APPENDIX 8

Air Quality and Greenhouse Gas Revisions to Applicant's Environmental Information

Dudek was provided criteria air pollutant and greenhouse gas (GHG) emission calculations for the East County (ECO) Substation, Tule Wind, and Energia Sierra Juarez (ESJ) Gen-Tie projects prepared by Insignia Environmental, Investigative Science and Engineering (ISE), and Entrix, respectively. Each consultant used a different approach to estimate the construction and operational emissions, and in some cases, left out important emissions sources or included calculations for some emission sources that were not evaluated by other consultants. Also, new suppliers for the water for construction were identified, which required a shift in the county in which the emissions would occur and a corresponding change in the estimated emissions.

In all cases, Dudek performed a third-party review of all technical information. Dudek corrected errors in methodologies or specific calculations, performed independent calculations to fill in data gaps, and attempted to make the reported emissions consistent between the three projects to the extent possible.

The document summarizes the revisions to the criteria pollutant and GHG emission information provided by the project applicants. For additional information, please see information provided below and in the pdf worksheet files for the revised calculations.

ECO SUBSTATION

Criteria Air Pollutants

1. Dudek corrected the daily operational emissions for the ECO Substation in Table 4.3-12 of the Proponent's Environmental Assessment (PEA). Operational emissions were erroneously reported in the PEA. The daily operational emissions for the ECO Substation from the URBEMIS 2007 output were added to the estimated emissions from testing of two emergency generators.
2. Dudek estimated the criteria air pollutant emissions associated with transport of water for construction based on the values in the PEA. In the PEA, it was assumed that water truck trips would total 4,320 vehicle-miles traveled per day within Imperial County between the project site and a water supply in Imperial County. Truck emissions were estimated using California statewide emission factors; thus, they would still be valid for truck travel in San Diego County. Based on a revised water supply as far away as the city of San Diego (approximately 140 miles round trip) and 43 trips per day for a total of 6,020 vehicle-miles traveled, the estimated emissions were scaled up by multiplying the previously calculated values by a factor of 1.4 (6,020/4,320).
3. The emissions associated with hauling water were added to the emissions associated with mass grading for the ECO substation and use of two propane generators since this period would generate the maximum daily emissions during the 8-month period in which water would be

transported. Later phases that would require water deliveries would result in lower combined emissions than this period. Similarly, the annual emissions associated with water delivery were added to the 2010 emissions since water delivery was assumed to occur in 2010 at the beginning of the construction activity.

Greenhouse Gas Emissions

1. Dudek estimated the GHG emissions for water hauling using the same approach as discussed above for criteria pollutant emissions except the previously estimated annual GHG emissions were scaled up by the different in vehicle-miles traveled. These emissions were added to the other construction emissions in 2010 because the water delivery was anticipated to occur between June 2010 and January 2011.
2. The PEA reported the annual GHG construction emissions (metric tons carbon dioxide equivalent (CO_2E) per year) by project component but not total project emissions by calendar year (2010 to 2012). Dudek estimated the total project GHG construction emissions (as CO_2E) by year and, in order to account for overlapping construction phases, the original values from the PEA for each of the four project components were put in a spreadsheet and then totaled by year. The estimated CO_2E emissions for on-road trucks, on-road light-duty (LD) vehicles, and off-road equipment for each year were calculated using the annual CO_2 emissions for each source category multiplied by the ratio of the total CO_2E emissions to the total CO_2 emissions for all three years. Adjusted GHG emissions associated with water hauling (as discussed above) were added to the 2010 emissions.

TULE WIND

Criteria Air Pollutants and Greenhouse Gas Emissions

1. Construction equipment – ISE conservatively used Tier 0 (pre-1996, pre-control) off-road diesel equipment emission factors for calculations of criteria air pollutants from diesel construction equipment, although the off-road equipment would likely be newer. Dudek also used the Tier 0 emission factors rather than recalculating the emissions from this equipment and corrected minor errors (e.g., application of emission factors from the wrong equipment category). ISE used a 1941 reference as the basis to assume that CO_2 from diesel engines would be emitted at a ratio of 27:1 compared to carbon monoxide (CO). This reference does not reflect that modern diesel engines have low CO emissions; thus, this ratio is too low. ISE assumed that methane (CH_4) emissions were "trace, if not negligible." Furthermore, ISE used an erroneous calculation for GHG emissions that assumed nitrous oxide (N_2O) emissions are 30% of oxides of nitrogen (NO_x) emissions. This assumption was not documented, and it could not be independently verified. N_2O emissions are typically a small contribution relative to NO_x emissions from combustion sources. Dudek recalculated the GHG emissions from construction

equipment using the California Air Resources Board's (CARB's) OFFROAD2007 CO_2 emission factor for diesel equipment (568.3 grams per horsepower hour). The CO_2 emissions were adjusted using factors for CH_4 and N_2O for off-road vehicles from the California Climate Action Registry's *General Reporting Protocol* (GRP) to calculate the total GHG emissions as CO_2E.

2. Construction worker vehicles – ISE's *Construction Air Quality Conformity Assessment* based the construction worker vehicle emission on the average daily trips (ADT) in the traffic study for the project. The traffic study reported an ADT of 1,250 passenger-car equivalents (PCE) based on round-trips by 125 workers per day and 200 trucks per day (converted to PCE as a ratio of 2.5 PCE per truck). Thus, the number of estimated worker vehicle trips was over-reported in the ISE report. Dudek recalculated the worker vehicle trip emissions from 125 workers (250 daily one-way trips) using the vehicle distribution for light-duty auto, light-duty truck, medium-duty truck, and motorcycles in the ISE report (renormalized the distribution to equal 100%), a one-way trip distance of 30 miles as indicated in the ISE report, and the EMFAC2007 emission factors for these vehicle classifications from the ISE report for criteria air pollutants and CO_2. To estimate the total GHG emissions (as CO_2E), the CO_2 emissions were adjusted using a U.S. Environmental Protection Agency (EPA) adjustment factor for passenger vehicles.

3. Delivery trucks – As noted above, ISE assumed 1,250 ADT for *construction worker vehicles*, while the traffic study reported 200 trucks per day. While the vehicle classifications used by ISE to calculate construction worker vehicle emissions did include medium-duty and heavy-duty trucks, the percentages of these trucks reflected normal roadway distributions of vehicles and not those associated with an intense construction project with substantial truck activity. Thus, trucks used for delivery of concrete materials (aggregate, sand, cement, water), water for fugitive dust control, wind turbine components, and other materials were under-reported by assuming approximately 70 trucks per day, which is fewer than the trucks in the traffic study. Dudek calculated the emissions of delivery and other trucks using a one-way trip distance of 30 miles as indicated in ISE's *Construction Air Quality Conformity Assessment*, 400 daily one-way truck trips, and EMFAC2007 emissions factors for heavy-duty trucks from the ISE report for criteria air pollutants and CO_2. To estimate the total GHG emissions (as CO_2E), the CO_2 emissions were adjusted using GRP factors for CH_4 and N_2O from heavy-duty diesel trucks.

4. Paved road dust – ISE's *Construction Air Quality Conformity Assessment* did not estimate emissions associated with construction vehicles or operational employee vehicles traveling on paved roads to and from the construction site. These emissions were estimated for the ECO Substation and ESJ Gen-Tie projects. For consistency, Dudek estimated the emissions associated with on-road heavy-duty trucks and passenger vehicles traveling on paved roads

using emission calculations and factors from Section 13.2.1 (Paved Roads) of the EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) and San Diego County silt loading utilizing factors from CARB's area-wide source methodology for paved road dust. The annual, but not daily, paved road dust emissions were adjusted for rainfall, assuming 18 days exceeding 0.01 inch of rainfall.

5. Employee vehicles – ISE's *Construction Air Quality Conformity Assessment* did not include an estimate of criteria air pollutant or GHG emissions from employee vehicles during operation of the wind farm. Iberdrola updated the information related to the number of workers associated with operation of the Tule Wind Project. The facility would require 12 full-time workers for an ADT of 24 (12 employees per day × 2 trips per day). Dudek calculated the employee vehicle exhaust emissions using the vehicle distribution for light-duty auto and light-duty trucks in the ISE report (renormalized the distribution to equal 100%), a one-way trip distance of 30 miles as indicated in the ISE report, and the EMFAC2007 emission factors for these vehicle classifications from the ISE report for criteria air pollutants and CO_2. To estimate the total GHG emissions (as CO_2E), the CO_2 emissions were adjusted using an EPA adjustment factor for passenger vehicles. Paved road emissions for employee trips were also estimated using the method described previously.

6. Concrete plant emissions – ISE's *Construction Air Quality Conformity Assessment* indicated the use of an on-site temporary concrete batch plant; however, the emissions associated with the concrete batch plant were not calculated. The Applicant's Environmental Document indicated that the wind turbine foundations would need between 275 and 707 cubic yards of concrete (491 cubic yards average) per tower. Thus, a total of 65,794 cubic yards would be required if 134 wind turbines were installed. Assuming a 192-day period for installation of foundations (as indicated in the ISE report, foundations would be installed during the Underground Utilities Construction/ Tower Work Phase), the batch plant would produce an average of 343 cubic yards of concrete per day. The concrete batch plant's PM_{10} and $PM_{2.5}$ emissions were estimated using factors from Section 11.12 (Concrete Batching) of the EPA's AP-42. The batch plant was assumed to use a 110-horsepower diesel generator, based on the size of generators used for a similar wind energy project. The concrete batch plant's generator emissions utilized factors corresponding to the applicable CARB/EPA off-road emission standards for a Tier 3 compression-ignition (diesel) engine in 2011.

7. The Tule Wind project would also require imported water for construction, likely from sources near the project site in San Diego County. It was anticipated that 60 water trucks per day would be required. The estimated construction emissions assumed up to 200 total trucks each day, as discussed above. Therefore, water trucks are accounted for in current calculations, and separate calculations for these trips were not deemed necessary.

8. Turbine component delivery trucks could be traveling through Imperial County, and some

could be coming from the Port of San Diego or other locations. It is estimated that about 2,000 total trucks (134 turbines x 15 trucks per turbine) would be required to deliver turbine components over 192 days (the period for turbine installation in ISE's *Construction Air Quality Conformity Assessment* for the Tule Wind Project). This would be equivalent to approximately 10 trucks per day. Conservatively assuming up to 20 trucks per day traveling 97 miles (approximately 200 miles round trip) through Imperial County, the total vehicle-miles traveled would be:

20 truck round trips/day × 200 miles/trip ≈ 4,000 vehicle-miles traveled/day

The *Construction Air Quality Conformity Assessment* and traffic study for the Tule Wind Project assumed up to 200 trucks per day each traveling 60 miles round trip, which would be 12,000 vehicle-miles traveled per day. Because 4,000 is much less than 12,000 vehicle-miles traveled, it can be assumed that the turbine component delivery trucks are accounted for in current calculations and that separate calculations for these trips were not necessary. This approach would apply to criteria air pollutants and GHGs.

9. Transmission Line – The emissions associated with construction of aboveground portions of the on-site collector lines and the 9.7-mile off-site transmission line from the Tule Wind Project to the Boulevard Substation were not included in the ISE *Construction Air Quality Conformity Assessment*. Only the emissions associated with trenching and related activities for on-site collector lines were evaluated. Because the 13.3-mile 138 kV transmission line for the ECO Substation Project would involve comparable types and numbers of poles (116 steel poles for Tule Wind and 98 steel poles and 9 wooden poles for ECO), the same maximum daily and annual emissions for the ECO Substation transmission line were assumed for the Tule Wind transmission line. The emissions associated with the installation of the transmission line were added to the estimated emissions for the Tower Construction/Finish Work Phase, which would generally occur during the same time period, to estimate the total emissions associated with this time period.

ESJ GEN-TIE

Greenhouse Gas Emissions

1. Using spreadsheet calculations provided by Entrix, Dudek added the CO_2E emissions associated with on-site construction equipment and vehicles for the ESJ Gen-Tie transmission line within San Diego County (220 short tons CO_2E per year), 66 short tons CO_2E per year from San Diego trucking wind turbine components from the Port of San Diego, 12% (portion of total travel distance within San Diego and Imperial Counties) of 4,985 short tons CO_2E per year for trucking wind turbine components from Houston (a one-way distance of 178 miles through San Diego and Imperial Counties from the east), and 9% (portion of total travel

distance within San Diego and Imperial Counties) of 6,647 short tons CO_2E per year for trucking wind turbine components from the Midwest (a one-way distance of 178 miles through San Diego and Imperial Counties from the east). The annual tons CO_2E were then divided total by 1.1023 to calculate metric tons CO_2E per year.

APPENDIX A

ECO Substation Emissions Calculations

ECO Substation Project
Estimated GHG Emissions by Calendar Year

	ECO Substation			SWPL			138 kW			Boulevard Substation			Total
	tons CO2	MT CO2E	MT CO2E	tons CO2	MT CO2E	MT CO2E	tons CO2	MT CO2E	MT CO2E	tons CO2	MT CO2E	MT CO2E	MT CO2E
Total On-Road		1,010.92			3.72			695.02			262.04		
2010 On-Road	177.79		163.03										163.03
2011 On-Road	226.10		207.33				757.96		695.02	261.75		240.01	1,142.36
2012 On-Road	698.57		640.57	4.06		3.72				24.02		22.03	666.31
Total On-Road-LD		2,099.31			6.68			450.97			65.06		
2010 On-Road-LD	57.81		53.00										53.00
2011 On-Road-LD	1,793.49		1,644.21	0.47		0.43	491.91		450.97	50.27		46.08	2,141.69
2012 On-Road-LD	438.61		402.10	6.82		6.25				20.70		18.98	427.33
Total Off-Road		3,382.26			95.43			1,282.50			626.24		
2010 Off-Road	1,485.84		1,360.28										1,360.28
2011 Off-Road	2,172.33		1,988.75	6.08		5.57	1,400.88		1,282.50	603.78		552.75	3,829.57
2012 Off-Road	36.30		33.23	98.16		89.86				80.27		73.49	196.58
Grand Total for Components			6,492.49			105.83			2,428.49			953.34	9,980.15

	Water and Fill Material		
2010 On-Road	1,600.10	3,333.19	2,044.63
2011 On-Road	2,034.91		1,865.95
			3,910.58

	Generators	
2010 Off-Road		42.84
		13,933.57

2010	3,663.77
2011	8,979.58
2012	1,290.22
Total	13,933.57

Notes:
1. The annual CO2 emissions for each source category (On-Road, On-Road-LD, and Off-Road) were calculated by multiplying the annual CO2 emissions by the ratio of the total CO2E emissions to the total CO2 emissions for the category.
2. Emissions for water hauling would occur within San Diego County in 2010. Estimated emissions from the ECO Substation PEA were increased by a factor of 6020/4320 to account for the revised trips between the City of San Diego and the project site instead of a location in Imperial County.
3. Emissions for hauling fill material would occur primarily in Imperial County in 2011.

APPENDIX B

Tule Wind Emissions Calculations

Criteria Air Pollutant Emissions

Tule Wind Project
Summary of Construction Emissions
(Rough Grading/Tower Base Work Phase and 2011 Annual)

	lbs/day					
Source	VOC	NOx	CO	SOx	PM10	PM2.5
Off-Road Equipment	20.27	177.30	103.10	4.87	9.92	9.10
Fugitive Dust	—	—	—	—	44.70	9.30
Worker Vehicles	1.29	5.38	38.05	0.05	0.17	0.17
Delivery and Other Trucks	10.63	235.03	99.21	0.34	7.14	7.12
Paved Road Dust	—	—	—	—	537.90	80.33
Total	32.20	417.71	240.35	5.27	599.83	106.02

Maximum daily emissions would occur during Rough Grading/Tower Base Work phase.

	tons/year					
Source	VOC	NOx	CO	SOx	PM10	PM2.5
Off-Road Equipment	2.60	22.33	12.47	0.41	1.26	1.16
Fugitive Dust	—	—	—	—	3.71	0.77
Concrete Batch Plant	0.19	0.56	0.69	0.00	0.04	0.04
Worker Vehicles	0.20	0.84	5.94	0.01	0.03	0.03
Delivery and Other Trucks	1.66	36.66	15.48	0.05	1.11	1.11
Paved Road Dust	—	—	—	—	82.88	12.38
Total	4.64	60.40	34.57	0.47	89.03	15.48

Maximum annual emissions would occur during 2011.

Tule Wind Project
Summary of Construction Emissions
(Tower Construction/Finish Work and Transmission Line and 2012 Annual)

	lbs/day					
Source	VOC	NOx	CO	SOx	PM10	PM2.5
Off-Road Equipment	5.02	51.27	20.30	0.03	0.00	2.90
Worker Vehicles	1.29	5.38	38.05	0.05	0.17	0.17
Delivery and Other Trucks	10.63	235.03	99.21	0.34	7.14	7.12
Paved Road Dust	—	—	—	—	537.90	80.33
Transmission Line	63.71	256.68	248.17	5.95	67.96	16.03
Total	80.66	548.35	405.72	6.37	613.18	106.54

Maximum daily emissions would occur during the Tower Construction/Finish Work phase.

	tons/year					
Source	VOC	NOx	CO	SOx	PM10	PM2.5
Off-Road Equipment	0.69	6.68	2.85	0.00	0.38	0.37
Fugitive Dust	—	—	—	—		
Worker Vehicles	0.15	0.63	4.45	0.01	0.02	0.02
Delivery and Other Trucks	1.24	27.50	11.61	0.04	0.84	1.11
Paved Road Dust	—	—	—	—	62.16	9.28
Transmission Line	0.49	1.69	5.71	1.01	0.07	0.06
Total	2.58	36.50	24.62	1.06	63.46	10.84

Maximum annual emissions would occur during 2012.

Tule Wind Project
Construction Off-Road Equipment Emissions (Unmitigated)

Emission Factors

	lb/hp-hr					
	VOC	NOx	CO	SOx	PM10	PM2.5
Track Backhoe	0.0030	0.0220	0.0150	0.0020	0.0010	0.0009
Dozer	0.0030	0.0220	0.0150	0.0020	0.0010	0.0009
Hydraulic Crane	0.0030	0.0230	0.0090	0.0020	0.0015	0.0014
Loader/Grader	0.0030	0.0220	0.0150	0.0020	0.0010	0.0009
Side Boom	0.0030	0.0310	0.0130	0.0020	0.0015	0.0014
Water Truck	0.0020	0.0210	0.0060	0.0020	0.0015	0.0014
Concrete Truck	0.0020	0.0210	0.0060	0.0020	0.0015	0.0014
Concrete Pump	0.0020	0.0180	0.0110	0.0020	0.0010	0.0009
Dump/Haul Trucks	0.0020	0.0210	0.0060	0.0020	0.0015	0.0014
Paver Blade	0.0010	0.0230	0.0070	0.0020	0.0010	0.0009
Roller Compactor	0.0020	0.0200	0.0070	0.0020	0.0010	0.0009
Scraper	0.0010	0.0190	0.0110	0.0020	0.0015	0.0014

Rough Grading/Tower Base Work

			Daily Load	Duty Cycle	lbs/day						tons/period					
	Qty. Used	HP	Factor (%)	(hrs/day)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Dozer - D6 Cat	2	250	50	6	4.50	33.00	22.50	0.02	1.50	1.38	0.43	3.17	2.16	0.00	0.14	0.13
Dozer - D8 Cat	2	300	50	8	7.20	52.80	36.00	4.80	2.40	2.21	0.69	5.07	3.46	0.46	0.23	0.21
Loader/Trencher	2	150	50	8	3.60	26.40	18.00	0.01	1.20	1.10	0.35	2.53	1.73	0.00	0.12	0.11
Water Truck	2	200	50	4	1.60	16.80	4.80	0.01	1.20	1.10	0.15	1.61	0.46	0.00	0.12	0.11
Mini Excavator	1	50	50	4	0.10	2.40	1.10	0.00	0.15	0.20	0.01	0.23	0.11	0.00	0.01	0.02
Dump/Haul & Drills	4	300	20	4	1.92	20.16	5.76	0.01	1.44	1.32	0.18	1.94	0.55	0.00	0.14	0.13
Scraper	1	450	75	4	1.35	25.65	14.85	0.02	2.03	1.86	0.13	2.46	1.43	0.00	0.19	0.18
Total					20.27	177.30	103.10	4.87	9.92	9.10	1.95	17.02	9.90	0.47	0.95	0.87

Underground Utilities Construction/Tower Work

			Daily Load	Duty Cycle	lbs/day						tons/period					
	Qty. Used	HP	Factor (%)	(hrs/day)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Track Backhoe	2	150	50	6	2.70	19.80	13.50	0.01	0.90	0.83	0.26	1.90	1.30	0.00	0.09	0.08
Dozer - D4 Cat	2	200	50	6	3.60	26.40	18.00	0.01	1.20	1.10	0.35	2.53	1.73	0.00	0.12	0.11
Loader	1	150	50	6	1.35	9.90	6.75	0.01	0.45	0.50	0.13	0.95	0.65	0.00	0.04	0.05
Water Truck	1	200	50	4	0.80	8.40	2.40	0.00	0.60	0.55	0.08	0.81	0.23	0.00	0.06	0.05
Concrete Truck	16	250	25	0.5	1.00	10.50	3.00	0.01	0.75	0.69	0.10	1.01	0.29	0.00	0.07	0.07
Dump/Haul Truck	2	300	45	4	2.16	22.68	6.48	0.01	1.62	1.49	0.21	2.18	0.62	0.00	0.16	0.14
Total					11.70	97.68	50.20	0.05	5.60	5.16	1.12	9.38	4.82	0.01	0.54	0.50

Tower Construction/Finish Work

			Daily Load	Duty Cycle	lbs/day						tons/period					
	Qty. Used	HP	Factor (%)	(hrs/day)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Skid Steer Cat	1	150	50	6	1.35	9.90	6.75	0.01	0.45	0.50	0.13	0.95	0.65	0.00	0.04	0.05
Hydraulic Crane	1	200	25	4	0.60	4.60	1.80	0.00	0.30	0.28	0.06	0.44	0.17	0.00	0.03	0.03
Water Truck	1	200	50	4	0.80	8.40	2.40	0.00	0.60	0.55	0.08	0.81	0.23	0.00	0.06	0.05
Welding Rig	1	50	50	4	0.20	1.80	1.10	0.00	0.10	0.09	0.02	0.17	0.11	0.00	0.01	0.01
Dump/Haul Truck	6	300	45	0.5	0.81	8.51	2.43	0.00	0.61	0.56	0.08	0.82	0.23	0.00	0.06	0.05
Paver/Compactor	1	150	35	8	0.42	9.66	2.94	0.01	0.42	0.39	0.04	0.93	0.28	0.00	0.04	0.04
Roller	1	150	35	8	0.84	8.40	2.94	0.01	0.42	0.39	0.08	0.81	0.28	0.00	0.04	0.04
Total					5.02	51.27	20.30	0.03	2.90	2.85	0.48	4.92	1.95	0.00	0.28	0.27

	lbs/day						tons/yr					
	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Maximum Daily Emissions	20.27	177.30	103.10	4.87	9.92	9.10						
2010 Annual Emissions (tons/yr)							0.26	2.30	1.34	0.06	0.13	0.12
2011 Annual Emissions (tons/yr)							2.60	22.33	12.47	0.41	1.26	1.16
2012 Annual Emissions (tons/yr)							0.69	6.68	2.85	0.00	0.38	0.37

(1) Period = 192 days for each construction phase

Tule Wind Project
Construction Motor Vehicle Emissions
(San Diego County)

EMFAC 2007 Year 2012 Emission Rates

	gm/mile @ 45 MPH					
	ROG	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	0.055	0.253	1.937	0.003	0.008	0.008
Light Duty Trucks (LDT)	0.057	0.391	2.416	0.003	0.017	0.017
Medium Duty Trucks (MDT)	0.087	0.796	2.662	0.005	0.018	0.018
Motorcycles (MCY)	2.642	1.504	29.672	0.002	0.024	0.024
Heavy Duty Trucks (HDT)	0.402	8.884	3.750	0.013	0.270	0.269

Proposed Project

Worker Trips	% of ADT	ADT 125	lb/day					
			ROG	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	72.4%	91	0.66	3.05	23.32	0.04	0.10	0.10
Light Duty Trucks (LDT)	20.4%	25	0.19	1.29	7.99	0.01	0.06	0.06
Medium Duty Trucks (MDT)	6.7%	8	0.09	0.84	2.82	0.01	0.02	0.02
Motorcycles (MCY)	0.5%	1	0.35	0.20	3.92	0.00	0.00	0.00
Total	100.0%	125	1.29	5.38	38.05	0.05	0.17	0.17
	% of ADT	ADT 200						
Trucks (Delivery and Other)								
Heavy Duty Trucks (HDT)	100.0%	200	10.63	235.03	99.21	0.34	7.14	7.12
Total Motor Vehicles			11.93	240.41	137.25	0.40	7.32	7.29

Worker Trips	tons/yr					
	ROG	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	0.10	0.48	3.64	0.01	0.02	0.02
Light Duty Trucks (LDT)	0.03	0.20	1.25	0.00	0.01	0.01
Medium Duty Trucks (MDT)	0.01	0.13	0.44	0.00	0.00	0.00
Motorcycles (MCY)	0.05	0.03	0.61	0.00	0.00	0.00
Total	0.20	0.84	5.94	0.01	0.03	0.03
Trucks (Delivery and Other)						
Heavy Duty Trucks (HDT)	1.66	36.66	15.48	0.05	1.11	1.11
Total Motor Vehicles	1.86	37.50	21.41	0.06	1.14	1.14

Tule Wind Project
Construction Paved Road Emissions
(San Diego County)

Emission Factor (1)
$E = k * (sL/2)^{0.65} * (W/3)^{1.5}$ [maximum day]
$E = k * (sL/2)^{0.65} * (W/3)^{1.5} * (1 - P/4N)$ [annual]

		Units	Delivery and Other Trucks	Worker Trips	Total
k	particle size multiplier (PM_{10})	lb/VMT	0.016	0.016	
k	particle size multiplier ($PM_{2.5}$)	lb/VMT	0.0024	0.0024	
sL	silt loading (2)	g/m^2	0.047	0.047	
W	weight (empty)	tons	20		
	weight (loaded)	tons	40		
	weight (mean)	tons	30	2.4	
E	emission factor (PM_{10})	lb/VMT	0.0442	0.00100	
E	emission factor ($PM_{2.5}$)	lb/VMT	0.0066	0.00015	
P	days of rainfall > 0.01 in	days	18	18	
N	days in period	days	365	365	
	one-way trip distance	miles	30	30	
	average vehicle trips	ADT	200	125	
	VMT/day		12,000	7,500	
	PM_{10} daily	lb/day	530.40	7.50	537.90
	$PM_{2.5}$ daily	lb/day	79.20	1.13	80.33
	VMT/yr		3,744,000	2,340,000	
	PM_{10} annual w/ rain adjustment	ton/yr	81.72	1.16	82.88
	$PM_{2.5}$ annual w/ rain adjustment	ton/yr	12.20	0.17	12.38

Notes:
1. Emission factors from AP-42, Section 13.2.1 (Paved Roads).
2. Silt loading from California Air Resources Board, Areawide Source Methodologies, Section 7.9, Entrained Paved Road Dust, Paved Road Travel (July 1997).

Tule Wind Project
Motor Vehicle Operational Emissions

EMFAC 2007 Year 2012 Emission Rates	gm/mile @ 45 MPH					
	VOC	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	0.055	0.253	1.937	0.003	0.008	0.008
Light Duty Trucks (LDT)	0.057	0.391	2.416	0.003	0.017	0.017
Paved Road Dust	—	—	—	—	0.454	0.068

Proposed Project

Employee Trips	% of ADT	ADT 24	lb/day					
			VOC	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	78.1%	19	0.14	0.64	4.87	0.01	0.02	0.02
Light Duty Trucks (LDT)	21.9%	5	0.04	0.26	1.60	0.00	0.01	0.01
Paved Road Dust			—	—	—	—	0.72	0.11
Total	100.0%	24	0.18	0.89	6.47	0.01	0.75	0.14

Employee Trips	tons/yr					
	VOC	NOx	CO	SOx	PM10	PM2.5
Light Duty Autos (LDA)	0.02	0.10	0.76	0.00	0.00	0.00
Light Duty Trucks (LDT)	0.01	0.04	0.25	0.00	0.00	0.00
Paved Road Dust	—	—	—	—	0.11	0.02
Total	0.03	0.14	1.01	0.00	0.12	0.02

One-way Trip Distance 30 miles

Greenhouse Gas Emissions

Tule Wind Project
Summary of Construction GHG Emissions

	metric ton CO2E/yr			
	2010	2011	2012	Total
Wind Farm				
Off-Road Equipment	123.6	1,193.6	356.4	1,673.7
Worker Vehicles	64.0	767.5	575.6	1,407.0
Delivery and Other Trucks	437.3	5,247.3	3,935.5	9,620.0
Transmission Line	—	—	2,428.5	2,428.5
Total	624.9	7,208.4	7,296.0	15,129.2

1. GHG emissions associated with construction of the transmission line were assumed to be the same as those calculcated for the ECO Substation Project. While the ECO Substation Project's transmission line consists of 13.3 miles and 98 poles, and the Tule Wind tranmission line consists of 9.7 miles and 116 poles, the construction emissions are assumed to be the same for the purpose of thise analysis.

Tule Wind Project
Construction Diesel Equipment GHG Emissions

Rough Grading/Tower Base Work

	Qty. Used	HP	Daily Load Factor (%)	Duty Cycle (hrs/day)	CO2 Emission Factor (lb/HP-hr)	Pounds/Day	Tons/Period
Dozer - D6 Cat	2	250	50	6	1.25	1,875	180.0
Dozer - D8 Cat	2	300	50	8	1.25	3,000	288.0
Loader/Trencher	2	150	50	8	1.25	1,500	144.0
Water Truck	2	200	50	4	1.25	1,000	96.0
Mini Excavator	1	50	50	4	1.25	125	12.0
Dump/Haul & Drills	4	300	20	4	1.25	1,200	115.2
Scraper	1	450	75	4	1.25	1,688	162.0
Total						10,388	997.2

(1) Emission factor from CARB OFFROAD model.
(2) Period = 192 days

Underground Utilities Construction/Tower Work

	Qty. Used	HP	Daily Load Factor (%)	Duty Cycle (hrs/day)	CO2 Emission Factor (lb/HP-hr)	Pound/Day	Tons/Period
Track Backhoe	2	150	50	6	1.25	1,125	108.0
Dozer - D4 Cat	2	200	50	6	1.25	1,500	144.0
Loader	1	150	50	6	1.25	563	54.0
Water Truck	1	200	50	4	1.25	500	48.0
Concrete Truck	16	250	25	0.5	1.25	625	60.0
Dump/Haul Truck	2	300	45	4	1.25	1,350	129.6
Total						5,663	543.6

(1) Emission factor from CARB OFFROAD model.
(2) Period = 192 days

Tower Construction/Finish Work

	Qty. Used	HP	Daily Load Factor (%)	Duty Cycle (hrs/day)	CO2 Emission Factor (lb/HP-hr)	Pound/Day	Tons/Period
Skid Steer Cat	1	150	50	6	1.25	563	54.0
Hydraulic Crane	1	200	25	4	1.25	250	24.0
Water Truck	1	200	50	4	1.25	500	48.0
Welding Rig	1	50	50	4	1.25	125	12.0
Dump/Haul Truck	6	300	45	0.5	1.25	506	48.6
Paver/Compactor	1	150	35	8	1.25	525	50.4
Roller	1	150	35	8	1.25	525	50.4
Total						2,994	287.4

(1) Emission factor from CARB OFFROAD model.
(2) Period = 192 days

Total CO2 Emissions	1,828.2	tons/yr
2010 Annual CO2 Emissions	135.0	tons/yr
2011 Annual CO2 Emissions	1,303.8	tons/yr
2012 Annual CO2 Emissions	389.3	tons/yr
2010 Annual CO2E Emissions	123.6	metric tons/yr
2011 Annual CO2E Emissions	1,193.6	metric tons/yr
2012 Annual CO2E Emissions	356.4	metric tons/yr

Tule Wind Project
Construction Motor Vehicle GHG Emissions
(San Diego County)

EMFAC 2007 Year 2012 Emission Rates	CO2 gm/mile @ 45 MPH
Light Duty Autos (LDA)	285.724
Light Duty Trucks (LDT)	357.605
Medium Duty Trucks (MDT)	485.087
Motorcycles (MCY)	125.795
Heavy Duty Trucks (HDT)	1400.000

Proposed Project Action

Worker Trips	% of ADT	ADT 125	CO2 lb/day	CO2 ton/yr
Light Duty Autos (LDA)	72.4%	91	3,439.27	536.5
Light Duty Trucks (LDT)	20.4%	25	1,182.56	184.5
Medium Duty Trucks (MDT)	6.7%	8	513.32	80.1
Motorcycles (MCY)	0.5%	1	16.64	2.6
Total	100.0%		5,151.79	803.7

Trucks (Delivery and Other)	% of ADT	ADT 200		
Heavy Duty Trucks (HDT)	100.0%	200	37,037.04	5,777.8

Total Motor Vehicles	42,188.82	6,581.5

Total CO2 Emissions	6,581.5	tons/yr
Worker Vehicles	803.7	tons/yr
Trucks	5,777.8	tons/yr
Total CO2E Emissions	6,014.7	metric tons/yr
Worker Vehicles	767.5	metric tons/yr
Trucks	5,247.3	metric tons/yr

Tule Wind Project
Motor Vehicle Operational GHG Emissions

EMFAC 2007 Year 2012 Emission Rates	CO2 gm/mile @ 45 MPH
Light Duty Autos (LDA)	285.724
Light Duty Trucks (LDT)	357.605

Proposed Project

Employee Trips	% of ADT	ADT 24	CO2 lb/day	CO2 ton/yr
Light Duty Autos (LDA)	78.1%	19	718.09	112.0
Light Duty Trucks (LDT)	21.9%	5	236.51	36.9
Total	100.0%		954.60	148.9

Total CO2 Emissions	149	tons/yr
Total CO2E Emissions	142	metric tons/yr
One-way Trip Distance	30	miles

Tule Wind Project
CO_2-to-CO_2 Equivalent Factors

	Source	Units	CO_2	CH_4	N_2O	CO_2E/CO_2
Global Warming Potential			1	21	310	
Diesel Equipment	1	kg/gal	10.15	0.00058	0.00026	1.009
Diesel Trucks	2	g/mi	1,450.00	0.0051	0.0048	1.001
Passenger Vehicles	3					1.053

1. California Climate Action Registry. 2009. *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions*, Version 3.1, Tables C.6 and C.7.
2. California Climate Action Registry. 2009. *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions*, Version 3.1, Tables C.3 and C.4.
3. US EPA, Office of Transportation and Air Quality. 2005. *Greenhouse Gas Emissions from a Typical Passenger Vehicle* (EPA420-F-05-004), p. 4.

Concrete Batch Plant Emissions

Tule Wind Project
Concrete Batch Plant Emissions Calculations

Assumptions

-491 cubic yards of concrete per tower (average of 275 and 707 from Project Description) --> 65,794 cubic yards total

-batch plant emissions would occur over a 192-day phase

-batch plant would therefore produce approximately 343 cubic yards of concrete per day

Batch Plant Emissions

Batch Plant Activity	PM-10 Emission Factor lb/yd^3	PM10 lb/day	PM2.5 lb/day[1]	PM10 tons/year	PM2.5 tons/year
Aggregate delivery to ground storage	0.0031	1.06	0.71	0.10	0.07
Sand delivery to ground storage	0.0007	0.24	0.16	0.02	0.02
Aggregate transfer to conveyor	0.0031	1.06	0.71	0.10	0.07
Sand transfer to conveyor	0.0007	0.24	0.16	0.02	0.02
Aggregate transfer to elevated storage	0.0031	1.06	0.71	0.10	0.07
Sand transfer to elevated storage	0.0007	0.24	0.16	0.02	0.02
Cement delivery to Silo	0.0001	0.03	0.02	0.00	0.00
Cement supplement delivery to Silo	0.0002	0.07	0.05	0.01	0.00
Weigh hopper loading	0.0038	1.30	0.87	0.13	0.08
Central mix loading	0.0048	1.65	1.10	0.16	0.11
TOTAL		**6.96**	**4.67**	**0.67**	**0.45**

Source (Emission Factors): AP-42. Section 11.12 Concrete Batching. Table 11.12-6.
Source (PM2.5 percentage): http://www.arb.ca.gov/ei/speciate/pmsize_07242008.xls
1. PM2.5 calculated as 67% of PM10.

Tule Wind Project
Concrete Batch Plant Emissions Calculations

Batch Plant Generator Emissions

Engine Rating	110	HP
Fuel Input	2.0	MMBtu/hr
Operating Schedule	8.0	hr/day
	1,536	hr/yr

	VOC (2)	NOx	CO	SOx (3)	PM10	PM2.5 (4)	CO2 (5)
gm/BHP-hr (1)	1.00	3.00	3.70	0.005	0.22	0.21	568.3
lb/hr	0.24	0.73	0.90	0.00	0.05	0.05	137.82
lb/day	1.94	5.82	7.18	0.01	0.43	0.42	1102.52
tons/yr	0.19	0.56	0.69	0.00	0.04	0.04	105.84

Notes:
(1) Based on EPA/CARB off-road engine emission standards for Tier 3 engine, except ROC, SOx, and CO2.
(2) Tier 3 standard is NOx + HC. HC/VOC is assumed to be 1.0 gm/BHP-hr. Diesel engines generally have HC emissions emissions well below 1.0 gm/BHP-hr.
(3) Based on 15 ppm (0.0015%) sulfur by weight.
(4) PM2.5 fraction = 97.6% of PM10 (http://www.arb.ca.gov/ei/speciate/pmsize_07242008.xls for "STAT. I.C. ENGINE -DIESEL")
(5) Emission factor from CARB OFFROAD model.

Equipment	HP	# of Units	Duration (Days)	Category	Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5[1]	CO2
Batch Plant Generator	110	1	192	Off-Road	1.94	5.82	7.18	0.01	0.43	0.42	1102.52

Emissions (tons/year) VOC	NOx	CO	SOx	PM10	PM2.5[1]	CO2
0.19	0.56	0.69	0.00	0.04	0.04	105.84