Poseidon's Carlsbad Seawater Desalination Project

San Diego Coastkeeper
Rick Heede
Climate Mitigation Services
5-Aug-08

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data linked to summary tables

Table 1	Baseline						
Poseidon calculation	Horsepower	Demand	Year	Electricity	Emission Factor	Emissions	Emissions
	HP	MW	hrs/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
	1	0.7457	kW/HP				(metric)
Poseidon's "Baseline Design"	41,995	31.316	8,760	274,325	780.8	214,190,400	97,156
includes Pelton wheel, high-efficiency (not "premium") motors (60-70%!)							
Check on Poseidon's MWh calc:	4,898	kWh/AF *	56,000	AF/yr =	274,288	MWh/yr	OK, close enough
baseline: 15.02 kWh/kgal (4,898 kWh/AF)							
CMS adopts Poseidon's Baseline calculation				274,325	781	214,190,400	97,156

CMS note: CMS does not have acces to plant engineering specifications, but general motor specs are unrealistically LOW,
and CMS posits that motor efficiencies are either erroneous OR great and cost-effective savings are feasible

Note: this calculation is made because Poseidon's stated (Table 2) motor efficiencies are unrealistically LOW;
High-efficiency motors (NEMA) are roughly 93+ percent efficient, with max eff ~95.5 percent;
Partial load problem? Unlikely with continuous loads, and the high value (to Poseidon) of installing all 92+ percent motors.

CMS calculation							
High-Efficiency Design minus Px energy recove	47,853						
75 percent of nameplate	35,890						
93 percent efficient motors	33,377	MW	hrs/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
add Px energy recovery (-10,200 HP)	23,177	17.283	8,760	151,403	780.8	118,213,860	53,621
		Indicated electric intensity:		2,704	kWh/AF-yr	CMS conclusion: improbably low	

Table 2	Calculation of "Service Facilities" electricity demand and emissions						
CMS calculation	Horsepower	kW equiv	Year	Electricity	Emission Factor	Emissions	Emissions
	HP		hrs/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
	1	0.7457	kW/HP				
Analysis of Service Facilities (Table 2)							
HVAC	250	186	8,760	1,633	780.8	1,275,095	578
Lighting	120	89	8,760	784	780.8	612,045	278
Controls and Automation	40	30	8,760	261	780.8	204,015	93
Air compressors	100	75	8,760	653	780.8	510,038	231
Other misc power uses	250	186	8,760	1,633	780.8	1,275,095	578
Sum of Service Facilities	**760**	**566.7**		**4,965**	**3,904**	**3,876,288**	**1,758**

Table 3	Calculation of "Service Facilities" electricity and emission *intensity*				
CMS calculation	Floor area	Electricity	Emissions	Electricity	Emissions
	sf	kWh/yr	lb CO2	kWh/sf-yr	lb CO2/sf-yr
Electric intensity calculation, desalination facility	44,452	4,964,571	3,876,288	112	87
Electric intensity calculation, pretreatment area	42,632	4,964,571	3,876,288	116	91
Electric intensity calculation, desalination facility + pretreatment area	87,084	4,964,571	3,876,288	57	45

Poseidon proposes modest efficiency improvements to its baseline plant design:
1. replacing pressure exchanger energy recovery in place of Pelton Wheel (table 5)
2. two "premium-efficency motor upgrades (Table 5)
3. and modest "Green Building Design" (Table 6)

Table 3b	Analysis of Service Facilities		
CMS calculation	Electricity	Floor area	Electric intensity
Service Facilities subsector	kWh/yr	sf	kWh/sf-yr
HVAC	1,633,083	87,084	18.8
Lighting	783,880	87,084	9.0
Controls and Automation	261,293	87,084	3.0
Air compressors	653,233	87,084	7.5
Other misc power uses	1,633,083	87,084	18.8
Sum of Service Facilities	**4,964,571**	**87,084**	**57.0**

CMS note: the lighting calculation, if divided by the total floor area of both the desalination facility & pretreatment area,
and assuming the same lighting intensity, equate to 9 kWh per sf per year.
This is 50 percent higher illumination than a well-lit office building (~6 kWh/sf-yr). Poseidon can do better with lighting efficiency.

Table 4	Calculation of SDG&E emission factor		
	SDG&E generation	Emissions	Emission factor
2006	GWh/yr	tonnes CO2	lb CO2/MWh
Generation	5,169.3	916,258.9	390.76
Purchased	13,938.9	5,851,066.8	925.42
Total & EF	**19,108.2**	**6,767,325.7**	**780.78**

CMS preliminary EF per MWh delivered
Emission factor
lb CO2/MWh
6% T&D losses
830.62

CMS note: SDG&E emission factor appears to lb CO2 per MWh *generated*,
not per MWh *delivered*
CMS has contacted SDG&E's Air Division
SDG&E PUP report posted at CCAR website, www.climateregistry.org

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Emission Reduction Measures calculated by Poseidon & Climate Mitigation Services

Table 5 — Savings from Premium-Efficiency Motors + Pressure Exchanger Energy Recovery

Poseidon calculation	HP	Power	Year	Electric Savings	Emission Factor	Saved emissions	Saved emissions
		MW	hrs/yr	MWh/yr	lb CO_2/MWh	lb CO_2	tonnes CO_2
	1	0.7457	kW/HP				
"High-Efficiency design"	37,653	28.08	8,760	245,962	780.8	192,044,556	**87,111**
Premium-efficiency motors (>500 HP)							
Poseidon: savings from Px & pump moto	(4,342)	(3.24)		(28,363)	780.8	(22,145,844)	(10,045)

CMS calculations	HP reduction	Power reduction	Year	Electric Savings	Emission Factor	Saved emissions	Saved emissions
Pressure exchanger energy recovery	(2,650)	(1.976)	8,760	(17,311)	780.8	(13,516,003)	(6,131)
Seawater intake pumps	(262)	(0.195)	8,760	(1,711)	780.8	(1,336,299)	(606)
Product water transfer pumps	(1,330)	(0.992)	8,760	(8,688)	780.8	(6,783,504)	(3,077)
CMS: savings from Px & pump motors	(4,242)	(3.163)	8,760	(27,710)	780.8	(21,635,806)	(9,814)

Conclusion: CMS calculated total HP savings are 100 HP lower than Poseidon's, which results in lower saved MWh and CO_2.

energy intensity equiv: to 13.488 kWh/kgal (4,397 kWh/AF)

Check on Poseidon's MWh calc:	4,397	kWh/AF *	56,000	AF/yr =	246,232	MWh/yr	OK, close enough
value of 262 HP-reduction	(262)			(1,711,471)	$ 0.114	$ (195,108)	
Annual electricity cost of a 2,100 HP motor	2,100	1.57	8,760	13,718	780.8	10,710,795	**4,858**
				13,717,895	$0.114	$ 1,563,840	

Table 6 — Efficient plant design ("Green building design")

	HP	Demand reductio	Year	Electric Savings	Emission Factor	Emissions	Emissions
		MW	hrs/yr	MWh/yr	lb CO_2/MWh	lb CO_2	tonnes CO_2
	1	0.7457	kW/HP				
Poseidon proposal: modest savings							
Green building design, 6% savings	(46)	(34)	-	(298)	781	(232,577)	(105)
Green building design, 10% savings	(76)	(57)	-	(496)	781	(387,629)	(176)
Green building design, 8% savings (ave Poseic	(61)	(45)	-	(397)	781	(310,103)	(141)
CMS proposal: far higher savings							
Green building design, 20% savings	(152)	(113)	-	(993)	781	(775,258)	(352)
Green building design, 30% savings	(228)	(170)	-	(1,489)	781	(1,162,886)	(527)
Green building design, 40% savings	(304)	(227)	-	(1,986)	781	(1,550,515)	(703)
	30% savings	(1,489)	MWh at	$ 0.114	per kWh =	$ (169,788)	

Table 7 — On-Site Solar Power Generation

Poseidon calculation	HP	Demand reductio	Year	Electric Savings	Emission Factor	Saved emissions	Saved emissions
		MW	hrs/yr	MWh/yr	lb CO_2/MWh	lb CO_2	tonnes CO_2
	1	0.7457	kW/HP				
Poseidon PV proposal				(777)	780.8	(606,674)	(275)

CMS note: Poseidon's cited Appendix H not available at CCC or CSLC websites, hence CMS cannot evaluate the proposal

Poseidon: "solar panels on a roof surface of ~50,000 square feet, with the potential to generate approx 777 MWh/yr of electricity."

CMS note: the desalination plant has a floor area of 44,542 SF

Table 7b — CMS calculation of on-site PV generation

CMS calculation	PV area	kW	Ave Hrs/yr	Conversion effic	MWh/yr	Saved emissions	Saved emissions
	sf	100 sf/kW	percent	percent	MWh/yr	lb CO_2	tonnes CO_2
						781	
CMS calculation	50,000	500	1,825	83%	757	(591,351)	(268)

Hours per year: 5 hr/d * 365 d/yr = 1,825 hr/yr

Table 8 — Use of "Sequestered" CO2 for water treatment

	HP	Demand reductio	Year	Electricity use	Emission Factor	Saved emissions	Saved emissions
		MW	hrs/yr	MWh/yr	lb CO_2/MWh	lb CO_2	tonnes CO_2
	1	0.7457	kW/HP				
Use of sequestered CO_2 for water treatment		Poseidon estim:	2,081	long tons		in metric tonnes:	(2,076)

Table 8b — CMS adopts sequestered CO2 analysis from John Rosenblum

				Electricity use			Net emissions
John Rosenblum analysis				MWh/yr			tonnes CO_2
Estimated minimum: CO_2 compression only		CO_2 source:	Mississippi eGRID	160		Estim. minimum:	75
Estimated maximum: CO_2 compression + refrigeration etc		CO_2 source:	refinery steam	293		Estim. maximum:	225
Average of the above CO_2 compression estimates				226		average	150
Re-release of 50 percent of the CO_2 injection from system CO_2 degasification					1,600	tonnes	(800)
Net CO_2 emissions reduction from system CO_2 injection (compression emissions plus CO_2 degasification)							(650)

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Table 9 — Reducing Energy Needs for Water Reclamation

	HP	Demand reductio	Year	Electric Savings	Emission Factor	Saved emissions	Saved emissions
		MW	hrs/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
	1	0.7457	kW/HP				
Poseidon calculation verified			Poseidon:	(1,950)	780.8	(1,522,541)	(691)
	CMS duplicates Poseidon's estimate						
CMS adopts Poseidon calculation			Poseidon:	(1,950)	780.8	(1,522,541)	(691)

Table 10 — Avoided Emisssions Through Displaced Imported Water

	MWD source	Agency intensity	Electricity	Saved Electricity	Emission Factor	Emissions	Emissions
	AF/yr	kWh/AF	MWh/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
	1	0.7457	kW/HP				
Poseidon calculation	56,000	3,416	191,296	(191,296)	781	(149,362,004)	(67,750)
		3416 kWh/AF	Poseidon: 190,641 MWh/yr			Poseidon estimate:	67,506

	MWD source	Agency intensity	Electricity	Saved Electricity	Emission Factor	Emissions	Emissions
	AF/yr	kWh/AF	MWh/yr	MWh/yr	lb CO2/MWh	lb CO2	tonnes CO2
CMS calculation	see Table 9b						
				CRA EF:	(0.75*0)+(0.25*1218.864)		
Colorado River Aquifer (CRA)	33,600	1,916	64,378	(64,378)	304.716	(19,616,885)	(8,898)
State Water Project (SWP)	22,400	3,416	76,518	(76,518)	700.400	(53,593,487)	(24,310)
Total Imported Water	56,000	2,516	140,896	(140,896)	519.6	(73,210,372)	(33,208)
					(average)		

Poseidon bases its calculations on the assumption that CSDP will displace only SWP water.
Must apportion savings of both SWP and CRW, with, of course, differing energy intensity (kWh/AF).
Must also account for the emission rate by both SWP and Colorado River water. See Table 10.

San Diego County Water Authority

Table 10b — Imported water allocation

	MWD Imported	Percent
	AF in 2006	
Colorado River Aqueduct (CRA)	347,466	60.0%
State Water Project (SWP)	231,644	40.0%
Total Imported water	579,110	100.0%
Total Consumption	687,253	

Table 10c — Water use by sector, 2006

	H2O consumption	Percent
	AF	
Residential	378,709	55.10%
Commercial & Industrial	163,499	23.79%
Agriculture	96,114	13.99%
Public & Other	48,852	7.11%
Total consumption	687,254	100.00%

Table 11 — Wetlands Carbon Sequestration

	Carbon uptake	Wetland area	Wetland area	C Sequestered	C Sequestered	Conversion	CO2 Sequestered
	kg C/m2-yr	acres	m2	kg C/yr	tonnes C/yr	CO2 per C	tonnes CO2/yr
		1 acre =	4,047				
Poseidon:							
Low estimate (Low carbon fixation rate)	0.033	37	149,734	(4,941)	(4.9)	3.664191	(18.1)
High estimate (High carbon fixation rate)	0.343	37	149,734	(51,359)	(51.4)	3.664191	(188.2)
Average Low and High estimates	0.188			(28,150)	(28.1)		(103)
CMS adopts Poseidon calculation	0.188			(28,150)	(28.1)		(103)

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Emission Sources not estimated by Poseidon

Table 12	Desalination Facility & Pipeline Construction: Trucking Emissions						
EIR Chapter 4.10 Traffic	Round-trips	Distance per trip	Total distance	Fuel economy	Fuel use	CO_2 emissions	CO_2 emissions
Desalination Facility Construction Trips	#	miles/roundtrip	miles	mpg	gallons diesel	lb CO_2	tonnes CO_2
						22.384 lb CO_2/gal	
Trucking: Oil Tank Demolition & Excavation							
Oil Tank demolition	1,190	9.2	10,948	6.4	1,711	38,291	17
Site remediation (1,800 yards)	260	9.2	2,392	6.4	374	8,366	4
Oil tank demolition & excavation subtotal	**1,450**		**13,340**		**2,084**	**46,657**	21
Desalination Plant Construction							
Site grading / excavation (41,400 yards)	5,920	9.2	54,464	6.4	8,510	190,488	86
Plant construction: structures	3,580	9.2	32,936	6.4	5,146	115,194	52
Paving and lansdcaping	500	9.2	4,600	6.4	719	16,089	7
Intake Pump Station - earthwork		9.2	-	6.4	-	-	-
Intake Pump Station - structures	1,600	9.2	14,720	6.4	2,300	51,483	23
Intake Pump Station - paving	300	9.2	2,760	6.4	431	9,653	4
Intake & Discharge Pipeline Construction		9.2	-	6.4	-	-	-
Excavation and earthwork (10,440 yards)	1,300	9.2	11,960	6.4	1,869	41,830	19
Pipe installation	160	9.2	1,472	6.4	230	5,148	2
Paving	50	9.2	460	6.4	72	1,609	1
Desalination construction subtotal	**13,410**		**123,372**		**19,277**	**431,494**	196
Pipeline Construction Trips (Table 4.10-2)							
Earthworks (596,400 yards)	85,200	9.2	783,840.0	6.4	122,475.0	2,741,480.4	1,244
Pipe delivery	2,400	100	240,000.0	5.8	41,379.3	926,234.5	420
Asphalt delivery	8,800	20	176,000.0	6.4	27,500.0	615,560.0	279
Pipeline construction, subtotal	**96,400**		**1,199,840**		**191,354**	**4,283,275**	1,943
Total Construction Trucking	111,260		1,336,552		212,716	4,761,425	2,160

Table 12b	Desalination Facility & Pipeline Construction: Equipment Emissions							
	Constr. Equip.	Crew	Months	Total equip time	Fuel	CO_2 emissions	CO_2 emissions	
	#			hours	gallons diesel	lb CO_2	tonnes CO_2	
Desalination Facility Construction Trips				1 mo = 120 hrs	assume 8 gal /hr	diesel fuel EF		crew-
Oil Tank Demolition & Excavation				equip run time		22.384 lb CO_2/gal		months
Oil Tank demolition	4	10	4.5	2,160	17,280	386,796	175	45
Site remediation	2	12	2.0	480	3,840	85,955	39	24
Desalination Plant Construction				-	-	-	-	-
Site grading / excavation	13	20	5.0	7,800	62,400	1,396,762	634	100
Plant construction: structures	15	40	15.0	27,000	216,000	4,834,944	2,193	600
Paving and lansdcaping	5	15	4.0	2,400	19,200	429,773	195	60
Intake Pump Station - earthwork	10	20	3.0	3,600	28,800	644,659	292	60
Intake Pump Station - structures	11	25	9.0	11,880	95,040	2,127,375	965	225
Intake Pump Station - paving	2	10	1.0	240	1,920	42,977	19	10
Intake & Discharge Pipeline Construction				-	-	-	-	-
Excavation and earthwork (10,440 yards)	7	15	6.0	5,040	40,320	902,523	409	90
Pipe installation	5	15	6.0	3,600	28,800	644,659	292	90
Paving	2	5	0.5	120	960	21,489	10	3
Total Desalination Plant Equipment	76	187	56	64,320	514,560	11,517,911	5,224	1,307

Table 12c	Desalination Facility & Pipeline Construction: Worker Commuting Emissions					
	Crew	Crew	Crew	Commuting	Total distance	Fuel use	CO_2 emissions
	days per month	crew-months	total crew days	miles per day	total miles	fuel (gallons)	tonnes CO_2
Crew commuting	20	1,307	26,130	10	261,300	14,033	125

CMS: assume 10 miles commute per working day, 20 days/mo, and average vehicle fuel economy of 18.6 mpg.

Table 12d	Desalination Facility & Pipeline Construction: Sum		
	Fuel	CO_2 emissions	CO_2 emissions
Plant construction segment	gallons	lb CO_2	tonnes CO_2
Total Construction Trucking	212,716	4,761,425	2,160
Total Desalination Plant Equipment	514,560	11,517,911	5,224
Crew commuting	14,033	274,968	125
Total Desalination Plant Construction	741,309	16,554,305	7,509

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Table 13 — Desalination Facility Operations: Annual Trucking & Commuting Emissions

Operational traffic trips summary	trips per year	Distance per trip	Total distance	Fuel economy	Fuel use	CO2 emissions	CO2 emissions
	#	miles	miles	mpg	gallons fuel	lb CO2	tonnes CO2
						22.384 lb CO2/gal	diesel
						19.594 lb CO2/gal	gasoline (commuting)
Water treatment chemicals (4 trips/day)	1,460	400	584,000	6.4	91,250	2,042,540	926
Equipment and parts (1 trip/day)	365	50	18,250	8.0	2,281	51,064	23
Waste solids disposal (1 trip/day)	365	18	6,570	6.4	1,027	22,979	10
Solids residual disposal (6 trips/day)	2,190	18	39,420	6.4	6,159	137,871	63
Employees & visitors (108 trips/day)	39,420	10	394,200	18.6	21,171	414,820	188
Total operational trucking & commuting	43,800		1,042,440		121,888	2,669,274	1,211

Table 14 — Summary of Poseidon emissions & reduction estimates

Poseidon Calculations	CO2 emissions lb CO2	CO2 emissions tonnes CO2	Percent of baseline
Baseline emissions	214,190,400	97,156	100.0%
"High-Efficiency design": motors & pressure exchanger	(22,145,844)	(10,045)	-10.3%
Efficient plant design	(310,103)	(141)	-0.1%
On-Site Solar Power Generation	(606,674)	(275)	-0.3%
Use of sequestered CO2 for water treatment	(4,577,100)	(2,076)	-2.1%
Reducing energy needs for water reclamation	(1,522,541)	(691)	-0.7%
Avoided emissions through displaced imported water	(149,362,004)	(67,750)	-69.7%
Sequestration in wetlands	(227,397)	(103)	-0.1%
Carbon sequestration: San Diego County reforestation	(540,127)	(245)	-0.3%
Poseidon estimate of annual offset requirement	34,898,610	15,830	16.3%

Note: CMS has re-calculated, corrected minor errors, and averaged Poseidon's ranges; see Tables above

Table 15 — Summary of CMS emissions & reduction estimates

CMS calculations	CO2 emissions lb CO2	CO2 emissions tonnes CO2	Percent of baseline
Baseline emissions	214,190,400	97,156	100.0%
"High-Efficiency design": motors & pressure exchanger	(21,635,806)	(9,814)	-10.1%
Efficient plant design	(1,162,886)	(527)	-0.5%
On-Site Solar Power Generation	(591,351)	(268)	-0.3%
Use of sequestered CO2 (net of emissions & re-gasificati	(1,433,076)	(650)	-0.7%
Reducing energy needs for water reclamation	(1,522,541)	(691)	-0.7%
Avoided emissions through displaced imported water	(73,210,372)	(33,208)	-34.2%
Sequestration in wetlands	(227,397)	(103)	-0.1%
Carbon sequestration: San Diego County reforestation	(540,127)	(245)	-0.3%
Subtotal for same suite of baseline & CO2 reductions	113,866,844	51,650	53.2%
Additional sources calculated by CMS			
Operations: Annual Trucking & Commuting	2,669,274	1,211	1.2%
CMS estimate of annual offset requirement	116,536,118	52,860	54.4%

Note: CMS considers it plausible that the CSDP's motor/pump/pipe efficiency can be improved, and that the baseline may be too high.

Table 16 — Construction emissions

CMS calculations	CO2 emissions lb CO2	CO2 emissions tonnes CO2
Construction trucking	4,761,425	2,160
Construction equipment	11,517,911	5,224
Crew commuting	274,968	125
Total	16,554,305	7,509

Cell: I11
Comment: Rick Heede:
The calculation below is driven by fundamentals, starting with Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, Table 2, page 9) statement of total horsepower (41,995 HP) converted to MW, MWh/yr, and using emissions factor (SDG&E, 2006) the total baseline project emissions. The calculated MWh and emissions estimate agrees with Poseidon results (which is only 9 tonnes CO2 higher).

Cell: B16
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 10, "the Baseline Design includes high efficiency motors for all pumps, except the largest reverse osmosis feed pumps, and a Pelton wheel energy recovery system which is the most widely used "standard' energy recovery system today. The total desalination power. use under the Baseline Design is 31.3 aMW, which corresponds to a unit power use of 15.02 kWh/kgal fn9(4,898 kWh/AF).fn10"

Cell: D29
Comment: Rick Heede:
Rosenblum correclty points out that: "There will be need to change flows and pressures (VSD) as sea-water changes seasonally (temp, salinity, algae/silt) and as the membranes and filters go through their loading cycles (e.g. huge differences before/after off-line cleaning)." This, however, does not explain the low efficiency ratings for the Carlsbad motor "specifcations."

Cell: C38
Comment: Rick Heede:
Stated in Poseidon's "Energy Minimization & Reduction Plan," Jul08, Table 2.

Cell: E52
Comment: Rick Heede:
Poseidon EIR "Project description" page 3-20: "The desalination facility will consist of an enclosed building approximately 44,552 square feet in size that would house the reverse osmosis process area, water treatment chemicals storage and pumps, product water pumps, administrative offices and other appurtenant facilities to support the plant. The building would be located on the eastern portion of the approximately 4-acre desalination project site. To the west of the building would be a 42,632 square foot pretreatment area."

Cell: B103
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 10. "In addition to the state of the art-pressure exchanger system described above, the High-Energy
Efficiency Design incorporates premium efficiency motors and variable frequency drives (VFDs)
on desalination plant pumps that have motors of 500 horsepower or more. The total desalination
plant energy use under the High-Energy Efficiency Design is a28. 1 MW, which corresponds to
unit power use of 13.488 kWh/kgal (4,397kWh/AF)fn12."

In Table 2, Poseidon's shows HP and MW totals after crediting "premium-efficiency motors" for motors exceeding 499 HP and little else. "Green building design," PV, wetlands construction and offsets, and other measures will be calculated below. The present purpose is to verify Poseidon's calculations, not evaluate the sufficiency of the efficiency measures.

Cell: B107
Comment: Rick Heede:
CMS calculations are calculated from Poseidon's Table 2 - Comparison of Baseline and High-Efficiency Power Budget. CMS enters HP reduction for each item, then calculates saved MW, saved MWh/yr, and emissions (in lb CO2 and tonnes CO2).

Cell: B108
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 10: The main energy savings result from the use of pressure exchangers instead of Pelton wheels for energy recovery. The pressure exchangers are projected to yield 2,650 hp (2.0 aMW)fn13 3of power savings, which is 6.3% reduction of the total power use of 31.3 aMW. Converted into unit power savings, the energy reduction of 2.0 aMW corresponds to 0.95 kWh/kgal (fn14) (310kWh/AF).fn15"

Cell: B109
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 11: The installation of premium-efficiency motors and VFDs on large pumps would result in additional 1.2 aMW (4%) of power savings.

Cell: B126
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 11: "The potential energy savings associated with the implementation of the green building design as compared to that for a standard building design are in a range of 300 MWh/yr to 500 MWh/yr. The potential carbon footprint reduction associated with this design is between 106 and 177 tons of CO2 per year. The energy savings associated with incorporating green building design features into the desalination plant structures (i.e., natural lighting, high performance fluorescent lamps, high-efficiency HVAC and compressors, etc.) are based on the assumption that such features will reduce the total energy consumption of the plant service facilities by 6 to 10%."

Cell: B130
Comment: Rick Heede:
CMS believes that Poseidon can cost-effectively design, construct, commission, and operate its two buildings -- the desalination plant and the pretreatment area -- that captures far greater efficiencies than evidenced in Poseidon's Tables 2 and 4 (6 and 10 percent, which CMS averages above). Poseidon has not offered sufficient engineering estimates for CMS to assess the design. Experience suggests that Poseidon can do better

than 6-10 percent below standard design. Note: Also see CMS tables 3 and 3b for building energy and intensity calculations.

Cell: B142
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 12: "If the solar installation described by Brummitt is implemented, the main desalination plant building would accommodate solar panels on a roof surface of approximately 50,000 square feet, with the potential to generate approximately 777 MWh/yr of electricity. ... Poseidon will use commercially reasonable efforts to implement an on-site solar power project if it is reasonably expected to provide a return on the capital investment over the life of the Project."

Details in their cited Appendix H. CMS: not found; CSLC website does not have Poseidon's 3Jul08 submission (www.slc.ca.gov/Reports/Carlsbad_Desalination_Plant_Response.html)

Cell: I148
Comment: Rick Heede:
CMS thanks Ted Flanigan, Executive Director of EcoMotion, Irvine, California, www.ecomotion.us, for providing rules of thumb for PV system design and generation. EcoMotion facilitates, researches, and manages the installation of commercial-scale PV systems in southern California.

Cell: B162
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, page 14: "To the extent that it is reasonably available, Poseidon intends to acquire the carbon dioxide from a recovery operation. Use of recovered CO2 at the Project would sequester 2,100 tons of CO2 per year in the Project product water. The total annual use of carbon dioxide (i.e., 2,100 tons/CO2 per year) in the water treatment process was determined based on the daily carbon dioxide consumption presented in Table 4.6-2 of Section 4.6 "Hazards and Hazardous Materials" of the certified Carlsbad desalination project Enviromnental Impact Report (ER). The daily consumption of CO2 in this table is 12,540 lbs of CO2/day. The annual consumption is calculated as 12,540 lbs/day x 365 days /2,200 lbs/ton = 2,080.5 lbs of CO2/yr (which was rounded to 2,100 ibs/yr). The daily amount of carbon dioxide in Table 4.6-2 of the EIR was calculated based on the dosage needed to provide adequate hardness (concentration of calcium bicarbonate) in the seawater to protect the water distribution system from corrosion. This amount was determined based on pilot testing of distribution system piping and household plumbing at the Carlsbad seawater desalination demonstration project. The testing was completed using the same type of calcium carbonate chips as those planned to be used in the fullscale operations. Every load of carbon dioxide delivered to the desalination plant site will be accompanied by a certificate that states the quantity, quality and origin of the carbon dioxide and indicates that this carbon dioxide was recovered as a site product from an industrial application of known type of production (i.e., brewery, ethanol plant, etc.), and that it was purified to meet the requirements associated with its use in drinking water applications (i.e., the chemical is NSF approved)."

CMS note: Poseidon calculates in long tons (2,200 lb/ton). CMS converts to metric tonnes in this table (2,076 tonnes CO2). Also, Poseidon uses "2,080.5 lbs of CO2/y" but clearly means tons/yr.

Cell: I166
Comment: Rick Heede:
John Rosenblum was, like CMS, asked to review and assess Poseidon's "Energy Minimization and Reduction Plan" by San Diego Coastkeeper.

Cell: B168
Comment: Rick Heede:
John Rosenblum, 30Jul08: "The reference I used for CO2 with the MI and NM manufacturing plants is "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2006" EPA 430-R-08-005, section 4.11 Carbon Dioxide. Both plants extract CO2 from geological sources (i.e. sequestered). The GHG emissions I am trying to calculate relate to the electrical energy required to compress the CO2 for liquid delivery. Even if Poseidon obtains CO2 from a recovery system, the same compression energy will still be required, but the emissions might be lower or higher depending how the electricity is produced (thats why I also sent a petrochemical plant example). It is very unlikely that CO2 recovery will occur at a high enough pressure to produce liquid.

I felt that the NM and MI sources were not releasing sequestered CO2 (except for production losses) but merely transfering into cyclinders - so that the end-use would define whether or not there is an emission. An agricultural/food-processing CO2 source might not have been counted as a GHG emission, but the end-user could claim a credit if the CO2 ends up sequestered (I leave that argument to you). Recovery from a petrochemical plant (or a utility) would allow those facilities to claim the GHG credit - then the end-use would become a new GHG emission unless the CO2 ends up sequestered (again, you know more than me).

More importantly the new documentation from CCC staff includes Poseidon's description of how they will use CO2 and limestone (CaCO3 - so no calcination emissions) for post RO treatment. Poseidon references the 2005 EIR (Appendix C, Attachment 2 Distribution System Corrosion Control for Desalinated Seawater) which assumes the use of hydrated lime (Ca(OH)2) for their 2,100 tons/yr. With limestone, the dosage will probably be ~1,600 tons/yr (~75% of the 2,100 tons/yr needed for slaked lime).

However there will be a large excess of CO2 after passing through the limestone (probably about 50% of the initial dosage) that will need to be removed/neutralized. The quickest and cheapest way is to release the excess CO2 in a degassification tower. So my estimate is that only 800 tons/yr will be sequestered and 800 tons/yr will be emitted. The alternative of using chemicals to neutralize the excess CO2 with soda ash (Na2CO3) is hugely expensive and would make the post treatment far more complex."

Cell: I168
Comment: Rick Heede:
CMS has converted John Rosenblum's results from short tons CO2 to metric tonnes CO2. Mr. Rosenblum's re-calculation also reduces the required CO2 input from 2,100 tons to 1,600 tons, and both his original CO2 compression energy & emissions estimate and the re-realease of of 50 percent of the re-gasification estimates reflect this change (i.e., earlier results have been multiplied by (1600/2100).

Cell: E169
Comment: Rick Heede:

John R: "Mississippi eGrid (1135 lbCO2/MWh+0.042 lbCH4/MWh+0.013 lbN2O/MWh); GWP for CH4=21; GWP for N2O=310"

Cell: B170
Comment: Rick Heede:
John R: "compression + refrigeration + 5% on-site compression + 1% release for temperature control; not including transportation."

Cell: E170
Comment: Rick Heede:
John R: "refinery steam turbine (eff=30%); crude oil 20.33 kg C/MMBtu"

Cell: B173
Comment: Rick Heede:
John Rosenblum, 1Aug08: "the limestone process changes the use of liquid CO2 - and the neccessity of overdosing and subsequent degassification." 4Aug08: "The EIR dosage cals were based on 30 mg/l CO2 for 50 MGD. I converted to kg/day then divided by 1000 kg = 1 metric tonne. "

Cell: B191
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, pages 14-15: "The Project will result in Avoided Emissions because it will cause a change in operations by the Carlsbad Municipal Water District (CMWD), which owns and operates a water reclamation facility that includes micro-filtration (MF) and RO treatment for 25% of its water supply. The purpose of the MF/RO system is to reduce the salinity of the recycled water to below 1,000 mg/L so it will be suitable for irrigation. The elevated salinity of the recycled water is due in part to the salinity of the City's drinking water supply. The Project will effectively eliminate this problem by lowering the salinity in the source water of the communities upstream of the water recycling facility, thereby eliminating the need for operation of the MFIRO portion of the water recycling process. Implementation of the Project will significantly reduce or possibly eliminate the need to operate the MF/RO system, leading to Avoided Emissions from the lower electricity use by CMWD. This will reduce the carbon footprint of the Carlsbad Water Reclamation Facility as follows: 1,950 MWh/yr x 780.79 lbs of CO2/MWh 1,522,541 lbs of C02/yr (690 tons of CO2/yr)."

Cell: C209
Comment: Rick Heede:
Allocated as percent by source of imported water in Table 9b, and used to allocate the 56,000 acre-feet of water in acre-feet per year to each source of import. This assumes that the appropriate water offset is imported water only (as Poseidon claims), and exclude San Diego County Water Authority's non-import sources (e.g., Local Supply 110,633 AF (p11: of which surface water 80,850 AF, wells 10,652 AF, Reclamation 14,828 AF, groundwater 4,304 AF). See Table 10b for details.

Cell: G209
Comment: Rick Heede:
CMS calls on the California Coastal Commission and the Department of Water Resources to investigate the matter and revise the emission factors CMS used for both SWP and CRA. CMS applies the emission factors discussed below, and has used a conservative approach. That said, the issue is complicated, contracts over power sources change, EF of marketed power also changes over time.

Cell: D213
Comment: Rick Heede:
Wilkinson (2000), page 21: "Both California State Water Project (SWP) and Colorado River supplies are energy-intensive due to pumping requirements. The SWP supplies average 2,956 kWh/acre foot for delivery pumping alone, with Colorado River supplies averaging 1,916 kWh/acre foot."

Cell: G213
Comment: Rick Heede:
Wilkinson (2000), page 32: ""Electricity to run the CRA pumps is provided by power from hydroelectric projects on the Colorado River as well as off-peak power purchased from a number of utilities. The Metropolitan Water District has contractual hydroelectric rights on the Colorado River to "more than 20 percent of the firm energy and contingent capacity of the Hoover power plant and 50 percent of the energy and capacity of the Parker power plant." Energy purchased from utilities makes up approximately 25 percent of the remaining energy needed to power the Colorado River Aqueduct."

CRW emission factor: CMS, as a conservatism, uses Arizona's state average emission rate of 1,218.864 b CO2/MW (rather than California's of 700.4 lb CO2/MWh). (Source: US EPA eGRID emissions database, "EGRDST04" for Arizona state average emissions "State annual CO2 output emission rate (lb/MWh)". CMS ignores methane emissions from teh hydropower dams (chiefly a factor for reservoirs with high organic content), as well methane and nitrous emissions from powerplants (to stay consistent with SDGE's emissions factor).

The formula becomes: (0.75*0)+(0.25*1218.864)

Cell: B215
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, pages 16: "The total amount of electricity needed to provide treated water to Poseidon's public agency partners via the SWP facilities is shown in Table 1. The net power requirement to pump an acrefoot of water through the East Branch of the SWP is 3,248 KWh (source: DWR). Approximately 2% of the SWP water pumped to Southern California is lost to evaporation from Department of Water Resources' reservoirs located south of the Tehachapi Mountains (source: DWR). The evaporation loss results in a net increase of 68.3 KWh per acre-foot of SWP water actually delivered to Southern California homes and businesses. Finally, prior to use, the SWP water must be treated to meet Safe Drinking Water Act requirements. The San Diego County Water Authority (SDCWA) entered into a service contract with CH2M Hill Constructors, Inc., to operate its Twin Oaks Water Treatment Plant with a guaranteed electricity consumption of 100 KWh/AF of water treated (source: SDCWA). The electricity required to deliver an acre foot of treated water to the SDCWA is shown in Table 3."

SWP total energy demand: 3,416 kWh/AF.

SWP emission factor: 700.4 lb CO2/MWh. (Source: US EPA eGRID emissions database, "EGRDST04" for California state average emissions "State annual CO2 output emission rate (lb/MWh)".

Cell: D215
Comment: Rick Heede:
Poseidon "Energy Minimization and Reduction Plan," Table 3: State Water Project Supply Energy Use, page 16.

Cell: G215
Comment: Rick Heede:
SWP emission factor: 700.4 lb CO2/MWh. (Source: US EPA eGRID emissions database, "EGRDST04" for California state average emissions "State annual CO2 output emission rate (lb/MWh)".

Rosenblum comments: "DWR has a 10 year contract with SCE for off-peak coal fired elec from Arizona for the 75% of energy used in S.Cal pumps - that will expire before 2010. They have been able to use these pumps 80% at off-peak and 20% in the day. I assumed that daytime is an average of SCE+PG&E. My estimate for now is: 75%*80%*(1254.02+21*0.018+310*0.015)+(75%*20%+25%)*AVERAGE(641.26,455.81) = 975 lb-CO2/MWh. By the time the Carlsbad desal comes on line DWR will have new contracts w/o coal and with more renewables, so maybe the same as the avg. for SCE and PG&E = 549 lb-CO2/MWh."

CMS retains use of the higher State of California emission factor, again as a conservatism.

Cell: I225
Comment: Rick Heede:
San Diego County Water Authority (2007) Fluid Thinking, Solid Results, 2006 Annual Report, www.sdcwa.org

Cell: C228
Comment: Rick Heede:
San Diego County Water Authority (2007) Fluid Thinking, Solid Results, 2006 Annual Report, page 9: Imported Water Supply: Colorado River: 347,466 AF, State Water Project: 231.644 AF, Total: 579,110 AF.

Cell: H234
Comment: Rick Heede:
The abov consumption data sums to 687,174 AF, slightly lower than SDCWA's total.

Cell: B243
Comment: Rick Heede:
Poseidon's "Energy Minimization of Greenhouse Gas Reduction Plan," 3Jul08, pages 17: "Based on a detailed study completed in a coastal lagoon in Southern California, the average annual rate of carbon sequestration in coastal wetland soils is estimated at 0.033 kg of C/m 2.yr (a 5,000 year average, Brevick E.C. and Homburg J.A., 2004).fn20. In tidal ecosystems, sediment accumulation rates (via suspended sediment supply, tidal water flooding, etc.) exhort a major control on carbon sequestration rates. Soil carbon sequestration rates determined recently in the Tijuana Estuary on the Mexico/USA border were determined to be 0.343 kg of C/m 2.yr (Cahoon et. al 1996).fn21. (4 = Cahoon, D.R., J.C. Lynch, and A. Powell, Marsh vertical accretion rates in a Southern California estuary, U.S.A., Estuar. Coast. Shelf Sci., 43, 19-32, 1996). The total area of the proposed wetland project is 37 acres."

Cell: I260
Comment: Rick Heede:
The California Coastal Commission correctly notes that Poseidon has not estimated emissions from construction activities (Staff memorandum W4a, "Revised Findings," page 104). CMS offers a preliminary estimate of trucking, equipment, facility construction, pipeline construction, and crew transportation emissions below (but based on incomplete data from Poseidon), and the CMS estimate should be viewed as preliminary.

CMS also estimates annual operating emissions from trucking of materials and water treatment chemicals, equipment, truckign of waste solids and residuals, and commuting of the estimated 108 employees of the Carlsbad facility. These estimates, too, should be considered highly preliminary, and can be greatly improved by Poseidon by, for example, specifying the geographic origing and trucking distance of water treatment chemicals. CMS adds these operational emissions to the baseline of emissions.

Cell: B264
Comment: Rick Heede:
Poseidon EIR, Chapter 4.10: Transportation and Traffic, tables 4.10-1, 4.10-2, and 4.10-4 (Operational).

Cell: D264
Comment: Rick Heede:
CMS uses data from Poseidon EIR Transportation & Traffic, chapter 4.10, page 4.10-8: "The average round trip distance from the construction areas to the airport is approximately 9.2 miles."

For pipe delivery, CMS assumes 100 miles from source to Carlsbad and return (no actual data is available), and 20 miles roundtrip for road paving material.

Cell: F264
Comment: Rick Heede:
U.S. DOE (2007) Transportation Energy Data Book, edition 26, Davis & Diegel, Oak Ridge National Laboratory, www-cta.ornl.gov/data/Index.html, Table 5.4.

Cell: B279

Comment: Rick Heede:
Poseidon EIR, Transportation and Traffic, p. 4.10-6: "The project would involve installation of approximately 91,800 linear feet of 24 to 48 inch pipeline" and involve 1,510 round-trip truck trips.

Cell: I295
Comment: Rick Heede:
Poseidon (or its contractors, e.g., Scientific Resources Associates, San Diego) provided no useful data in the Air Quality chapter or its Appendix D on construction equipment, bhp rating, hours of operation, or fuel consumption.

CMS thus roughly estimates fuel consumption based on the following data -- generic equipment list and months of operation (EIR Air Quality, Chapter, Table 4.10-1) -- and the following assumptions: each piece of equipment was operated in the range of ~0.014 to 0.042 gallons of fuel per hour per horsepower, was operated 75 percent of each day (120 hrs per month), accounting for partial load cycles during the day, and that the mix of equipment (cement mixers to large road graders and excavators) averaged a fuel consumption rate of 8 gallons per hour. Large excavators might use ~20 gal/hr, whereas a backhoe might use ~4 gal/hr. CMS acknowledges that this is a back-of-the-envelope calculation made in the absence of useful data being provided by Poseidon.

Cell: C296
Comment: Rick Heede:
Poseidon EIR, Appendix D: Airt Quality Technical Rpt, Tables 4, 5, 6. Equipment includes: loaders, cranes, graders, excavators, cement mixers, backhoes, compactors, forklifts, welders, pavers, rollers, pumps, etc -- often several of each, for indicated months of work.

Cell: G298
Comment: Rick Heede:
Equipment horsepower, average duty cycle per day, idling time, and partial loads all vary. CMS used Table 2.5, p. 28 from: Gransberg, Douglas, Calin M. Popescu, & Richard Ryan (2006) Construction Equipment Management for Engineers, Estimators, and Owners, CRC, 568 pp. for Average Fuel Consumption Factors (gallons/hr/HP), typically ranging from "favorable" trucks on-hwy 0.014-0.029 gal/hr/HP to wheel loader 0.020-0.024, twin engine scraper 0.026-0.027 gal/hr/HP. CMS adopts an average value of 8 gallons per operating hour, and assumes 120 hrs per month per piece of construction equipment. A large excavator, for example, may use 20 gallons per hour, a backhoe ~4 gal/hr. Clearly not a preferred estimation procedure, but reasonable in lieu of useful data from Poseidon.

Cell: B311
Comment: Rick Heede:
Poseidon EIR, Transportation and Traffic, p. 4.10-6: "The project would involve installation of approximately 91,800 linear feet of 24 to 48 inch pipeline."

Cell: D320
Comment: Rick Heede:
Crw-motnhs are calculated from Poseidon data, and is calculated in Table 12b.

Cell: F320
Comment: Rick Heede:Poseidon
Poseidon does not calculate construction crew emissions (or any construciton fuel and emissions). CMS assumes an average crew commute of 10 miles per day.

Cell: I346
Comment: Rick Heede:
CMS estimates annual operating emissions from trucking of materials and water treatment chemicals, equipment, trucking of waste solids and residuals, and commuting of the estimated 108 employees of the Carlsbad facility. These estimates should be considered highly preliminary, and can be greatly improved by Poseidon by, for example, specifying the geographic origing and trucking distance of water treatment chemicals. CMS adds these operational emissions to the baseline of emissions.

Cell: C347
Comment: Rick Heede:
Data from Poseidon EIR, Chapter 4, Transportation and Traffic, Table 4.10-4: Operational Traffic Trips Summary.

Cell: D347
Comment: Rick Heede:
To CMS' knowledge, Poseidon has not provided data on the geographic origin of chemical inputs. CMS assumes an average of 200 miles round-trip for chemicals (LA to Carlsbad is 174 miles rt), 70 miles rt for equipment and parts, and

Cell: F347
Comment: Rick Heede:
U.S. DOE (2007) Transportation Energy Data Book, edition 26, Davis & Diegel, Oak Ridge National Laboratory, www-cta.ornl.gov/data/Index.html, Table 5.4.

Average fuel economy of employee commuter vehicles from CMS research on vehicle types, distribution, and fuel economies of commuter vehicles; average: 18.6 mpg.