vessels and barge dredge vessels would be decelerated. This would result in many engines being replaced later than the proposed amendments compliance schedule. Both the estimated new equipment cost and regulatory cost of this alternative are lower than the proposed amendments. As shown in Table D-21, the estimated new equipment compliance cost for this alternative is $44 million which is about $2 million lower than the proposed amendments compliance schedule. As shown in Table D-22, the estimated regulatory cost for this alternative is $14 million which is about $1 million lower than the proposed amendments compliance schedule. The diesel PM and NOx reductions associated with this alternative, as shown in Table D-23, would be about 332,000 pounds PM and 2,128 tons of NOx. This alternative has significantly less

emission reductions benefit with a slightly less regulatory cost compared to the proposed amendments compliance schedule. The cost-effectiveness for this alternative is a significantly higher than the proposed amendments at $43 per pound of diesel PM reduced, as shown above in Table D-24.

This alternative would slow down engine replacements resulting in higher diesel PM and NOx emissions. The engine replacement comparison for both alternatives is shown in Table D-20. This alternative was not selected as it is not as cost-effective nor beneficial for air quality and public health as the proposed amendments.

REFERENCES:

(ARB, 2003a) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Residential and Commercial Solid Waste Collection Vehicles*, June, 2003.

(ARB, 2003b) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure for Stationary Compression-Ignition Engines*, September, 2003.

(ARB, 2003c) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate*, October, 2003.