

Appendix I

Modified Baseline Analysis

Advanced Clean Fleets Regulation

California Air Resources Board

Date of Release: August 30, 2022

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I. Introduction and Background

As previously discussed, the Legal Baseline used for impact analysis did not include implementation of the Heavy-Duty Inspection and Maintenance (HD I/M) regulation because its approval was not finalized. Therefore, staff is including an additional analysis here that compares the proposed regulation to a Modified Baseline. The Modified Baseline accounts for the effects of the HD I/M regulation, which was heard by the Board in December 2021 but has not yet been approved by Office of Administrative Law. The HD I/M regulation would reduce statewide particulate matter (PM) and oxides of nitrogen (NOx) emissions from heavy-duty engines by ensuring that the emission control systems are operating as designed and are repaired in a timely manner if they malfunction. The HD I/M regulation is anticipated to be fully approved into the California Code of Regulations by the time the proposed regulation would be implemented in 2023. In addition, the Modified Baseline accounts for the potential effects of the proposed Advanced Clean Cars (ACC) II regulation that is expected to lower criteria emissions standards for Class 2b-3 vehicles that would be included in the proposed regulation. The ACC II regulation is anticipated to be presented to the Board in the summer of 2022, but that regulation's impacts on the proposed ACF regulation's emissions benefits are negligible, accounting for less than 0.1 tons per day for vehicles over 8500 pounds Gross Vehicle Weight Rating (GVWR). In general, staff used the same benefit and cost impact analysis methodologies as described above for the Legal Baseline to analyze the scenario including the proposed HD I/M and ACC II regulations in the baseline. Broadly, the Modified Baseline has lower criteria pollutant emissions and higher costs than the Legal Baseline which changes both the costs and benefits of the proposed regulation. The Modified Baseline does not substantially change the alternatives analysis, nor the conclusions drawn when using the Legal Baseline.

II. Benefits

A. Criteria Emissions Benefits

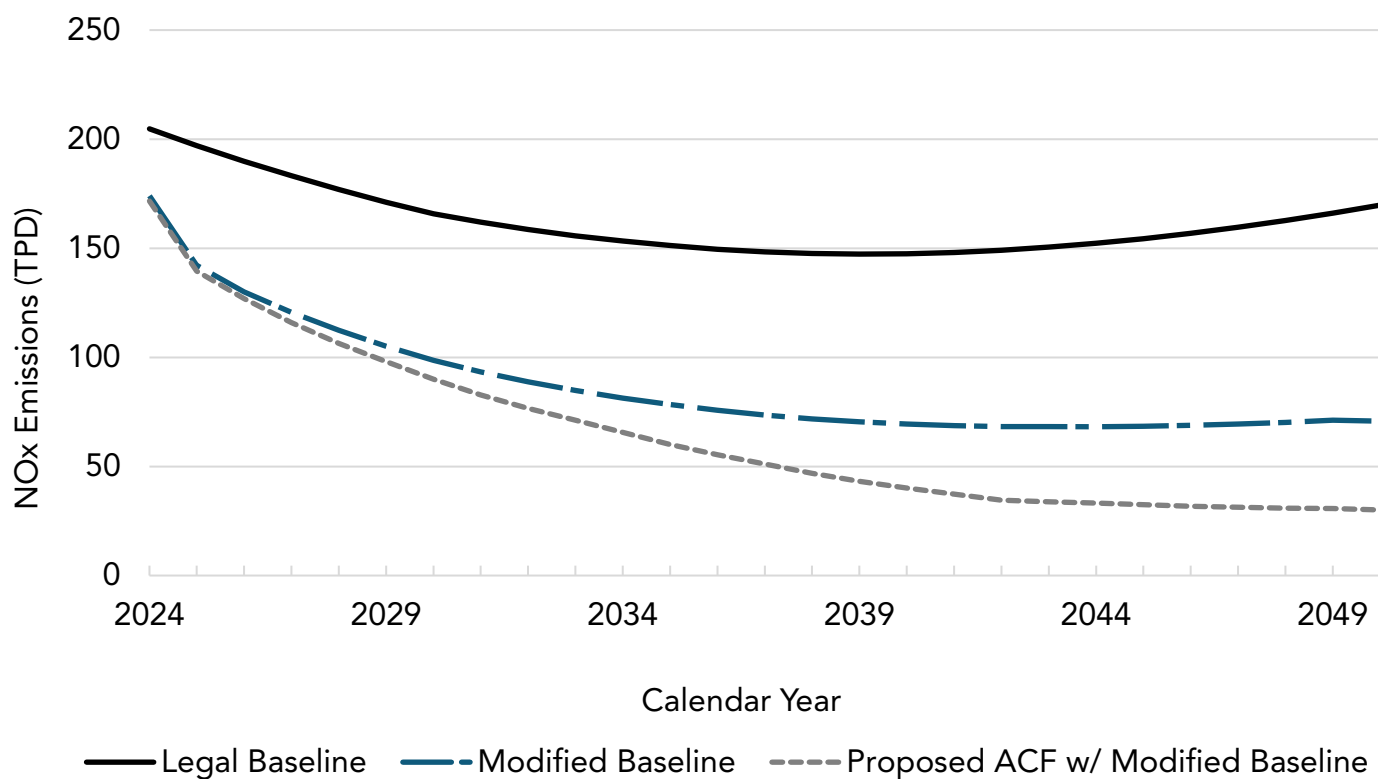
The emissions benefits for the proposed ACF regulation with the Modified Baseline are shown in Table 1. The cumulative NOx and PM emissions benefits of the proposed ACF regulation with the Modified Baseline are projected to be about 55 percent and 25 percent lower respectively, compared to the analysis using the Legal Baseline because the HD I/M program will ensure that heavy-duty engine emissions standards continue to be met throughout the vehicles' operating life through implementation of more comprehensive vehicle inspection and maintenance. This change lowers both the NOx and PM emissions benefits expected from the proposed ACF regulation when a zero-emission vehicle (ZEV) is purchased instead of an internal combustion engine (ICE) vehicle.

Table 1. Projected Statewide Tank-to-Wheel NOx and PM2.5 Emissions Benefits of the Proposed ACF Regulation with the Modified Baseline

Calendar Year	NOx (tpd)	PM2.5 (tpd)
2024	2.4	0.030
2025	2.6	0.032
2026	3.1	0.047
2027	4.8	0.072
2028	6.0	0.092
2029	7.1	0.13
2030	8.7	0.18
2031	10.6	0.245
2032	12.2	0.303
2033	13.6	0.354
2034	15.8	0.433
2035	18.3	0.523
2036	20.3	0.599
2037	22.5	0.682
2038	24.9	0.768
2039	27.3	0.861
2040	29.2	0.942
2041	31.4	1.09
2042	33.8	1.21
2043	34.4	1.27
2044	35.0	1.33
2045	36.0	1.40
2046	37.0	1.47
2047	38.2	1.54
2048	39.3	1.61
2049	40.5	1.68
2050	40.7	1.74

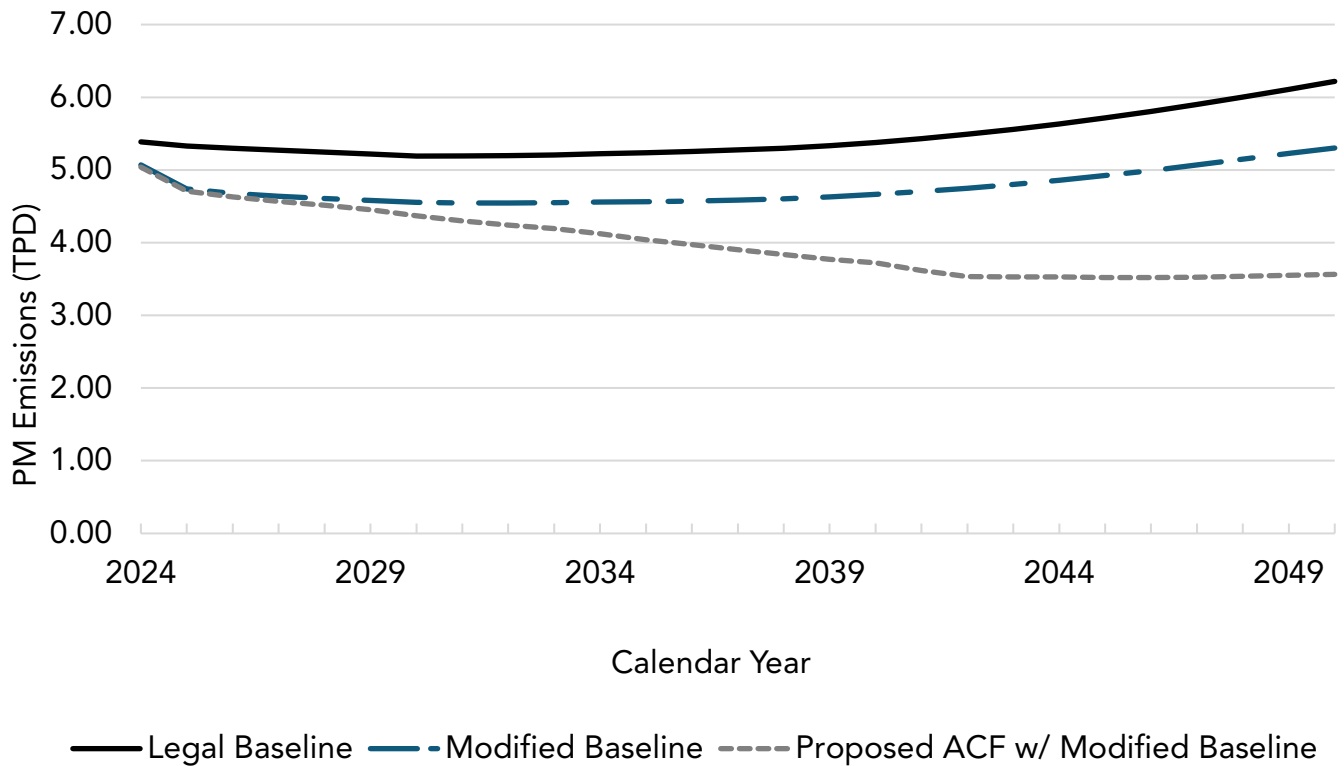
Figure 1 compares the NOx emissions of the proposed ACF regulation with Modified Baseline, the Legal Baseline, and the Modified Baseline scenarios. The cumulative NOx emissions benefits of the proposed regulation with the Modified Baseline compared to the Legal Baseline and Modified Baseline from 2024-2050 are approximately 815,000 tons and 185,800 tons, respectively.

Figure 1. Projected Tank-to-Wheel NOx Emissions Benefits for the Proposed ACF Regulation with Modified Baseline relative to the Legal Baseline and Modified Baseline (tpd)



Similarly, Figure 2 compares the PM emissions for the proposed ACF regulation with the Modified Baseline, Legal Baseline, and Modified Baseline. The cumulative PM emissions benefits of the proposed ACF regulation with the Modified Baseline compared to the Legal Baseline and Modified Baseline from 2024-2050 are approximately 12,400 tons and 6,400 tons, respectively.

Figure 2. Projected Tank-to-Wheel Particulate Matter Emissions Benefits for the Proposed ACF Regulation with Modified Baseline Relative to the Legal Baseline and Modified Baseline (tpd)



B. GHG Emissions Benefits

The HD I/M regulation does not change the GHG emissions of heavy-duty vehicles, so there are no changes in the GHG emissions reductions or SC-CO₂ between the Modified Baseline and the Legal Baseline. All GHG emission calculations and results from ISOR Chapter V – Air Quality, Section C – Emissions Inventory Results, Subsection 2 – Greenhouse Gas Benefits are identical between the two baseline scenarios.

C. Health Benefits

Table 2 summarizes staff’s estimated avoided statewide and regional premature mortality, hospitalizations, and emergency room (ER) visits associated with the proposed ACF regulation relative to the Modified Baseline for 2024 through 2050.

Table 2. Regional and Statewide Avoided Mortality and Morbidity Incidents from 2024 to 2050 Under the Proposed ACF Regulation Versus the Modified Baseline

Air Basin	Avoided Cardiopulmonary Deaths	Avoided Hospitalizations for cardiovascular illness	Avoided Hospitalizations for respiratory illness	Avoided ER visits for asthma
Great Basin Valleys	2 (1 - 2)	0 (0 - 0)	0 (0 - 1)	1 (0 - 1)
Lake County	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	47 (37 - 57)	7 (0 - 14)	8 (2 - 15)	18 (11 - 25)
Mountain Counties	26 (20 - 32)	2 (0 - 5)	3 (1 - 5)	9 (5 - 12)
North Central Coast	13 (10 - 15)	2 (0 - 4)	3 (1 - 5)	7 (4 - 10)
North Coast	5 (4 - 6)	1 (0 - 1)	1 (0 - 1)	2 (1 - 2)
Northeast Plateau	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Sacramento Valley	127 (99 - 155)	16 (0 - 32)	19 (5 - 34)	47 (30 - 65)
Salton Sea	34 (27 - 42)	5 (0 - 10)	6 (1 - 11)	16 (10 - 22)
San Diego County	128 (100 - 156)	19 (0 - 38)	23 (5 - 40)	50 (32 - 69)
San Francisco Bay	238 (186 - 292)	38 (0 - 75)	46 (11 - 81)	128 (81 - 175)
San Joaquin Valley	495 (388 - 604)	63 (0 - 123)	75 (18 - 132)	175 (111 - 239)
South Central Coast	36 (28 - 44)	6 (0 - 11)	7 (2 - 12)	15 (10 - 21)
South Coast	1696 (1327 - 2074)	292 (0 - 572)	349 (82 - 615)	852 (539 - 1165)
Statewide	2850 (2228 - 3485)	452 (0 - 886)	540 (126 - 952)	1321 (836 - 1807)

The total statewide valuation of health benefits for the proposed ACF regulation with the Modified Baseline are estimated to be \$29.9 billion as summarized in Table 3. The health benefit valuation is about 14 percent lower relative to the analysis using the Legal Baseline, due to the lower projected NOx and PM emissions benefits.

Table 3. Statewide Valuation from Avoided Health Outcomes for the Proposed ACF Regulation versus the Modified Baseline (million 2021\$)

Year	Avoided cardiopulmonary mortality	Avoided hospitalizations for cardiovascular illness	Avoided hospitalizations for respiratory illness	Avoided ER visits for asthma	Avoided annual total valuation*
2024	8	1	1	4	\$83.75
2025	8	1	1	4	\$83.75
2026	11	1	2	5	\$115.17
2027	16	2	3	8	\$167.55
2028	21	3	3	10	\$219.89
2029	26	4	4	12	\$272.27
2030	33	5	6	16	\$345.62
2031	42	6	7	20	\$439.83
2032	50	7	9	24	\$523.63
2033	57	9	10	27	\$596.99
2034	67	10	12	32	\$701.70
2035	79	12	15	38	\$827.44
2036	90	14	17	42	\$942.67
2037	101	16	19	47	\$1,057.90
2038	113	18	21	53	\$1,183.58
2039	125	20	24	59	\$1,309.32
2040	136	22	26	63	\$1,424.54
2041	150	24	29	70	\$1,571.19
2042	165	26	31	76	\$1,728.24
2043	170	27	32	79	\$1,780.62
2044	176	28	34	81	\$1,843.52
2045	183	29	35	84	\$1,916.81
2046	190	31	37	87	\$1,990.22
2047	198	32	38	90	\$2,073.97
2048	205	33	40	94	\$2,147.32
2049	213	35	42	97	\$2,234.19
2050	217	36	42	99	\$2,273.07
Total Benefit*	\$29,796.61	\$27.91	\$29.09	\$1.17	\$29,851.77

*Note: Totals may differ due to rounding

III. Costs

A. Direct Costs

The Modified Baseline has higher costs than the Legal Baseline due to the costs associated with the HD I/M regulation which affects non-gasoline Class 4-8 vehicles operating within California. ZEVs are not subject to many provisions of the HD I/M regulation and as a result can avoid many of the costs associated with the regulation.¹ Costs associated with the HD I/M regulation are derived from the Staff Report and are summarized in Table 4. These costs differ depending on whether the vehicle is based in-state or out-of-state, and whether the vehicle is equipped with on-board diagnostics (OBD).

Table 4. Annual Heavy-Duty Inspection and Maintenance Costs per Vehicle

Cost Category	Non-OBD In-State	Non-OBD Out-of-State	OBD In-State	OBD Out-of-State	ZEV
Inspection Result Reporting	\$5.70	\$5.70	\$0	\$0	\$0
Periodic Testing and Follow-up Testing	\$41	\$401	\$24	\$24	\$0
Repair Costs	\$279	\$211	\$228	\$172	\$0

The cost of the proposed ACF regulation, assuming all cost increases would be borne by fleets operating in California, is -\$13.4 billion between 2020 and 2050 compared to the Modified Baseline. These savings are \$0.9 billion greater than when the proposed ACF regulation is compared to the Legal Baseline. Figure 3 and Table 5 illustrate the incremental difference in cost between the proposed ACF regulation and the Modified Baseline scenario. For simplicity, all costs which are identical to the Legal baseline have been lumped together into one group, titled "Cost Versus Legal Baseline", which are identical to the costs displayed in the Staff Report. The benefit-cost ratio of the proposed regulation versus the modified baseline is shown in Table 6.

¹ California Air Resources Board, [Proposed Heavy-Duty Inspection and Maintenance Regulation – Appendix F: Further Details on Costs and Economic Analysis](https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/hdim2021/appf.pdf), 2021 (web link: <https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/hdim2021/appf.pdf>, last accessed January 2022).

Figure 3. Total Estimated Direct Costs of Proposed ACF Regulation Relative to the Legal Baseline Scenario (million 2021\$)

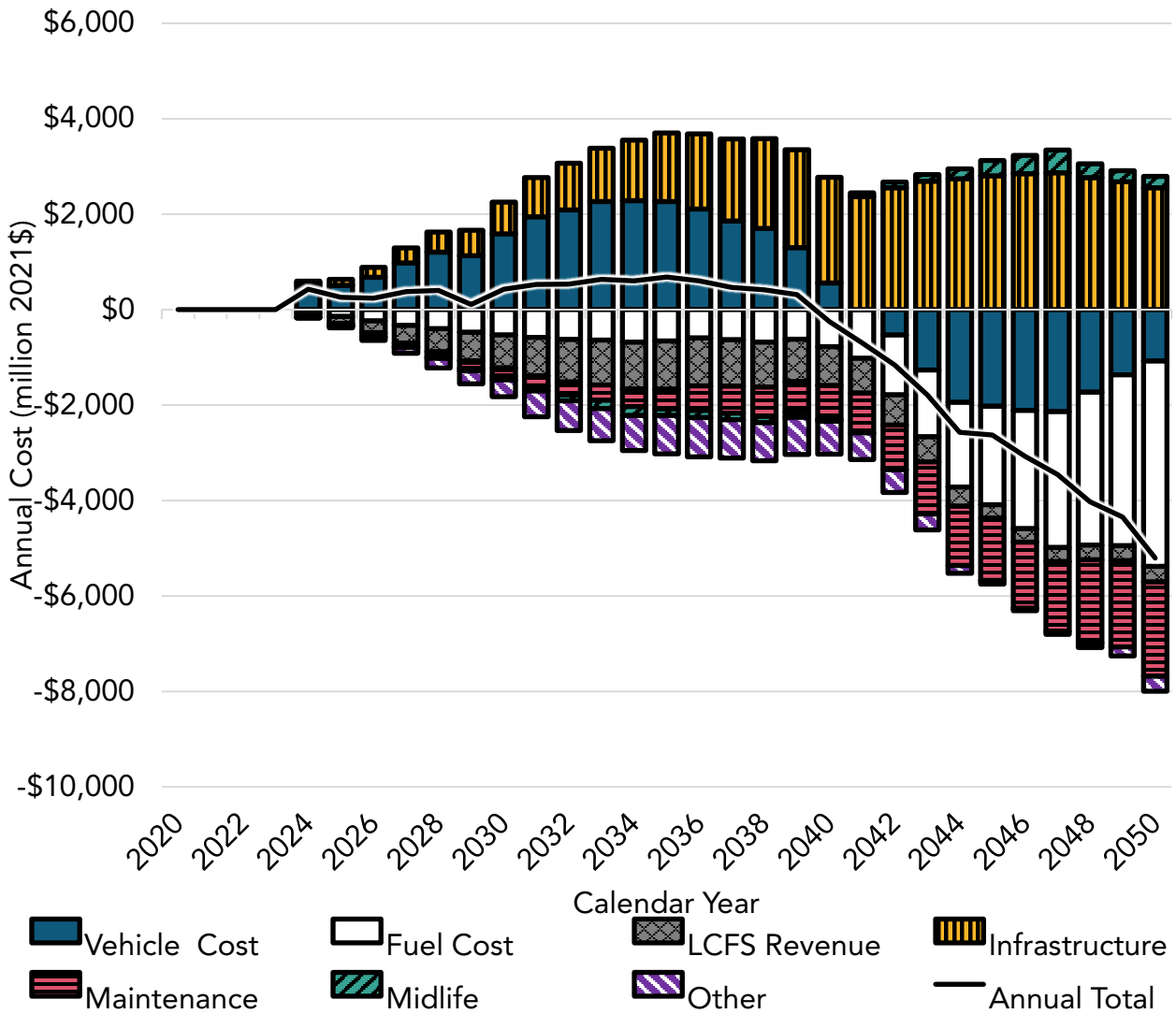


Table 5. Total Incremental Direct Costs of Proposed ACF Regulation Relative to Modified Baseline Scenario (million 2021\$)

Year	Cost Versus Legal Baseline	Heavy-Duty Inspection and Maintenance Program	Total*
2024	\$426	-\$1	\$425
2025	\$253	-\$2	\$250
2026	\$236	-\$4	\$232
2027	\$374	-\$6	\$368
2028	\$402	-\$8	\$394
2029	\$103	-\$11	\$92
2030	\$427	-\$13	\$413
2031	\$524	-\$16	\$508
2032	\$533	-\$20	\$514
2033	\$634	-\$22	\$611
2034	\$598	-\$26	\$572
2035	\$680	-\$30	\$650
2036	\$598	-\$32	\$566
2037	\$463	-\$35	\$428
2038	\$409	-\$38	\$371
2039	\$310	-\$41	\$269
2040	-\$256	-\$43	-\$299
2041	-\$698	-\$45	-\$743
2042	-\$1,162	-\$48	-\$1,210
2043	-\$1,790	-\$49	-\$1,839
2044	-\$2,576	-\$51	-\$2,627
2045	-\$2,629	-\$53	-\$2,682
2046	-\$3,075	-\$55	-\$3,130
2047	-\$3,457	-\$58	-\$3,515
2048	-\$4,026	-\$60	-\$4,086
2049	-\$4,343	-\$63	-\$4,406
2050	-\$5,206	-\$66	-\$5,272
Total*	-\$22,163	-\$899	-\$23,063

*Note: Totals may differ due to rounding

Table 6. Benefit-Cost Ratio of the Proposed ACF Regulation Versus the Modified Baseline (billion \$2021)

-	Total Costs	Cost-Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Proposal	\$63.4	\$86.4	\$31.7	-\$33	\$85.1	\$21.7	1.3

B. Macroeconomics

Table 7, Table 8, Figure 4 and Figure 5 shows the impact of the proposed ACF regulation relative to the Modified Baseline on select macroeconomic indicators in the economy. The macroeconomic analysis of the proposed ACF regulation using the Modified Baseline shows that the major macroeconomic indicators would have a similar range of impact as using the Legal Baseline from 2024 to 2050, though they vary by year.

Table 7. Change in the Growth of Economic Indicators Relative to the Modified Baseline

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
	Change (2021M\$)	-43	-2,420	-4,168	-5,276	-3,796	-2,293	-4,276
Personal Income	% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
	Change (2021M\$)	-764	-3,854	-6,195	-7,140	-4,744	-2,180	-2,070
Employment	% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
	Change in Jobs	21	-18,836	-33,107	-43,138	-34,578	-25,573	-41,992
Output	% Change	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%	-0.10%
	Change (2021M\$)	-99	-4,256	-7,379	-9,506	-7,440	-5,253	-9,117
Private Investment	% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
	Change (2021M\$)	-172	-1,040	-1,141	-453	1,200	2,437	2,492

Figure 4. Job Impacts by Major Sector Relative to the Modified Baseline

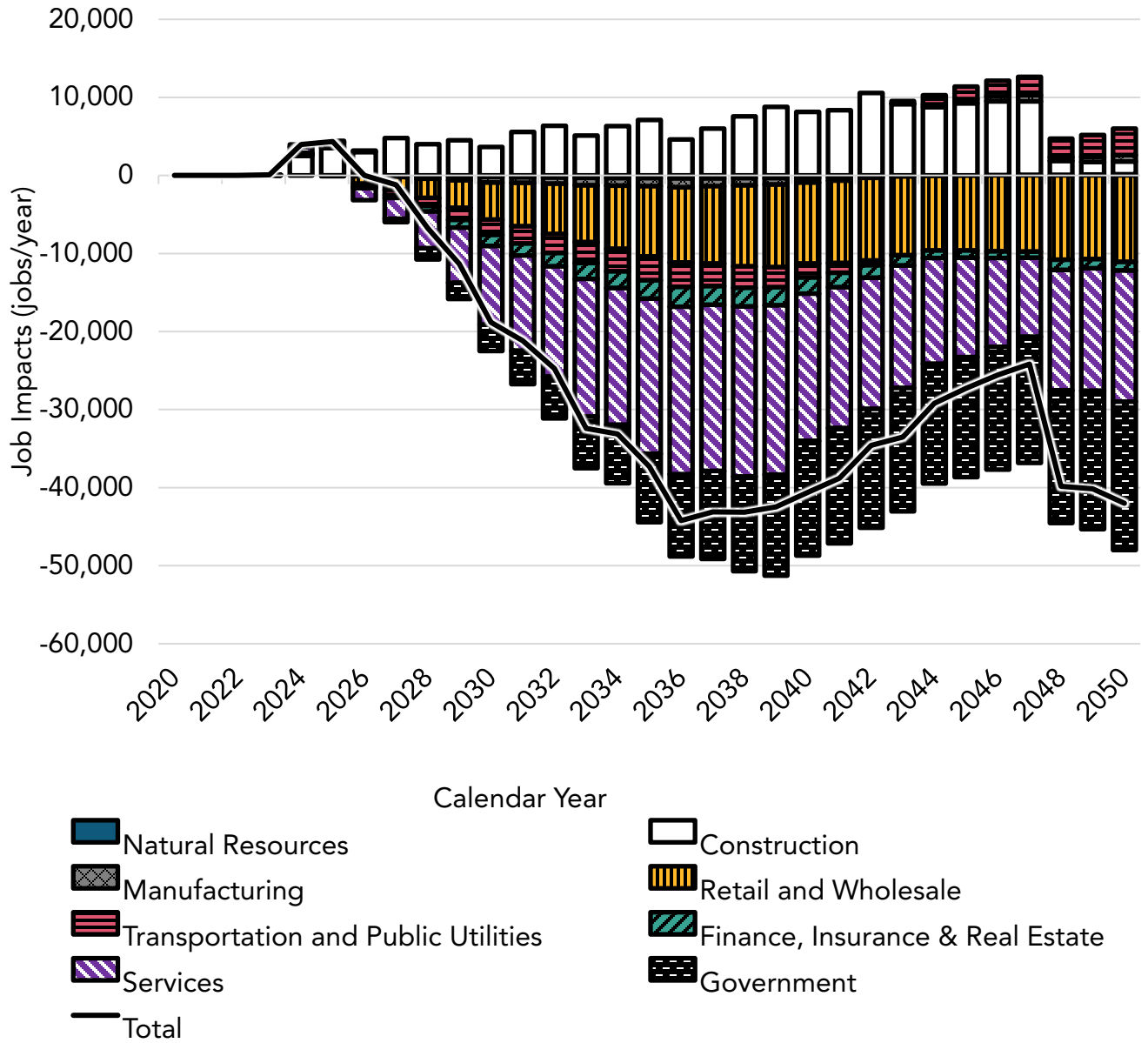
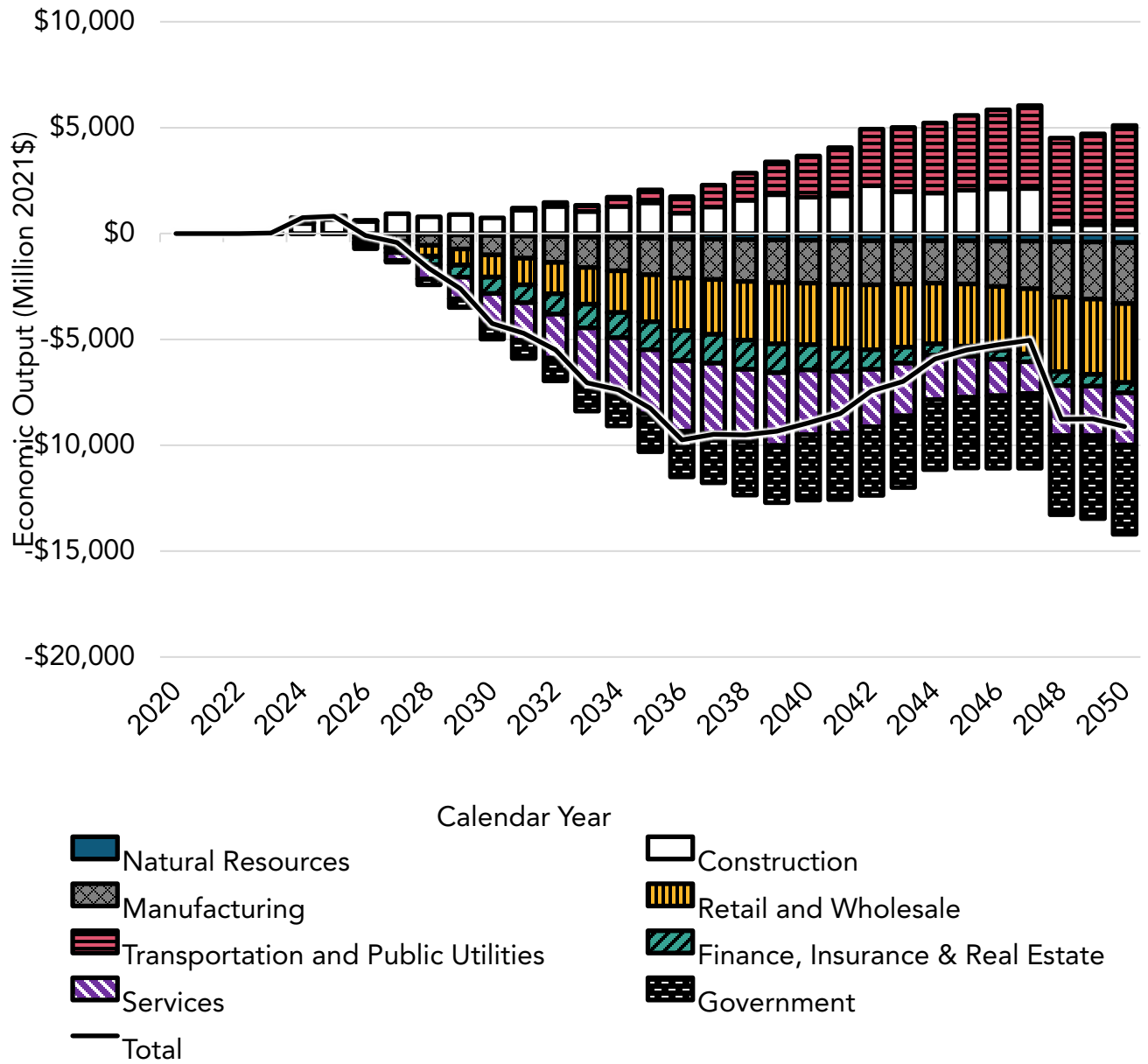


Figure 5. Change in Output by Major Sector Relative to the Modified Baseline



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Table 8 - Change in Growth of Economic Indicators for the Proposed ACF Regulation Relative to the Modified Baseline

Calendar Year	GSP Total Change (2021M\$)	GSP % Change	Personal Income Total Change (2021M\$)	Personal Income % Change	Employment Total Jobs	Employment % Change	Output Total Change (2021M\$)	Output % Change	Private Investment Total Change (2021M\$)	Private Investment % Change
2023	-55.26	0.00%	-48.17	0.00%	-568	0.00%	-103.58	0.00%	-18.73	-0.01%
2024	-165.73	-0.01%	-153.63	0.00%	-1734	-0.01%	-315.05	-0.01%	-68.97	-0.02%
2025	-115.28	0.00%	-123.83	0.00%	-1118	0.00%	-221.71	0.00%	-58.87	-0.01%
2026	-99.41	0.00%	-115.90	0.00%	-947	0.00%	-192.99	0.00%	-45.63	-0.01%
2027	-76.91	0.00%	-100.05	0.00%	-728	0.00%	-153.02	0.00%	-28.57	-0.01%
2028	-64.04	0.00%	-90.63	0.00%	-604	0.00%	-129.73	0.00%	-16.32	0.00%
2029	-56.15	0.00%	-84.17	0.00%	-528	0.00%	-115.12	0.00%	-8.27	0.00%
2030	-51.40	0.00%	-80.92	0.00%	-481	0.00%	-106.07	0.00%	-3.41	0.00%
2031	-49.35	0.00%	-80.06	0.00%	-459	0.00%	-101.82	0.00%	-1.00	0.00%
2033	-48.39	0.00%	-82.50	0.00%	-448	0.00%	-98.89	0.00%	-0.11	0.00%
2034	-49.36	0.00%	-85.63	0.00%	-454	0.00%	-100.05	0.00%	-0.81	0.00%
2035	-50.49	0.00%	-89.25	0.00%	-461	0.00%	-101.60	0.00%	-1.79	0.00%
2036	-51.89	0.00%	-93.49	0.00%	-470	0.00%	-103.75	0.00%	-2.88	0.00%
2037	-53.21	0.00%	-97.96	0.00%	-479	0.00%	-105.87	0.00%	-3.91	0.00%
2038	-53.90	0.00%	-102.05	0.00%	-483	0.00%	-107.02	0.00%	-4.69	0.00%
2039	-54.45	0.00%	-106.15	0.00%	-485	0.00%	-107.93	0.00%	-5.25	0.00%
2040	-55.26	0.00%	-110.76	0.00%	-490	0.00%	-109.39	0.00%	-5.72	0.00%
2041	-56.24	0.00%	-115.57	0.00%	-494	0.00%	-111.26	0.00%	-6.29	0.00%
2042	-57.32	0.00%	-120.81	0.00%	-500	0.00%	-113.35	0.00%	-6.81	0.00%
2043	-58.42	0.00%	-126.39	0.00%	-506	0.00%	-115.58	0.00%	-7.27	0.00%
2044	-59.53	0.00%	-132.23	0.00%	-512	0.00%	-117.86	0.00%	-7.66	0.00%
2045	-61.01	0.00%	-138.84	0.00%	-520	0.00%	-120.88	0.00%	-8.09	0.00%
2046	-11.86	0.00%	-67.24	0.00%	-117	0.00%	-32.50	0.00%	-1.94	0.00%
2047	-65.41	0.00%	-146.64	0.00%	-537	0.00%	-129.35	0.00%	-7.44	0.00%
2048	-65.96	0.00%	-156.60	0.00%	-546	0.00%	-131.16	0.00%	-8.82	0.00%
2049	-68.96	0.00%	-168.21	0.00%	-565	0.00%	-137.13	0.00%	-9.93	0.00%
2050	-71.45	0.00%	-179.44	0.00%	-580	0.00%	-142.28	0.00%	-10.71	0.00%

IV. Fiscal Impacts

A. Local Government

Table 9 shows the estimated fiscal cost to local governments due to the proposed ACF regulation relative to the Modified Baseline scenario. The fiscal impact to local government is estimated to be \$4.4 billion over the regulatory analysis period.

Table 9. Estimated Fiscal Impacts to Local Government Versus Modified Baseline (million 2021\$)

Year	Local Government Fleet Cost Pass-Through	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2024	-\$75	\$2	\$64	\$16	\$7
2025	-\$47	\$4	\$59	\$17	\$33
2026	-\$30	\$11	\$50	\$64	\$94
2027	-\$57	\$18	\$39	\$81	\$80
2028	-\$15	\$25	\$28	\$64	\$102
2029	\$32	\$39	\$10	\$98	\$179
2030	\$48	\$54	-\$10	\$98	\$190
2031	\$76	\$72	-\$32	\$123	\$239
2032	\$94	\$91	-\$53	\$127	\$258
2033	\$105	\$110	-\$72	\$105	\$248
2034	\$110	\$133	-\$97	\$127	\$272
2035	\$114	\$159	-\$123	\$125	\$275
2036	\$128	\$182	-\$147	\$70	\$233
2037	\$126	\$206	-\$173	\$79	\$237
2038	\$124	\$231	-\$201	\$87	\$241
2039	\$140	\$256	-\$225	\$81	\$253
2040	\$134	\$280	-\$251	-\$44	\$119
2041	\$126	\$304	-\$280	-\$27	\$124
2042	\$120	\$329	-\$309	-\$9	\$131
2043	\$114	\$344	-\$323	-\$69	\$67
2044	\$117	\$352	-\$335	-\$49	\$85
2045	\$119	\$365	-\$350	-\$28	\$106
2046	\$129	\$376	-\$369	-\$13	\$124
2047	\$147	\$387	-\$386	\$0	\$148
2048	\$168	\$398	-\$402	\$13	\$177
2049	\$185	\$409	-\$420	\$22	\$196
2050	\$203	\$431	-\$456	\$32	\$210
Total	\$2,438	\$5,568	-\$4,764	\$1,187	\$4,429

*Note: Totals may differ due to rounding

B. State Government

Table 10 shows the estimated fiscal impacts to the State government due to the proposed ACF regulation relative to Legal Baseline conditions each year. The fiscal impact to local government is estimated to be -\$38.2 billion over the regulatory analysis period.

Table 10. Estimated Fiscal Impacts on State Government (million 2021\$)

Year	CARB Staffing and Resources	State Fleet Cost Pass-Through	State Fuel Taxes	Energy Resources Fees	Registration Fees	State Sales Taxes	Depreciation	Total Fiscal Impact*
2023	-\$2	\$0	\$0	\$0	\$0	\$0	\$0	-\$2
2024	-\$3	-\$18	-\$15	\$0	\$0	\$14	-\$6	-\$29
2025	-\$3	-\$11	-\$27	\$0	-\$2	\$14	-\$24	-\$53
2026	-\$3	-\$7	-\$59	\$0	-\$8	\$54	-\$80	-\$104
2027	-\$3	-\$13	-\$101	\$0	-\$17	\$68	-\$177	-\$242
2028	-\$3	-\$3	-\$139	\$1	-\$24	\$54	-\$266	-\$381
2029	-\$3	\$7	-\$209	\$1	-\$35	\$83	-\$365	-\$521
2030	-\$3	\$11	-\$286	\$1	-\$52	\$83	-\$487	-\$733
2031	-\$3	\$18	-\$370	\$1	-\$72	\$104	-\$595	-\$918
2032	-\$3	\$22	-\$454	\$2	-\$90	\$107	-\$683	-\$1,099
2033	-\$3	\$25	-\$524	\$2	-\$108	\$88	-\$732	-\$1,252
2034	-\$3	\$26	-\$623	\$2	-\$136	\$107	-\$778	-\$1,405
2035	-\$3	\$27	-\$725	\$3	-\$164	\$106	-\$829	-\$1,586
2036	-\$3	\$30	-\$817	\$3	-\$193	\$59	-\$827	-\$1,748
2037	-\$3	\$30	-\$918	\$3	-\$226	\$66	-\$788	-\$1,837
2038	-\$3	\$29	-\$1,026	\$4	-\$259	\$73	-\$762	-\$1,944
2039	-\$3	\$33	-\$1,121	\$4	-\$286	\$69	-\$731	-\$2,035
2040	-\$3	\$31	-\$1,223	\$4	-\$309	-\$37	-\$584	-\$2,120
2041	-\$3	\$30	-\$1,338	\$5	-\$340	-\$23	-\$385	-\$2,054
2042	-\$3	\$28	-\$1,458	\$5	-\$369	-\$8	-\$254	-\$2,059
2043	-\$3	\$27	-\$1,507	\$5	-\$379	-\$58	-\$81	-\$1,997
2044	-\$3	\$27	-\$1,556	\$5	-\$394	-\$42	\$121	-\$1,840
2045	-\$3	\$28	-\$1,617	\$6	-\$409	-\$24	\$221	-\$1,800
2046	-\$3	\$30	-\$1,688	\$6	-\$421	-\$11	\$239	-\$1,849
2047	-\$3	\$35	-\$1,755	\$6	-\$431	\$0	\$225	-\$1,925
2048	-\$3	\$39	-\$1,823	\$6	-\$442	\$11	\$174	-\$2,038
2049	-\$3	\$43	-\$1,892	\$6	-\$451	\$18	\$85	-\$2,193
2050	-\$3	\$48	-\$2,042	\$7	-\$483	\$27	-\$8	-\$2,456
Total*	-\$92	\$572	-	\$89	-\$6,102	\$1,00	-\$8,378	-\$38,220

*Note: Totals may differ due to rounding