

**Table 1: Estimated Emissions Reductions from Cruise Ship Terminal  
San Diego Unified Port District**

	Cruise Line	Ship Name	Location	Connect Day	Connection Duration	Power Used	Connection was Successful?	Approximate Emissions Reduction (ton) <sup>1,2</sup>								
					HH/MM/SS	(KW-hr)		PM10	PM2.5	DPM	NOx	SO2	HC	CO	CH4	CO2
1	Holland America	Oosterdam	San Diego North	Saturday, November 20, 2010 <sup>3</sup>	1:31:55	10,355	Yes	0.004	0.004	0.004	0.16	0.02	0.005	0.01	0.001	4
2	Holland America	Oosterdam	San Diego North	Saturday, November 27, 2010	5:19:24	37,037	Yes	0.01	0.01	0.02	0.57	0.08	0.02	0.04	0.003	14.76
3	Holland America	Oosterdam	San Diego North	Saturday, December 04, 2010	7:51:29	53,900	Yes	0.02	0.02	0.02	0.82	0.11	0.03	0.06	0.005	21.48
4	Holland America	Oosterdam	San Diego North	Saturday, December 11, 2010	8:28:44	51,400	Yes	0.02	0.02	0.02	0.78	0.10	0.03	0.06	0.004	20.48
5	Holland America	Oosterdam	San Diego North	Saturday, December 18, 2010	7:58:45	51,500	Yes	0.02	0.02	0.02	0.79	0.10	0.03	0.06	0.004	20.52
6	Holland America	Oosterdam	San Diego North	Sunday, December 26, 2010	6:17:25	42,000	Yes	0.02	0.02	0.02	0.64	0.09	0.02	0.05	0.004	16.74
7	Holland America	Oosterdam	San Diego North	Sunday, January 02, 2011	7:47:02	52,400	Yes	0.02	0.02	0.02	0.80	0.11	0.03	0.06	0.004	20.88
8	Holland America	Oosterdam	San Diego North	Saturday, January 08, 2011	7:40:48	52,000	Yes	0.02	0.02	0.02	0.79	0.11	0.03	0.06	0.004	20.72
9	Holland America	Oosterdam	San Diego North	Saturday, January 15, 2011	8:06:47	55,100	Yes	0.02	0.02	0.02	0.84	0.11	0.03	0.06	0.005	21.96
10	Holland America	Oosterdam	San Diego North	Saturday, January 22, 2011	7:52:01	53,600	Yes	0.02	0.02	0.02	0.82	0.11	0.03	0.06	0.005	21.36
11	Holland America	Oosterdam	San Diego North	Saturday, January 29, 2011	8:06:07	54,600	Yes	0.02	0.02	0.02	0.83	0.11	0.03	0.06	0.005	21.76
12	Holland America	Oosterdam	San Diego North	Saturday, February 05, 2011	6:09:30	40,400	Yes	0.02	0.01	0.02	0.62	0.08	0.02	0.05	0.003	16.10
13	Holland America	Oosterdam	San Diego North	Saturday, February 12, 2011	7:53:09	52,500	Yes	0.02	0.02	0.02	0.80	0.11	0.03	0.06	0.004	20.92
14	Holland America	Oosterdam	San Diego North	Saturday, February 19, 2011	8:16:53	55,600	Yes	0.02	0.02	0.02	0.85	0.11	0.03	0.06	0.005	22.16
15	Holland America	Oosterdam	San Diego North	Saturday, February 26, 2011	8:05:19	54,000	Yes	0.02	0.02	0.02	0.82	0.11	0.03	0.06	0.005	21.52
16	Holland America	Oosterdam	San Diego North	Saturday, March 05, 2011	8:07:43	54,900	Yes	0.02	0.02	0.02	0.84	0.11	0.03	0.06	0.005	21.88
17	Holland America	Oosterdam	San Diego North	Saturday, March 12, 2011	8:04:50	54,700	Yes	0.02	0.02	0.02	0.84	0.11	0.03	0.06	0.005	21.80
18	Holland America	Oosterdam	San Diego North	Saturday, March 19, 2011	7:47:14	52,200	Yes	0.02	0.02	0.02	0.80	0.11	0.03	0.06	0.004	20.80
19	Holland America	Oosterdam	San Diego North	Saturday, March 26, 2011	11:20:33	78,200	Yes	0.03	0.03	0.03	1.19	0.16	0.04	0.09	0.007	31.17
20	Holland America	Oosterdam	San Diego North	Saturday, April 02, 2011	8:06:30	55,700	Yes	0.02	0.02	0.02	0.85	0.11	0.03	0.06	0.005	22.20

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21	Holland America	Oosterdam	San Diego North	Saturday, April 09, 2011	7:27:12	49,200	Yes	0.02	0.02	0.02	0.75	0.10	0.03	0.06	0.004	19.61
22	Holland America	Oosterdam	San Diego North	Saturday, April 16, 2011	8:14:06	56,800	Yes	0.02	0.02	0.02	0.87	0.12	0.03	0.06	0.005	22.64
<b>Total</b>					<b>166:33:26</b>	<b>1,118,092</b>		<b>0.45</b>	<b>0.41</b>	<b>0.47</b>	<b>17.07</b>	<b>2.28</b>	<b>0.58</b>	<b>1.26</b>	<b>0.09</b>	<b>445.6</b>

**Notes:**

**1. Emissions Methodology:** A refined emission reduction estimate would require vessel-specific emission factors. Emission reductions are calculated here based on default emission factors. The calculation methodology is from *Rulemaking to Consider Adoption of Proposed Regulations to Reduce Emissions from Diesel Auxiliary Engines on Ocean-Going Vessels while at Berth at a California Port*, (Appendix B: Emission Inventory Methodology), California Air Resources Board, December 6, 2007, per a March 10, 2009 email from Mr. Francisco Dóñez of the USEPA. The vessel call data used for the emissions calculation were provided by the Port.

$$E = Energy * \left( EF_{auxiliary} - EF_{grid} \right) * (453g/lb) / (2000lb/ton)$$

Where E = emission reduction(tons), Energy = energy consumed (Kw-hr), EF = the associated emission factor (g/kW-hr).

**2. Emission Factors**

Engine	Emission factors (g/kW-hr)								
	PM10	PM2.5	DPM	NOx	SO2	HC	CO	CH4	CO2
Marine Distillate (0.5% S)	0.38	0.35	0.38	13.9	2.1	0.52	1.10	0.09	690
Grid	0.014	0.014	0.00	0.0499	0.25	0.05	0.08	0.01	328.45

Marine Distillate emission factors obtained from Emissions Estimation Methodology for Ocean Going Vessels, California Air Resources Board, May 2008, <http://www.arb.ca.gov/regact/2008/fuelogv08/appdfuel.pdf>. PM10 emission factor was assumed to equal the diesel particulate matter (DPM) emission factor.

Grid emission factors as follows:

PM and NOx emission factors obtained from CARB's Ships at Berth – Grid-based shore power Calculator. Available at: <http://www.arb.ca.gov/bonds/gmbond/gmbond.htm>

HC and CO emission factors from Table 6 of CARB, *Air Pollution Emission Impacts Associated with Economic Market Potential of Distributed Generation in California*, June 2000.

SO2, CH4 and CO2 emission factors obtained from EPA, Emissions & Generation Resource Integrated Database (eGRID) CAMX section: [www.epa.gov/cleanenergy/energy-](http://www.epa.gov/cleanenergy/energy-)

3. The energy used on this connection was provided and estimated by Cochran Inc. The energy was estimated by multiplying the connection duration of 1.5 hours with the average power of 6.89 megawatts.

**4. Emission Equivalencies**

Greenhouse Gas

Based on USEPA's Greenhouse Gas Equivalencies Calculator (available at: <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results>), reducing:  
 100 tons of CO2 is equivalent to removing 17.3 passenger vehicles from the road for a year;  
 1 ton of CH4 is equivalent to removing 3.6 passenger vehicles from the road for a year.

Note that the passenger vehicles are defined as 2-axle 4-tire vehicles, including passenger cars, vans, pickup trucks, and sport/utility vehicles.

Other Pollutants

Based on ARB's EMFAC 2007 model run for 2011 emissions from passenger cars in San Diego County, reducing-  
 1 ton of PM10 emissions is equivalent to removing approximately 700,000 passenger cars from the road for a day;  
 1 ton of PM2.5 emissions is equivalent to removing approximately 1.2 million passenger cars from the road for a day;  
 1 ton of NOx emissions is equivalent to removing approximately 80,000 passenger cars from the road for a day;  
 1 ton of SO2 emissions is equivalent to removing approximately 6.5 million passenger cars from the road for a day;  
 1 ton of HC emissions is equivalent to removing approximately 70,000 passenger cars from the road for a day;