

Appendix L

Energy Calculations



Energy Appendix

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Energy Appendix

1. Construction Calculations

**The District
Construction Energy Analysis**

Annual Fuel Summary

Heavy-Duty Construction Equipment	
1,127,796	Total Project Consumption
375,932	Annual Consumption
Haul Trucks	
-	Total Project Consumption
-	Annual Consumption
Vendor Trucks	
196,782	Total Project Consumption
65,594	Annual Consumption
Workers	
106,834	Total Project Consumption
35,611	Annual Consumption
196,782	Project Consumption of diesel for Haul Trucks and Vendors
65,594	Annual Consumption
1,324,578	Total Gallons Diesel
106,834	Total Gallons Gasoline

3.0 Estimated Project Construction Duration (years)

441,526 Annual Average Gallons Diesel
35,611 Annual Average Gallons Gasoline

South Coast Air Basin Annual Fuel Consumption (2017)			Percent of Annual Project Compared to South Coast Air Basin
Source	Fuel Type	Gallons	
Workers ¹	Gasoline	4,715,655,418	0.0008%
Vendors ²	Diesel	955,737,693	0.0069%
Haul Trucks ³	Diesel	-	0.0000%

Notes:

- 1 EMFAC2011 Categories: LDA, LDT1, LDT2
- 2 EMFAC2007 Categories: MHDT, HHDT
- 3 EMFAC2011 Categories: T7 Single Construction

**The District
Construction Energy Analysis**

Off-Road Equipment

Equipment ≤ 50 hp

pounds fuel/hp-hr (OFFROAD2011 model, ≤ 50 hp): 0.408 lb/hp-hr
 diesel pounds/gallon (CARB density assumption): 7.07 lb/gal
 diesel gallons/hp-hr: 0.0577 gal/hp-hr
 Total <50 101,837 hp-hr
 Total diesel gallons: 5,877 gal

Equipment > 50 hp

pounds fuel/hp-hr (OFFROAD2011 model, > 50 hp): 0.367 lb/hp-hr
 diesel pounds/gallon (CARB density assumption): 7.07 lb/gal
 diesel gallons/hp-hr: 0.0519 gal/hp-hr
 Total >50 21,613,001 hp-hr
 Total diesel gallons: 1,121,920 gal

Total diesel gallons (off-road equipment): 1,127,796 gal

Project Area	Year	Phase	Equipment	Number	Hours/Day	HP	Load	Days	Total hp-hr
PA1	2018	Remedial Construction	Excavators	0.9	8	158	0.38	260	112,395
PA1	2018	Remedial Construction	Tractors/Loaders/Backhoes	0.9	8	97	0.37	260	67,186
PA1	2018	Remedial Construction	Scrapers	0.7	8	367	0.48	260	256,489
PA1	2018	Remedial Construction	Rubber Tired Dozers	0.7	8	247	0.4	260	143,853
PA1	2018	Remedial Construction	Graders	1.4	8	187	0.41	260	223,263
PA1	2018	Remedial Construction	Rollers	0.7	8	80	0.38	260	44,262
PA2	2018	Remedial Construction	Excavators	0.9	8	158	0.38	260	112,395
PA2	2018	Remedial Construction	Tractors/Loaders/Backhoes	0.9	8	97	0.37	260	67,186
PA2	2018	Remedial Construction	Scrapers	0.7	8	367	0.48	260	256,489
PA2	2018	Remedial Construction	Rubber Tired Dozers	0.7	8	247	0.4	260	143,853
PA2	2018	Remedial Construction	Graders	1.4	8	187	0.41	260	223,263
PA2	2018	Remedial Construction	Rollers	0.7	8	80	0.38	260	44,262
PA3	2018	Remedial Construction	Excavators	0.9	8	158	0.38	260	112,395
PA3	2018	Remedial Construction	Tractors/Loaders/Backhoes	0.9	8	97	0.37	260	67,186
PA3	2018	Remedial Construction	Scrapers	0.7	8	367	0.48	260	256,489
PA3	2018	Remedial Construction	Rubber Tired Dozers	0.7	8	247	0.4	260	143,853
PA3	2018	Remedial Construction	Graders	1.4	8	187	0.41	260	223,263
PA3	2018	Remedial Construction	Rollers	0.7	8	80	0.38	260	44,262
PA1	2018	Horizontal Construction	Excavators	2.5	8	158	0.38	260	312,208
PA1	2018	Horizontal Construction	Tractors/Loaders/Backhoes	2.9	8	97	0.37	260	216,488

PA1	2018 Horizontal Construction	Scrapers	0.2	8	367	0.48	260	73,283
PA1	2018 Horizontal Construction	Skid Steer Loaders	0.8	8	65	0.37	260	40,019
PA1	2018 Horizontal Construction	Paving Equipment	0.3	8	132	0.36	260	29,652
PA1	2018 Horizontal Construction	Rollers	1.2	8	80	0.38	260	75,878
PA1	2018 Horizontal Construction	Trenchers	0.6	8	78	0.5	260	48,672
PA1	2018 Horizontal Construction	Plate Compactors	3.8	8	8	0.43	260	27,190
PA1	2018 Horizontal Construction	Other Construction Equipment	1	8	172	0.42	260	150,259
PA1	2018 Horizontal Construction	Air Compressors	1.6	8	78	0.48	260	124,600
PA1	2018 Horizontal Construction	Concrete/Industrial Saws	3.1	8	81	0.73	260	381,270
PA1	2018 Horizontal Construction	Rough Terrain Forklifts	4.5	8	100	0.4	260	374,400
PA1	2018 Horizontal Construction	Cranes	1	7	231	0.29	260	121,922
PA2	2018 Horizontal Construction	Tractors/Loaders/Backhoes	1	8	97	0.37	260	74,651
PA2	2018 Horizontal Construction	Excavators	2.5	8	158	0.38	260	312,208
PA2	2018 Horizontal Construction	Tractors/Loaders/Backhoes	2.9	8	97	0.37	260	216,488
PA2	2018 Horizontal Construction	Scrapers	0.2	8	367	0.48	260	73,283
PA2	2018 Horizontal Construction	Skid Steer Loaders	0.8	8	65	0.37	260	40,019
PA2	2018 Horizontal Construction	Paving Equipment	0.3	8	132	0.36	260	29,652
PA2	2018 Horizontal Construction	Rollers	1.2	8	80	0.38	260	75,878
PA2	2018 Horizontal Construction	Trenchers	0.6	8	78	0.5	260	48,672
PA2	2018 Horizontal Construction	Plate Compactors	3.8	8	8	0.43	260	27,190
PA2	2018 Horizontal Construction	Other Construction Equipment	1	8	172	0.42	260	150,259
PA2	2018 Horizontal Construction	Air Compressors	1.6	8	78	0.48	260	124,600
PA2	2018 Horizontal Construction	Concrete/Industrial Saws	3.1	8	81	0.73	260	381,270
PA2	2018 Horizontal Construction	Rough Terrain Forklifts	4.5	8	100	0.4	260	374,400
PA2	2018 Horizontal Construction	Cranes	1	7	231	0.29	260	121,922
PA3	2018 Horizontal Construction	Tractors/Loaders/Backhoes	1	8	97	0.37	260	74,651
PA3	2018 Horizontal Construction	Excavators	2.5	8	158	0.38	260	312,208
PA3	2018 Horizontal Construction	Tractors/Loaders/Backhoes	2.9	8	97	0.37	260	216,488
PA3	2018 Horizontal Construction	Scrapers	0.2	8	367	0.48	260	73,283
PA3	2018 Horizontal Construction	Skid Steer Loaders	0.8	8	65	0.37	260	40,019
PA3	2018 Horizontal Construction	Paving Equipment	0.3	8	132	0.36	260	29,652
PA3	2018 Horizontal Construction	Rollers	1.2	8	80	0.38	260	75,878
PA3	2018 Horizontal Construction	Trenchers	0.6	8	78	0.5	260	48,672
PA3	2018 Horizontal Construction	Plate Compactors	3.8	8	8	0.43	260	27,190
PA3	2018 Horizontal Construction	Other Construction Equipment	1	8	172	0.42	260	150,259
PA3	2018 Horizontal Construction	Air Compressors	1.6	8	78	0.48	260	124,600
PA3	2018 Horizontal Construction	Concrete/Industrial Saws	3.1	8	81	0.73	260	381,270
PA3	2018 Horizontal Construction	Rough Terrain Forklifts	4.5	8	100	0.4	260	374,400
PA3	2018 Horizontal Construction	Cranes	1	7	231	0.29	260	121,922

PA1	2019 Horizontal Construction	Excavators	0.4	8	158	0.38	260	49,953
PA1	2019 Horizontal Construction	Tractors/Loaders/Backhoes	0.9	8	97	0.37	260	67,186
PA1	2019 Horizontal Construction	Scrapers	0.2	8	367	0.48	260	73,283
PA1	2019 Horizontal Construction	Skid Steer Loaders	0.5	8	65	0.37	260	25,012
PA1	2019 Horizontal Construction	Paving Equipment	0.3	8	132	0.36	260	29,652
PA1	2019 Horizontal Construction	Rollers	0.8	8	80	0.38	260	50,586
PA1	2019 Horizontal Construction	Trenchers	0.4	8	78	0.5	260	32,448
PA1	2019 Horizontal Construction	Plate Compactors	1.3	8	8	0.43	260	9,302
PA1	2019 Horizontal Construction	Other Construction Equipment	0.1	8	172	0.42	260	15,026
PA1	2019 Horizontal Construction	Air Compressors	0.5	8	78	0.48	260	38,938
PA1	2019 Horizontal Construction	Concrete/Industrial Saws	0.9	8	81	0.73	260	110,691
PA1	2019 Horizontal Construction	Rough Terrain Forklifts	1.3	8	100	0.4	260	108,160
PA1	2019 Horizontal Construction	Cranes	0.1	7	231	0.29	260	12,192
PA2	2019 Horizontal Construction	Excavators	0.4	8	158	0.38	260	49,953
PA2	2019 Horizontal Construction	Tractors/Loaders/Backhoes	0.3	8	97	0.37	260	22,395
PA2	2019 Horizontal Construction	Scrapers	0.1	8	367	0.48	260	36,641
PA2	2019 Horizontal Construction	Skid Steer Loaders	0.2	8	65	0.37	260	10,005
PA2	2019 Horizontal Construction	Paving Equipment	0.1	8	132	0.36	260	9,884
PA2	2019 Horizontal Construction	Rollers	0.3	8	80	0.38	260	18,970
PA2	2019 Horizontal Construction	Trenchers	0.1	8	78	0.5	260	8,112
PA2	2019 Horizontal Construction	Plate Compactors	0.4	8	8	0.43	260	2,862
PA2	2019 Horizontal Construction	Air Compressors	0.2	8	78	0.48	260	15,575
PA2	2019 Horizontal Construction	Concrete/Industrial Saws	0.3	8	81	0.73	260	36,897
PA2	2019 Horizontal Construction	Rough Terrain Forklifts	0.4	8	100	0.4	260	33,280
PA3	2019 Horizontal Construction	Excavators	0.4	8	158	0.38	260	49,953
PA3	2019 Horizontal Construction	Tractors/Loaders/Backhoes	0.3	8	97	0.37	260	22,395
PA3	2019 Horizontal Construction	Scrapers	0.1	8	367	0.48	260	36,641
PA3	2019 Horizontal Construction	Skid Steer Loaders	0.2	8	65	0.37	260	10,005
PA3	2019 Horizontal Construction	Paving Equipment	0.1	8	132	0.36	260	9,884
PA3	2019 Horizontal Construction	Rollers	0.3	8	80	0.38	260	18,970
PA3	2019 Horizontal Construction	Trenchers	0.1	8	78	0.5	260	8,112
PA3	2019 Horizontal Construction	Plate Compactors	0.4	8	8	0.43	260	2,862
PA3	2019 Horizontal Construction	Air Compressors	0.2	8	78	0.48	260	15,575
PA3	2019 Horizontal Construction	Concrete/Industrial Saws	0.3	8	81	0.73	260	36,897
PA3	2019 Horizontal Construction	Rough Terrain Forklifts	0.4	8	100	0.4	260	33,280

PA1	2019 Vertical Construction	Tractors/Loaders/Backhoes	1.7	8	97	0.37	260	126,907
PA1	2019 Vertical Construction	Rough Terrain Forklifts	1.7	8	100	0.4	260	141,440
PA1	2019 Vertical Construction	Cranes	0.8	7	231	0.29	260	97,537
PA1	2019 Vertical Construction	Welders	0.8	8	85	0.78	260	110,323
PA2	2019 Vertical Construction	Tractors/Loaders/Backhoes	0.4	8	97	0.37	260	29,860
PA2	2019 Vertical Construction	Cement and Mortar Mixers	0.3	8	9	0.56	260	3,145
PA2	2019 Vertical Construction	Paving Equipment	0.1	8	132	0.36	260	9,884
PA2	2019 Vertical Construction	Rollers	0.3	8	80	0.38	260	18,970
PA2	2019 Vertical Construction	Trenchers	0.3	8	78	0.5	260	24,336
PA2	2019 Vertical Construction	Air Compressors	2.8	8	78	0.48	260	218,051
PA2	2019 Vertical Construction	Rough Terrain Forklifts	1	8	100	0.4	260	83,200
PA2	2019 Vertical Construction	Cranes	0.7	7	231	0.29	260	85,345
PA2	2019 Vertical Construction	Skid Steer Loaders	0.9	8	65	0.37	260	45,022
PA2	2019 Vertical Construction	Welders	1.4	8	85	0.78	260	193,066
PA3	2019 Vertical Construction	Tractors/Loaders/Backhoes	11	8	97	0.37	260	821,163
PA3	2019 Vertical Construction	Rough Terrain Forklifts	11	8	100	0.4	260	915,200
PA3	2019 Vertical Construction	Cranes	3.7	7	231	0.29	260	451,111
PA3	2019 Vertical Construction	Welders	3.7	8	85	0.78	260	510,245
PA1	2020 Vertical Construction	Tractors/Loaders/Backhoes	3	8	97	0.37	260	223,954
PA1	2020 Vertical Construction	Paving Equipment	0.8	8	132	0.36	260	79,073
PA1	2020 Vertical Construction	Rollers	0.8	8	80	0.38	260	50,586
PA1	2020 Vertical Construction	Air Compressors	1	8	78	0.48	260	77,875
PA1	2020 Vertical Construction	Rough Terrain Forklifts	3	8	100	0.4	260	249,600
PA1	2020 Vertical Construction	Cranes	1.5	7	231	0.29	260	182,883
PA1	2020 Vertical Construction	Welders	1.5	8	85	0.78	260	206,856
PA1	2020 Vertical Construction	Pavers	0.8	8	130	0.42	260	90,854
PA2	2020 Vertical Construction	Cement and Mortar Mixers	0.2	8	9	0.56	260	2,097
PA2	2020 Vertical Construction	Paving Equipment	0.5	8	132	0.36	260	49,421
PA2	2020 Vertical Construction	Air Compressors	2.8	8	78	0.48	260	218,051
PA2	2020 Vertical Construction	Rough Terrain Forklifts	1	8	100	0.4	260	83,200
PA2	2020 Vertical Construction	Skid Steer Loaders	0.6	8	65	0.37	260	30,014
PA3	2020 Vertical Construction	Tractors/Loaders/Backhoes	9	8	97	0.37	260	671,861
PA3	2020 Vertical Construction	Paving Equipment	1	8	132	0.36	260	98,842
PA3	2020 Vertical Construction	Rollers	1	8	80	0.38	260	63,232
PA3	2020 Vertical Construction	Air Compressors	1	8	78	0.48	260	77,875
PA3	2020 Vertical Construction	Rough Terrain Forklifts	9	8	100	0.4	260	748,800
PA3	2020 Vertical Construction	Cranes	3	7	231	0.29	260	365,765
PA3	2020 Vertical Construction	Welders	3	8	85	0.78	260	413,712
PA3	2020 Vertical Construction	Pavers	1	8	130	0.42	260	113,568
Trash Relocation	2020 Remedial Construction	Off-highway Trucks	2	10	402	0.38	57	174,146
DDC	2020 Remedial Construction	Off-highway Trucks	30	10	402	0.38	80	3,666,240
DDC	2020 Remedial Construction	Cranes	3	10	231	0.29	80	160,776
							Total >50	21,613,001
							Total <50	101,837

**The District
Construction Energy Analysis**

On-Road Vendor Trucks

		miles/gallon	
EMFAC2014 Diesel Fuel Consumption Factor: ¹	0.1552 gallons/mile		6.4
Total Vendor Truck VMT:	1,196,598 miles		
Total VMT diesel gallons (on-road vendor trucks):	185,733		
			<i>Estimated Fuel Savings from</i>
EMFAC2014 Diesel Fuel Consumption Factor: ²	0.7645 gallons/hour		<i>Anti-Idling Regulation (64 percent based on</i>
Total Haul Truck Idle-Hours per Year:	14,452 hours		<i>estimated CARB emissions reductions):³</i>
Total Idling diesel gallons (on-road haul trucks):	11,048		30,690
Total diesel gallons (on-road haul trucks):	196,782 gal		

1. California Air Resources Board, EMFAC2014 (South Coast Air Basin; HHDT and MHDT; Annual; CY 2017; Aggregate MY; Aggregate Speed)
2. California Air Resources Board, EMFAC2014 (South Coast Air Basin; HHDT and MHDT; Annual; CY 2017; Aggregate MY; 5 miles per hour converted to hourly rate)
3. Source: California Air Resources Board (CARB), 2004. Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling, Appendix F, July 2004, <https://www.arb.ca.gov/regact/idling/idling.htm>, accessed November 2016.

Phase	Days	Trips/Day	Miles/Trip	VMT	Idle Hours
PA1 -2018 Remedial	260	3	6.9	5,382	65
PA1 -2018 Horizontal	260	45	6.9	80,730	975
PA1 - 2019 Horizontal	260	11	6.9	19,734	238
PA1 - 2019 Vertical	260	43	6.9	77,142	932
PA1 - 2020 Vertical	260	78	6.9	139,932	1,690
PA2 - 2018 Remedial	260	3	6.9	5,382	65
PA2 - 2018 Horizontal	260	45	6.9	80,730	975
PA2 - 2019 Horizontal	260	4	6.9	7,176	87
PA2 - 2019 Vertical	260	117	6.9	209,898	2,535
PA2 - 2020 Vertical	260	59	6.9	105,846	1,278
PA3 - 2018 Remedial	260	3	6.9	5,382	65
PA3 - 2018 Horizontal	260	45	6.9	80,730	975
PA3 - 2019 Horizontal	260	4	6.9	7,176	87
PA3 - 2019 Vertical	260	114	6.9	204,516	2,470
PA3 - 2020 Vertical	260	93	6.9	166,842	2,015
				Total Vendor Truck VMT:	1,196,598
				Total Idle-Hours:	14,452

**The District
Construction Energy Analysis**

On-Road Workers (LDA, LDT1, LDT2)

EMFAC2014 Gasoline Fuel Consumption Factor:¹ 0.0433 gallons/mile miles/gallon
 Total Worker VMT: 2,469,050 miles 23.1
Total VMT gasoline gallons (workers): 106,834

1. California Air Resources Board, EMFAC2014 (South Coast Air Basin; LDA, LDT1, LDT2; CY 2017; Aggregate MY; Aggregate Speed)

Phase	Days	One-Way Trips/Day	Miles/Trip	VMT
PA1 -2018 Remedial	260	20.7	14.7	79,001
PA1 -2018 Horizontal	260	36.78	14.7	140,573
PA1 - 2019 Horizontal	260	29.22	14.7	111,679
PA1 - 2019 Vertical	260	15	14.7	57,330
PA1 - 2020 Vertical	260	139.5	14.7	533,169
PA2 - 2018 Remedial	260	20.67	14.7	79,001
PA2 - 2018 Horizontal	260	36.78	14.7	140,573
PA2 - 2019 Horizontal	260	29.22	14.7	111,679
PA2 - 2019 Vertical	260	24	14.7	89,817
PA2 - 2020 Vertical	260	120	14.7	458,640
PA3 - 2018 Remedial	260	21	14.7	79,001
PA3 - 2018 Horizontal	260	37	14.7	140,573
PA3 - 2019 Horizontal	260	29	14.7	111,679
PA3 - 2019 Vertical	260	88	14.7	336,336
PA3 - 2020 Vertical	260	186	14.7	710,892
Total Worker VMT:				2,469,050

EMFAC2014 (v1.0.7) Emissions Inventory

Region Type: Air Basin

Region: South Coast

Calendar Year: 2017

Season: Annual

Vehicle Classification: EMFAC2007 Categories

Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

Region	CalYr	VehClass	MdlYr	Speed	Fuel	Population	VMT	Trips	Fuel_Consumption
South Coas	2017	HHDT	Aggregatec	Aggregated	DSL	79126.27936	10431256.09		0 1871.876
South Coas	2017	MHDT	Aggregatec	Aggregated	DSL	116610.1737	6438331.407		0 746.5833

VMT	Fuel Consumption (gal/day)	Annual VMT	ial Fuel Consumption (gals)
16869587	2618459	6,157,399,435.23	955,737,692.54
gal/mi			
0.1552178			

Energy Appendix

2. Operational Calculations

**The District
Operational Energy Analysis**

Energy and VMT Estimates

Source	Natural Gas	Electricity demand	Electricity demand	Annual Worker and
	demand (million kBTU/yr)	(million kWh/yr)	demand (million kWh/yr)	Visitor VMT
The District	44.536	35.508	3.269	173,254,308
Landfill Gas and Groundwater Treatment	9.40	0.350		
Total	53.936	35.858	3.269	173,254,308

Source	CalEEMod		Total Water Use (Mgal/yr)	Electricity Demand from water Demand (million kWh)
	Indoor Water Use (Mgal/yr)	Outdoor Water Use (Mgal/yr)		
The District	217.154	39.708	256.862	3.269

CalEEMod Water Electricity Factors	Electricity Intensity Factor To Supply (kWh/Mgal)	Electricity Intensity Factor To Treat (kWh/Mgal)	Electricity Intensity Factor To Distribute (kWh/Mgal)	Electricity Intensity Factor For Wastewater Treatment (kWh/Mgal)
The District	9727	111	1272	1911

Source: California Emissions Estimator Model (CalEEMod).

**The District
Operational Energy Analysis**

Fuel Usage from VMT

Annual VMT (All): 173,254,308 miles/year
(With trip and VMT reductions from land use characteristics and proximity to public transit.)

Fuel Type: ¹	GAS	DSL	ELEC
Percent:	94.77%	4.02%	1.21%
Miles per Gallon Fuel:	22.60	8.25	-
Annual VMT by Fuel Type :	164,195,362	6,964,135	2,094,811 miles/year
Annual Fuel Usage :	7,265,064	844,114	- gal/year
Annual Fuel Savings from Electric Vehicles: ²	-	-	92,688 gal/year (assumed to be gasoline)
Annual Fuel Savings from Bike Parking: ²	45,407 gal/year (assumed to be gasoline)		
	138,095	Total Gasoline savings (ELEC+Bike racks)	

Notes:

- California Air Resources Board, EMFAC2014, South Coast Air Basin; 2020; Annual; All vehicle types; Aggregate model year; Aggregate speed).
<https://www.arb.ca.gov/emfac/2014/>
- Assumes electric vehicles would replace traditional gasoline-fueled vehicles.

	Total CO₂ MT/yr	Fuel Type	Factor KGCO₂/gal	Gallons	Total Diesel (gal)	Total Gas (gal)
Emergency Generator	47.31	diesel	10.15	4,661.08		

Assumptions

- 10.15 diesel KgCO₂/gallon¹
- 8.91 gasoline KgCO₂/gallon¹
- 1 MT = 1,000 kilograms

Existing Flare Therm Usage

Meter 13618304

<u>Period</u>	<u>Days</u>	<u>Usage (therms)</u>	<u>Therms/ Day</u>
12/16/16 to 1/14/17	29	3,617	125
1/14/17 to 2/14/17	31	2,885	93
2/14/17 to 3/16/17	30	3,590	120
3/16/17 to 4/14/17	29	7,471	258
4/14/17 to 5/15/17	31	7,920	255
5/15/17 to 6/14/17	30	3,151	105
6/14/17 to 7/14/17	30	-	-
7/14/17 to 8/14/17	31	3,751	121



