

ENVIRON

DRAF TECHNICAL MEMORANDUM

To: Thomas Moore, Western Regional Air Partnership
From: John Grant, Rajashi Parikh, and Alison Pollack
Date: March 17, 2009
Subject: California PRP18b on-road, off-road equipment, and locomotive emission inventory updates

The current PRP18a emission inventory estimates for mobile sources in California were originally developed by ENVIRON in 2005¹ and then updated in the fall of 2007 (see Appendix A²). Those updated inventories reflected all “on the books” regulations in effect at that time. Since mid-2007, both the EPA and the California Air Resources Board (CARB) have promulgated new mobile source emissions standards. ENVIRON has developed updated California on-road, off-road equipment, and locomotive emission inventories for 2018, based on the most recently enacted regulations, for use in PRP18b regional air quality modeling to be conducted by WRAP. These emission inventory updates were developed based on discussion with and inputs from CARB staff. A brief description of emission inventory inputs, revisions, and processing is presented below.

ON-ROAD EMISSIONS

On December 12, 2008 California Air Resources Board (CARB) adopted the Statewide Truck and Bus rule requiring retrofitting of older on-road diesel trucks (<http://www.arb.ca.gov/regact/2008/truckbus08/truckbus08.htm>). The October 2008 Staff Report (Initial Statement of Reasons, ISOR) says that the rule will result in significant NO_x and PM emissions reductions: 105 TPD NO_x and 7.8 TPD PM statewide in 2017. While the effect of the rule will differ by county, CARB has not completed their analysis of the county-level effects. CARB therefore provided statewide heavy-duty diesel adjustment factors by pollutant.

On-road emissions were updated by applying the scaling factors provided by the CARB as shown in Table 1 to the previously generated 2018 on-road emission inventories (see Appendix A). Emissions from all other vehicle types were held constant from the previous 2018 emission inventory.

¹ Pollack, A.K., L. Chan, P. Chandraker, J. Grant, C. Lindhjem, S. Rao, J. Russell, C. Tran. 2006. “WRAP MOBILE Source Emission Inventories Update.” Prepared for Western Governors’ Association, Denver, CO. May.

² The September 2007 memo in the Appendix updated California emissions for 2002 and 2018. The 2002 emissions updates were used in the Plan02d emissions, which were used in WRAP air quality modeling in late 2007. The 2018 emissions updates reported therein have not been used in any modeling, and will be replaced by the emissions updates reported in this memo for PRP18b.

Table 1. CA 2018 on-road emission inventory scaling factors.

Pollutant	Medium Heavy-Duty Diesel Trucks	Heavy Heavy-Duty Diesel Trucks
Reactive Organic Compounds (ROG)	0.6277	0.5969
Nitrogen Oxides (NOx)	0.4450	0.6658
Particulate Matter (PM10 and PM2.5)*	0.6885	0.4624

* exhaust mode only

OFF-ROAD EMISSIONS

CARB's In-Use Off-Road Diesel Vehicles regulation was adopted on July 26, 2007 (<http://www.arb.ca.gov/regact/2007/ordiesl07/ordiesl07.htm>). This regulation is not incorporated into the OFFROAD2007 model, and was not incorporated into PRP18a emission inventory for CA. The Technical Support Document for the rule estimates statewide emissions reductions of about 5 TPD for PM and 48 TPD for NOx.

Off-road equipment emissions were generated by reducing emissions from the PRP18a emission inventory in accordance with percent reductions for equipment types affected, as provided by CARB. EIC codes for which emissions were reduced are shown in Appendix B. CARB's estimated percent reductions from the previous 2018 off-road equipment emission inventory (i.e., emissions estimated without this regulation implemented) to be applied to the appropriate EIC codes are 21.3% for NOx, and 64.3% for PM10 and PM2.5.

In addition to this CARB regulation, EPA announced final locomotive emissions standards (Tier 4), and estimated the expected benefit of normal fleet turnover and the additional benefit of the rule³. The regulations include a retrofit of existing equipment as well as new locomotive emission standards. CARB staff developed their own estimates of the effects of this rule on all locomotive emissions in California as 9.3% for NOx, 29.9% for PM10 and PM2.5, and 42.4% for HC.

GENERATION OF SMOKE AND NIF FILES

Emissions files were generated in the format needed for SMOKE emissions processing as described in Grant et.al.^{Error! Bookmark not defined.} The pollutants included in the SMOKE files are volatile organic compounds (VOC), NO_x, carbon monoxide (CO), ammonia (NH₃), sulfur dioxide (SO₂), particulate matter less than ten microns (PM10), EC10, OC10, SO4(10), particulate matter less than 2.5 microns (PM2.5), EC2.5, OC2.5, SO4(2.5), coarse PM (PMC), NO, and NO₂. Separate files were prepared by year and by season. The SMOKE files include emissions by county and SCC, which indicates equipment type and fuel type.

Annual emissions files in EPA's NIF format were also prepared for submission to the WRAP Emissions Data Management System (EDMS), the on-line repository of all WRAP emissions data (http://www.wrapdms.org/default_login.asp). These NIF files contain a smaller set of

³ EPA, 2008. "Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder," Assessment and Standards Division Office of Transportation and Air Quality U.S. Environmental Protection Agency, EPA420-R-08-001, March.

pollutants; the additional pollutants needed for air quality modeling are not included. Annual emissions NIF files were prepared for 2018.

EMISSIONS SUMMARIES

Annual 2018 on-road emissions by year for the previous (PRP18a) and current updated emission inventory are presented in Table 2. Results show considerable decreases in VOC, NO_x, PM₁₀, and PM_{2.5} emissions for heavy-duty diesel vehicles from the previous 2018 emissions inventory as a result of recent regulations. The emissions reductions from the PRP18a emission inventory for heavy-duty diesel vehicles (HDDV) in Table 2 are not exactly the same as the percent reductions implied in Table 1 because the HDDV category includes not just medium and heavy heavy-duty vehicles, but also a relatively small amount of emissions from light heavy-duty vehicles, urban and school buses, and motor homes. Annual off-road emissions by year are shown in Table 3. Results show considerable decreases in NO_x, PM₁₀, and PM_{2.5} off-road emissions from the previous 2018 emissions inventory as a result of recent regulations.

Table 2. California annual on-road emissions totals (tons per day)^a.

Vehicle Type	VOC	NOx	CO	PM10	PM2.5	SOx	NH3
2018 revised							
LDGV	110.4	72.6	907.0	18.3	10.7	2.0	2.0
LDGT1	120.0	98.6	984.7	17.3	11.9	1.7	1.4
LDGT2	37.7	39.7	351.6	5.9	4.2	0.7	0.4
HDGV	30.1	54.9	258.1	1.0	0.5	0.2	0.1
MC	40.4	11.5	273.2	0.3	0.2	0.0	0.0
LDDV	0.0	0.5	0.2	0.0	0.0	0.0	0.0
LDDT	0.2	4.2	1.6	0.2	0.1	0.0	0.0
HDDV	19.2	313.1	151.0	11.5	8.5	1.1	0.2
2018 Statewide Totals	358.2	595.1	2927.8	54.4	36.0	5.7	4.1
2018 previous							
LDGV	110.4	72.6	907.3	18.3	10.7	2.0	2.0
LDGT1	120.0	98.6	984.7	17.3	11.9	1.7	1.4
LDGT2	37.7	39.7	351.6	5.9	4.2	0.7	0.4
HDGV	30.1	54.9	258.1	1.0	0.5	0.2	0.1
MC	40.4	11.5	273.2	0.3	0.2	0.0	0.0
LDDV	0.0	0.5	0.2	0.0	0.0	0.0	0.0
LDDT	0.2	4.2	1.6	0.2	0.1	0.0	0.0
HDDV	30.3	414.1	151.0	18.2	14.7	1.1	0.2
2018 Statewide Totals	369.2	696.1	2,927.8	61.2	42.2	5.7	4.1
2018 percent change from revised to previous							
LDGV	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LDGT1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LDGT2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HDGV	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MC	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LDDV	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LDDT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HDDV	-36.6%	-24.4%	0.0%	-37.4%	-42.5%	0.0%	0.0%
2018 Statewide Totals	-3.0%	-14.5%	0.0%	-11.1%	-14.9%	0.0%	0.0%

^a EMFAC provides annual emission outputs in terms of tons per average weekday; for regional haze modeling, the EMFAC emissions were adjusted to estimate average annual day emission values.

Table 3. California annual off-road emissions totals (tons per day).

Off-road Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3
2018 revised							
Agricultural Equipment	8.6	51.7	94.3	2.3	2.1	0.00	0.00
Airport Ground Support Equipment	0.8	4.6	30.4	0.0	0.0	0.00	0.00
Commercial Equipment	11.0	18.5	351.7	1.2	0.9	0.00	0.00
Construction and Mining Equipment	23.5	129.4	204.6	2.7	2.3	0.02	0.02
Industrial Equipment	9.2	59.6	377.7	1.0	0.9	0.01	0.01
Lawn and Garden Equipment	81.6	10.5	596.7	0.9	0.7	0.00	0.00
Logging Equipment	0.5	2.6	12.7	0.1	0.1	0.00	0.00
Oil Field Equipment	1.7	13.1	8.4	0.1	0.1	0.00	0.00
Pleasure Craft	118.3	38.2	761.8	15.3	11.5	0.00	0.00
Recreational Equipment	87.9	2.8	259.4	0.6	0.4	0.69	0.96
Locomotive	7.08	121.8	44.3	3.0	2.8	0.07	0.05
Aircraft	46.3	78.4	341.0	10.4	10.3	5.23	0.02
2018 Statewide Totals	396.5	531.2	3,083.0	37.6	32.1	6.02	1.07
2018 previous							
Agricultural Equipment	8.6	51.7	94.3	2.3	2.1	0.00	0.00
Airport Ground Support Equipment	0.8	5.2	30.4	0.1	0.1	0.00	0.00
Commercial Equipment	11.0	18.5	351.7	1.2	0.9	0.00	0.00
Construction and Mining Equipment	23.5	163.8	204.6	6.7	5.9	0.02	0.02
Industrial Equipment	9.2	62.6	377.7	1.2	1.1	0.01	0.01
Lawn and Garden Equipment	81.6	10.5	596.7	0.9	0.7	0.00	0.00
Logging Equipment	0.5	2.6	12.7	0.1	0.1	0.00	0.00
Oil Field Equipment	1.7	16.7	8.4	0.4	0.4	0.00	0.00
Pleasure Craft	118.3	38.2	761.8	15.3	11.5	0.00	0.00
Recreational Equipment	87.9	2.8	259.4	0.6	0.4	0.69	0.96
Locomotive	12.3	134.2	44.3	4.3	4.0	0.07	0.06
Aircraft	46.3	78.4	341.0	10.4	10.3	5.23	0.02
2018 Statewide Totals	401.6	585.3	3,083.0	43.7	37.4	6.02	1.07
2018 change from previous to revised							
Agricultural Equipment	0%	0%	0%	0%	0%	0%	0%
Airport Ground Support Equipment	0%	-13%	0%	-57%	-64%	0%	0%
Commercial Equipment	0%	0%	0%	0%	0%	0%	0%
Construction and Mining Equipment	0%	-21%	0%	-60%	-61%	0%	0%
Industrial Equipment	0%	-5%	0%	-18%	-18%	0%	0%
Lawn and Garden Equipment	0%	0%	0%	0%	0%	0%	0%
Logging Equipment	0%	0%	0%	0%	0%	0%	0%
Oil Field Equipment	0%	-21%	0%	-64%	-64%	0%	0%
Pleasure Craft	0%	0%	0%	0%	0%	0%	0%
Recreational Equipment	0%	0%	0%	0%	0%	0%	0%
Locomotive	-42%	-9%	0%	-30%	-30%	0%	0%
Aircraft	0%	0%	0%	0%	0%	0%	0%
2018 Statewide Totals	-1%	-9%	0%	-14%	-14%	0%	0%

APPENDIX A

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Appendix B

Off-road Equipment EICs Associated with the CARB in-use diesel regulation

Category	EIC Code	Equipment Type
Airport Ground Support Equipment	86088912100070	A/C Tug Narrow Body
	86088912100090	A/C Tug Wide Body
	86088912100720	Baggage Tug
	86088912100790	Belt Loader
	86088912100820	Bobtail
	86088912100990	Cargo Loader
	86088912101010	Cargo Tractor
	86088912102720	Forklift
	86088912104180	Lift
Construction and Mining Equipment	86088912105660	Other GSE
	86088712100880	Bore/Drill Rigs
	86088712100900	Bore/Drill Rigs
	86088712100920	Bore/Drill Rigs
	86088712100930	Bore/Drill Rigs
	86088712100940	Bore/Drill Rigs
	86088712100950	Bore/Drill Rigs
	86088712100960	Bore/Drill Rigs
	86088712102000	Cranes
	86088712102020	Cranes
	86088712102040	Cranes
	86088712102050	Cranes
	86088712102060	Cranes
	86088712102070	Cranes
	86088712102080	Cranes
	86088712102100	Crawler Tractors
	86088712102110	Crawler Tractors
	86088712102120	Crawler Tractors
	86088712102130	Crawler Tractors
	86088712102140	Crawler Tractors
	86088712102150	Crawler Tractors
	86088712102160	Crawler Tractors
	86088712102580	Excavators
	86088712102590	Excavators
	86088712102600	Excavators
	86088712102610	Excavators
	86088712102620	Excavators
	86088712102630	Excavators
	86088712103700	Graders
	86088712103710	Graders
	86088712103720	Graders
	86088712103730	Graders
	86088712103740	Graders
	86088712103750	Graders
	86088712104700	Off-Highway Tractors
	86088712104710	Off-Highway Tractors
	86088712104720	Off-Highway Tractors
	86088712104730	Off-Highway Tractors
	86088712104740	Off-Highway Tractors
	86088712104750	Off-Highway Trucks
	86088712104760	Off-Highway Trucks
86088712104770	Off-Highway Trucks	

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Category	EIC Code	Equipment Type
	86088712104780	Off-Highway Trucks
	86088712104790	Off-Highway Trucks
	86088712105360	Other Construction Equipment
	86088712105370	Other Construction Equipment
	86088712105390	Other Construction Equipment
	86088712105410	Other Construction Equipment
	86088712106110	Pavers
	86088712106120	Pavers
	86088712106130	Pavers
	86088712106140	Pavers
	86088712106150	Pavers
	86088712106210	Paving Equipment
	86088712106230	Paving Equipment
	86088712106240	Paving Equipment
	86088712106250	Paving Equipment
	86088712107680	Rollers
	86088712107700	Rollers
	86088712107710	Rollers
	86088712107720	Rollers
	86088712107730	Rollers
	86088712107750	Rough Terrain Forklifts
	86088712107770	Rough Terrain Forklifts
	86088712107790	Rough Terrain Forklifts
	86088712107800	Rough Terrain Forklifts
	86088712107810	Rough Terrain Forklifts
	86088712107820	Rubber Tired Dozers
	86088712107830	Rubber Tired Dozers
	86088712107840	Rubber Tired Dozers
	86088712107850	Rubber Tired Dozers
	86088712107860	Rubber Tired Dozers
	86088712107890	Rubber Tired Loaders
	86088712107910	Rubber Tired Loaders
	86088712107920	Rubber Tired Loaders
	86088712107930	Rubber Tired Loaders
	86088712107940	Rubber Tired Loaders
	86088712107950	Rubber Tired Loaders
	86088712107960	Rubber Tired Loaders
	86088712108020	Scrapers
	86088712108030	Scrapers
	86088712108040	Scrapers
	86088712108050	Scrapers
	86088712108060	Scrapers
	86088712108270	Skid Steer Loaders
	86088712108290	Skid Steer Loaders
	86088712108600	Surfacing Equipment
	86088712108610	Surfacing Equipment
	86088712108620	Surfacing Equipment
	86088712108630	Surfacing Equipment
	86088712108640	Surfacing Equipment
	86088712108650	Surfacing Equipment
	86088712109320	Tractors/Loaders/Backhoes
	86088712109340	Tractors/Loaders/Backhoes
	86088712109350	Tractors/Loaders/Backhoes
	86088712109360	Tractors/Loaders/Backhoes
	86088712109420	Trenchers

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Category	EIC Code	Equipment Type
	86088712109470	Trenchers
	86088712109490	Trenchers
	86088712109500	Trenchers
	86088712109510	Trenchers
	86088712109530	Trenchers
Industrial Equipment	86088612100210	Aerial Lifts
	86088612100230	Aerial Lifts
	86088612100240	Aerial Lifts
	86088612100250	Aerial Lifts
	86088612102890	Forklifts
	86088612102920	Forklifts
	86088612102950	Forklifts
	86088612102960	Forklifts
	86088612102970	Forklifts
	86088612105560	Other General Industrial Equipmen
	86088612105580	Other General Industrial Equipmen
	86088612105600	Other General Industrial Equipmen
	86088612105610	Other General Industrial Equipmen
	86088612105620	Other General Industrial Equipmen
	86088612105630	Other General Industrial Equipmen
	86088612105640	Other General Industrial Equipmen
	86088612105810	Other Material Handling Equipment
	86088612105830	Other Material Handling Equipment
	86088612105840	Other Material Handling Equipment
	86088612105850	Other Material Handling Equipment
86088612105860	Other Material Handling Equipment	
Oil Drilling	86089112102391	Drill Rig (Mobile)
	86089112102392	Drill Rig (Mobile)
	86089112102393	Drill Rig (Mobile)
	86089112102394	Drill Rig (Mobile)
	86089112102395	Drill Rig (Mobile)
	86089112102396	Drill Rig (Mobile)
	86089112102397	Drill Rig (Mobile)
	86089112102398	Workover Rig (Mobile)
	86089112102399	Workover Rig (Mobile)
	86089112102400	Workover Rig (Mobile)
	86089112102401	Workover Rig (Mobile)
	86089112102402	Workover Rig (Mobile)
	86089112102403	Workover Rig (Mobile)
	86089112102406	Workover Rig (Mobile)

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