

## **Appendix D**

### **Costs and Cost Methodology**

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## **ECONOMIC IMPACTS ASSESSMENT**

The proposed amendments to the SWCV regulation are expected to provide substantial economic relief to the affected heavy crane fleets compared to the 2011 Truck and Bus regulation and a small increase to administrative reporting costs for reporting SWCVs. This chapter will discuss the methodology used in evaluating the economic impacts and the results of the analysis.

### **(a) OVERVIEW**

For purposes of determining compliance costs and emissions benefits, the business as usual scenario assumes all cranes will comply with the 2011 Truck and Bus regulation requirements beginning in 2019. This business as usual scenario includes costs for replacing existing cranes that currently do not have PM filters in 2019. The proposed amendments would add a new phase-in and associated reporting requirements for heavy crane fleets, which would require heavy cranes to be upgraded to those having 2010 model year or newer engines at a rate of 10 percent of the heavy cranes in the fleet per year from 2019 to 2027. The difference in costs would be the economic impact.

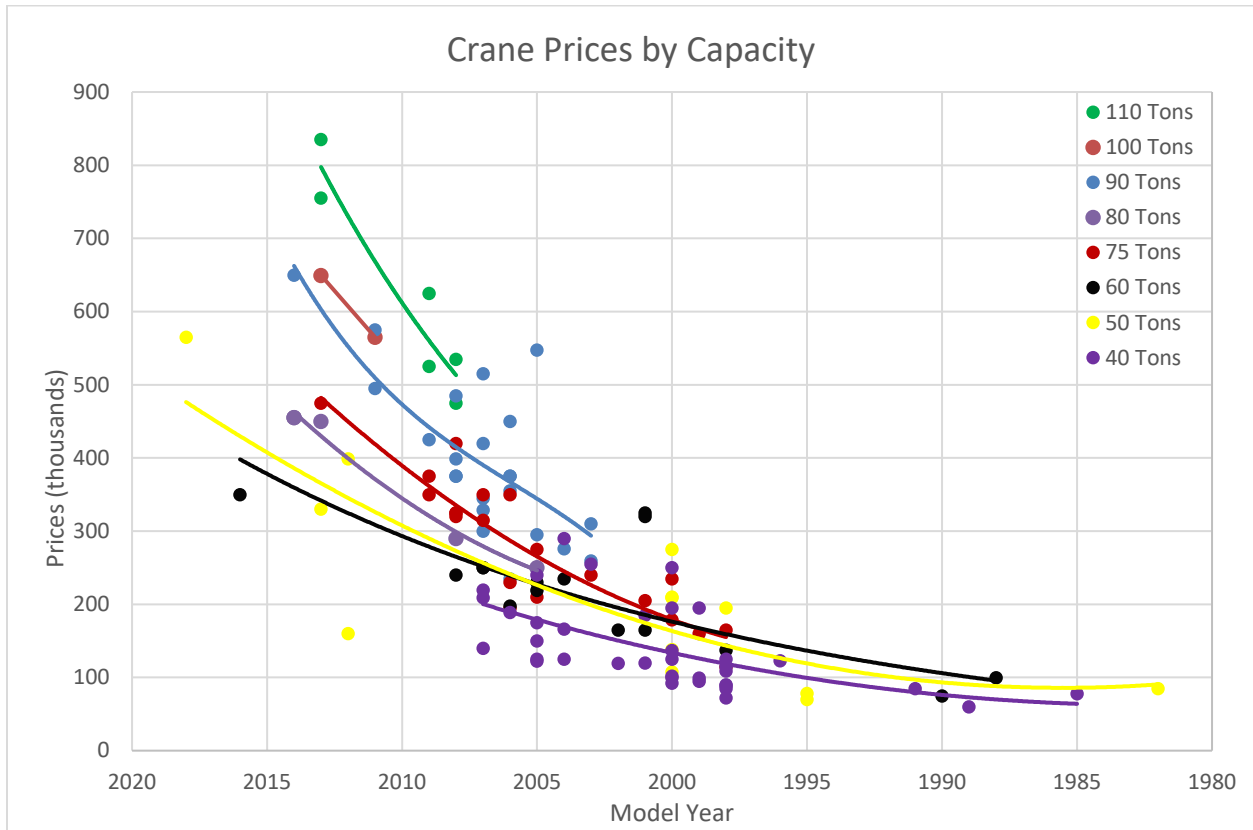
### **(b) DOLLAR CONVERSION AND AMORTIZATION**

The costs of compliance are based on 2018 dollars. Since the costs to meet the 2011 Truck and Bus regulatory requirements and the proposed amendments to the SWCV Regulation compliance are calculated on a year-by-year basis, no conversion is required. The cost of amortization (A) are calculated based on the formula  $A = P * r * (1+r)^n / ((1+r)^n - 1)$ , where P is the principal, n is the number of years, and r is the annual interest rate.

### **(c) HEAVY CRANE REPLACEMENT COST**

For the proposed amendments staff developed price curves by heavy crane capacity using for-sale vehicle price data downloaded from various online sources as of August 2018 (Cranenetwork.com, 2018) (Equipmenttrader.com, 2018) (Michelsmachinery.com, 2018). The stakeholders also provided staff new heavy crane pricing that was found to coincide with the price curves (by heavy crane capacities) shown below in Figure D-1 below.

**Figure D-1: Heavy Crane Prices (in thousands of dollars)**



Staff used the developed price curves in Figure 1 and estimated the residual values of used heavy cranes as shown in Table D-1.

**Table D-1: Estimated Residual Values of Used Heavy Cranes by Capacity**

Capacity	New	Estimated Residual Values		
		10 or less years old	11 to 20 years old	21+ years old
<40 tons	\$300,000	\$180,000	\$90,000	\$54,000
40 tons	\$485,000	\$291,000	\$145,500	\$87,300
45 tons	\$500,000	\$300,000	\$150,000	\$90,000
50 tons	\$575,000	\$345,000	\$172,500	\$103,500
60 tons	\$600,000	\$360,000	\$180,000	\$108,000
70 tons	\$800,000	\$384,000	\$192,000	\$115,200
75 tons	\$825,000	\$396,000	\$198,000	\$118,800
80 tons	\$850,000	\$408,000	\$204,000	\$122,400
90 tons	\$900,000	\$432,000	\$216,000	\$129,600
100 tons	\$1,000,000	\$480,000	\$240,000	\$156,000
110 tons	\$1,250,000	\$500,000	\$250,000	\$162,500
120 tons	\$1,500,000	\$600,000	\$300,000	\$195,000

The replacement cost to meet compliance would be the purchase price of a compliant vehicle subtract the resale value of the used equipment.

**(d) FLEET DATA**

Staff created the business-as-usual heavy crane fleets from the vehicles identified and verified as heavy cranes in the Truck Regulation Upload, Compliance and Reporting System (TRUCRS) as of August 2018. These reported heavy cranes are the ones that will be affected by the proposed amendments. The heavy cranes then were organized by their TRUCRS ID number, VIN, engine model year, and compliance option for the 2018 calendar year. Staff assumed that heavy cranes in Low-Use, an option that exempts the heavy cranes from the upgrade requirement, would continue be a low-use vehicle (proposed amendment for Backup vehicles traveling limited miles) and are excluded from the compliance analysis.

**(e) COST METHODOLOGY**

Staff estimated the economic impacts of removing heavy cranes from the 2011 Truck and Bus regulation and placing them in the SWCV Regulation. To perform this evaluation, staff estimated the costs that the fleet owners would incur to meet the 2011 Truck and Bus regulatory requirements and the costs associated with the proposed amendments to the SWCV Regulation from 2019 to 2027. The difference represents the economic impact.

**(f) ESTIMATED COSTS TO COMPLY WITH THE 2011 TRUCK AND BUS REGULATION REQUIREMENTS (BUSINESS AS USUAL)**

The 2011 Truck and Bus regulation requires that heavier vehicles be equipped with a PM filter starting in 2012 and later be replaced with those that meet the 2010 or newer emission standard. Because owners had limited ability to safely retrofit heavy cranes with PM filters, CARB granted heavy crane owners annual PM filter extensions until January 1, 2018. In 2018, all heavy crane operators were operating under the expectation that 10 percent of their cranes needed to have 2010 engines starting January 1, 2018 and the cranes that were already equipped with PM filters would not need to be replaced. Crane owners were required to report their crane information to demonstrate compliance. Because the 2014 amendments are being rescinded, heavy cranes that do not have PM filters are non-compliant and must be retired or replaced immediately. The replacement schedule is shown in Table D-2 below.

**Table D-2: Heavier Vehicle Replacement Schedule (Business as Usual)**

Engine Model	Compliance Deadlines
	2010 Engine By
Pre 1996	Jan. 1, 2019
1996-2006	Jan. 1, 2019
2007-2009	Jan. 1, 2023

Although the 2011 Truck and Bus regulation only requires the non-compliant heavy cranes be replaced with those that meet the 2010 or newer model year engine emissions standard, staff assumed owners would replace used equipment with new heavy cranes. There are three reasons for the assumption. The foremost is that some heavy cranes perform special tasks. By replacing with a newer used model, the heavy crane owner might have to modify the replacement heavy crane to suit the special needs. The second reason is availability, in that the vehicle owner might have difficulty finding newer used heavy cranes that meet the higher capacity needed. Lastly, at the workshops, heavy crane fleet owners stated that they typically purchase new cranes.

Today there are about 681 heavy cranes in California where 242 (36 percent) have 2010 or newer engines. However, now that the 2014 amendments are being rescinded, heavy cranes that could not be retrofitted with a PM filter will need to be replaced or parked immediately, and all other cranes with pre-2010 engines will need to be replaced between 2020 and 2023. Staff evaluated the business-as-usual heavy crane fleets and determined the replacements required each year between 2020 and 2023 to meet the 2011 Truck and Bus regulatory requirement. Table D-3 below shows the number of heavy cranes, by capacity, that must be replaced per the engine model year schedule.

**Table D-3: Number of Replacements per Year**

Replacement Year	Engine Model Year	Capacity														Total
		110	100	90	80	75	70	60	45	40	35	30	20	16	Unknown	
2019	Pre 1996	2			2	1	1	2		1	9	7			27	52
	1996 - 1999					1	9	1		17	2	3			43	76
	2000 - 2004			3	1	4	1	2	1	32	2				68	114
	2005 - 2006			6	1	3		1	1	20					37	69
2023	2007 - 2009	3	4	31	3	13		4		4	1		2	2	58	125

Using the replacement cost method specified in Section (A)(2), staff calculated the costs to meet the 2011 Truck and Bus regulatory requirement as shown in Table D-4. The costs are in 2018 dollars.

**Table D-4: Full Costs to Meet Business as Usual Requirements by Compliance Year**

	Business as Usual Requirements	
Calendar Year	# Replacements	Costs
2019	311	\$91,346,600
2023	125	\$44,319,000

As stated earlier, staff assumed owners would replace used equipment with new heavy cranes, and the costs per year shown above are total costs. However, it is unlikely that

heavy crane owners would pay for these cranes in full at the time of purchase. In general, the costs of the new heavy cranes are paid in installments over a period of several years. Staff calculated the compliance costs per year, assuming the payment period to be six years with an interest rate of six percent, which is typical for a crane purchase loan (CARB, 2018). Table D-5 shows the amortized compliance costs per year.

**Table D-5: Amortized Costs to Comply with the Business as Usual Requirements**

Calendar Year	Amortized Costs (Business as Usual)
2019	\$18,576,485
2020	\$18,576,485
2021	\$18,576,485
2022	\$18,576,485
2023	\$27,589,313
2024	\$27,589,313
2025	\$9,012,828
2026	\$9,012,828
2027	\$9,012,828
2028	\$9,012,828
2029	\$0
2030	\$0

**(g) ESTIMATED COSTS TO MEET THE PROPOSED AMENDMENTS**

The amendments to the SWCV Regulation would create a new phase-in option and associated reporting requirements for heavy crane fleets, which would require heavy cranes to be upgraded to those having 2010 model year or newer engines at a rate of 10 percent of the heavy cranes in the fleet per year from 2019 to 2027. The proposed schedule is shown in Table D-6. Heavy cranes that are equipped with a retrofit or OEM PM filter before January 1, 2018 are counted as meeting the 2010 engine requirement and are exempt from the replacement requirement.

**Table D-6: Proposed Phase-in Option**

Compliance Deadline as of January 1	Required Heavy crane Fleet Upgrades to 2010 Model Year Engines			
	1 Heavy crane Owner	2 Heavy crane Owner	3 Heavy crane Owner	4 or More Heavy cranes
2019			1	20%
2020		1		30%
2021				40%
2022	1		1	50%
2023				60%
2024				70%
2025		1		80%
2026			1	90%
2027				100%

Based on the replacement percentage set in Table D-6, staff evaluated the (business-as-usual) heavy crane fleets one by one and determined the number of heavy cranes that need to be replaced for each calendar year between 2019 and 2027. Because the replacement requirement for the phase-in option is not engine model year specific, staff made the assumption that fleet owners would replace the oldest heavy cranes first, except for those that the owner had identified as a Backup (low-use) vehicle. To be consistent with the 2011 Truck and Bus regulatory replacement calculation, staff also assumed the replacements would be new heavy cranes even though the phase-in option only requires replacement heavy cranes to be 2010 or newer model year engine compliant. Table D-7 below shows the number of heavy cranes by capacity that must be replaced per the new phase-in option.

**Table D-7: Replacement Requirement per Proposed Phase-in Option**

Replacement Year	Capacity													Total	
	120	90	80	75	70	60	45	40	35	30	28	25	14		Unknown
2019					1			1						3	5
2020			1	1	2	1				1		1		5	12
2021								2						3	5
2022			2		3			5	4	1		1	1	63	80
2023	1			1				7	2					4	15
2024			1					9	2			1		9	22
2025	1	1			1	1		10	1				1	21	37
2026		3		2	3	2		5	2		1		1	25	44
2027		5		3	2	1	1	6	2					14	34



Using the replacement cost method specified in Section (A)(2), Staff calculated the costs for the phase-in option. The costs to comply between 2019 and 2023 calendar years are shown in Table D-8. The costs are in 2018 dollars.

**Table D-8: Full Costs to Meet the Phase-In Option per Compliance Year**

Calendar Year	Heavy crane Phase-In Option	
	# Replacements	Costs
2019	5	\$1,820,500
2020	12	\$5,017,400
2021	4	\$1,533,400
2022	80	\$22,096,500
2023	15	\$6,061,700
2024	22	\$7,034,500
2025	37	\$12,540,400
2026	44	\$15,681,700
2027	34	\$14,564,400

Once again, the costs per year are calculated based on the values of new heavy cranes paid in full in the compliance year. Staff recalculated the compliance costs per year, assuming the payment period to be six years with an interest rate of six percent. Table D-9 shows the amortized compliance costs per year.

**Table D-9: Amortized Costs to Phase-In Option**

Compliance Year	Amortized Costs
2019	\$644,741
2020	\$1,665,093
2021	\$1,976,929
2022	\$6,470,531
2023	\$7,703,254
2024	\$8,859,290
2025	\$11,039,317
2026	\$13,208,037
2027	\$15,858,055
2028	\$11,364,453
2029	\$10,131,730
2030	\$8,701,175
2031	\$6,150,926
2032	\$2,961,855

## (h) REPORTING COSTS

When calculating the reporting costs, staff used the similar assumptions as in the 2008 Truck and Bus Regulation Technical Supporting Document (ARB, 2008). Since the 2011 Truck and Bus Regulation does not require reporting of any vehicles with a 2010 or newer engine and because staff assumed heavy cranes to be replaced with new ones (cranes with 2010 or later model year engines), the corresponding reporting cost of replacements to meet the 2011 Truck and Bus Regulation from 2020 to 2023 would be zero.

With regard to the proposed amendments, there are initial reporting costs for the in-use solid waste vehicles and accrued annual reporting costs for fleets utilizing the new phase-in option. The reporting of in-use solid waste vehicles is currently not required though almost half of the fleets are already reported. However, under the proposed amendments, all solid waste vehicles would have to be reported in TRUCRS. The costs incurred would predominately be for the initial reporting since minimal updates would only be needed for a small number of vehicles. The reporting costs for the Heavy Crane Phase-In Option, on the other hand, would be annual because crane fleets would have to select compliance options yearly due to changes in compliance requirements. There would not be an initial reporting cost since all cranes have already been reported in TRUCRS. The total reporting costs are shown in Table D-10.

**Table D-10: Reporting Costs for the Proposed Amendments**

Calendar Year	Solid Waste Vehicles	Heavy Cranes	Total
2019	\$78,450	\$13,275	\$91,725
2020	\$4,903	\$13,275	\$18,178
2021	\$4,903	\$13,275	\$18,178
2022	\$4,903	\$13,275	\$18,178
2023	\$4,903	\$13,275	\$18,178
2024	\$4,903	\$13,275	\$18,178
2025	\$4,903	\$13,275	\$18,178
2026	\$4,903	\$13,275	\$18,178
2027	\$4,903	\$13,275	\$18,178
2028	\$4,903	\$488	\$5,391
2029	\$4,903	\$488	\$5,391
2030	\$4,903	\$488	\$5,391
2031	\$4,903	\$488	\$5,391
2032	\$4,903	\$488	\$5,391

## (i) THE ECONOMIC IMPACT OF THE PROPOSED AMENDMENTS

The economic impacts would be the difference in costs between complying with the 2011 Truck and Bus regulation and the proposed amendments to the SWCV Regulation. Table D-11 shows the side-by-side amortized costs for business as usual and the proposed amendments to the SWCV Regulation. As shown in Table 13, the

proposed amendments smooth out the compliance costs over several years with an overall savings of about \$59 million.

**Table D-11: Side by Side Yearly Costs**

Calendar Year	Business as Usual Compliance	Proposed Amendments Upgrades	Proposed Amendments Reporting	Incremental Difference
2019	\$18,576,485	\$644,741	\$91,725	(\$17,840,019)
2020	\$18,576,485	\$1,665,093	\$18,178	(\$16,893,214)
2021	\$18,576,485	\$1,976,929	\$18,178	(\$16,581,378)
2022	\$18,576,485	\$6,470,531	\$18,178	(\$12,087,775)
2023	\$27,589,313	\$7,703,254	\$18,178	(\$19,867,881)
2024	\$27,589,313	\$8,859,290	\$18,178	(\$18,711,845)
2025	\$9,012,828	\$11,039,317	\$18,178	\$2,044,666
2026	\$9,012,828	\$13,208,037	\$18,178	\$4,213,386
2027	\$9,012,828	\$15,858,055	\$18,178	\$6,863,405
2028	\$9,012,828	\$11,364,453	\$5,391	\$2,357,015
2029	\$0	\$10,131,730	\$5,391	\$10,137,120
2030	\$0	\$8,701,175	\$5,391	\$8,706,566
2031	\$0	\$6,150,926	\$5,391	\$6,156,317
2032	\$0	\$2,961,855	\$5,391	\$2,967,245
			Total	(\$58,536,391)

**(j) REFERENCES**

Cranenetwork.com, August 2018, <https://cranenetwork.com>

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