Attachment 2: Water and Energy Savings and Green House Gas Calculation

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Attachment 2

Water-Energy and Greenhouse Gas Calculation Assumptions

Current Energy Use

Currently energy demand at the Ray Stoyer WRF is 979 kilowatts (kW), with an additional 411 kW of energy used at the influent pumping station. With the implementation of the AWT Demonstration Project, the WRF and the AWT Demonstration Plant are projected to use 1,221 kW, and 200 kW for the microfiltration/reverse osmosis (MF/RO) treatment process. For this evaluation, it is assumed the AWT process is implemented and the total energy demand of the Ray Stoyer WRF is 1.4 MW.

Greenhouse Gas Emissions Reductions

The Greenhouse Gas (GHG) emissions reductions calculations are primarily based on the energy embedded in imported water for its supply and conveyance.

In addition to these reductions, the development of the project will also result in an overall reduction in the GHG emissions at the landfill facility. The proposed project facilitates the use of organic wastes (fats, oils and grease (FOG), food wastes, and other organic wastes) for biogas energy production rather than disposing of them in landfills. The decomposition of organic wastes in landfills results in the generation of greenhouse gases. **Figure 2-1** provides an illustrated comparison of the baseline conditions and the greenhouse gas emissions of this project.

The industry has identified a beneficial effect from co-digestion. The anaerobic digestion of biosolids with organic wastes, and proper implementation of the co-digestion process has the potential to lower the process residuals 10 to 30 percent, ultimately resulting in less sludge requiring landfill disposal. Lower volumes of sludge requiring disposal will also reduce the emissions from trucks used for hauling sludge to the disposal facility or landfill.

The production of biosolids and the generation of energy (or fuel) will offset other energy requirements and thus also result in GHG emissions reductions, resulting in additional savings.

Greenhouse Gas Savings Summary:

- An estimated 1,826 kg CO_2e/year in GHG Reductions based on imported water savings
- Additional GHG emissions reductions based on the use of landfill materials
- The biogas generated (approximately 340 SCFM of bio-digester gas) will be converted into electricity

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Water Savings

Brine water produced as a result of treatment processes at Padre Dam's WRF will be supplied to the Sycamore Landfill for dust control and cover compaction. Currently, 16.8 acre-feet per year (AFY) of water is used for dust control purposes at the landfill; in the future, with landfill may need as much as 21 AFY. The AWT brine will replace the water currently used for dust control and cover compaction in a one to one ratio, resulting in a significant savings of water.

Water Savings Summary:

- 16.8 AFY of water saved by the innovative use of waste brine for dust control and cover compaction at the landfill.

Energy Savings

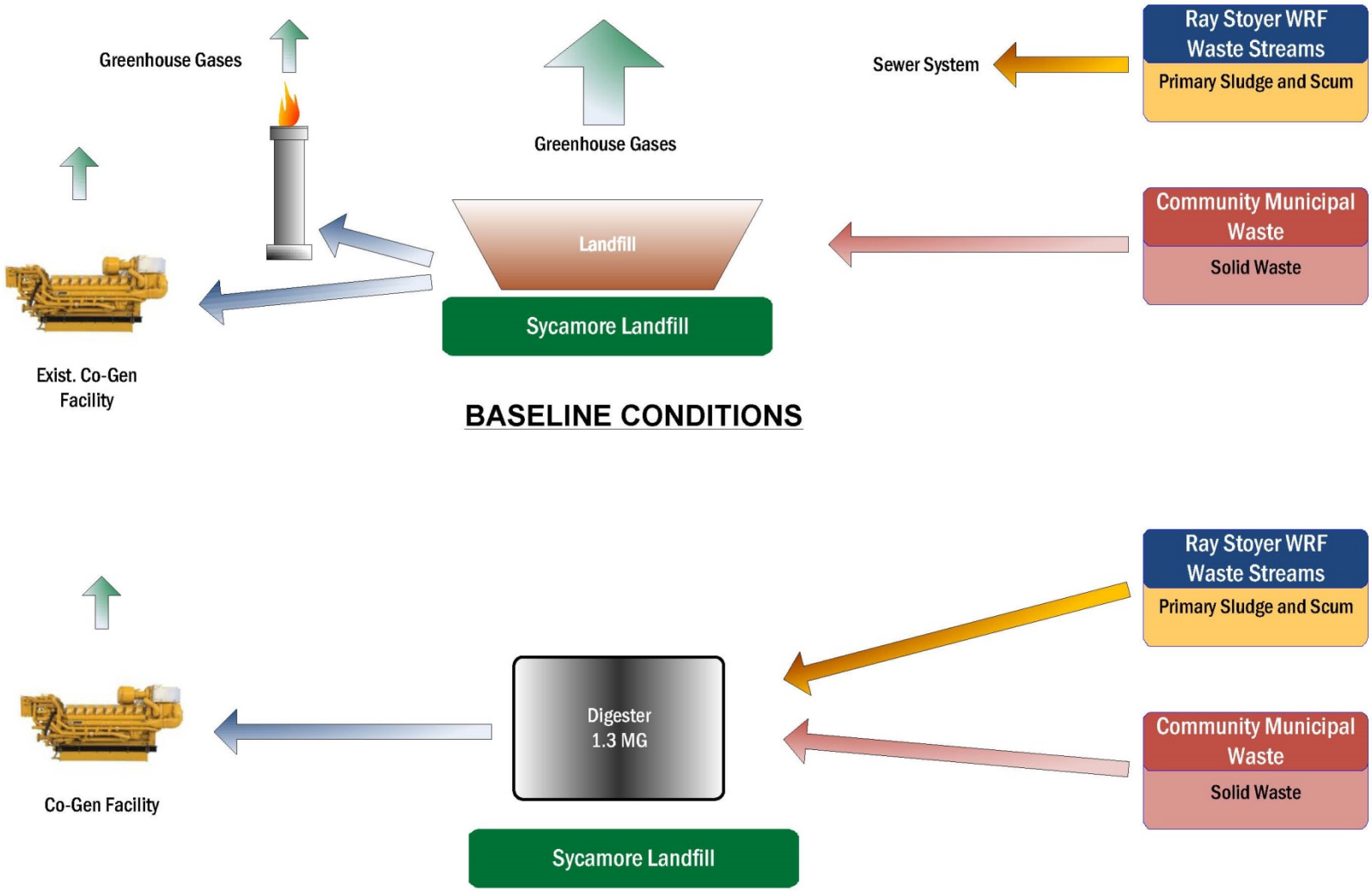
The co-digestion facility that will process the sludge from the WRF and organic waste from the landfill, is estimated to produce 340 SCFM of digester gas and generate 1.4 MW of electricity. Assuming that the generator would operate on average at 92% net power, with an operational uptime of 90%, the facility could generate an estimated 9,403 MWh per year. The electricity generated could be used by Padre Dam's WRF to offset the consumption of electricity from the grid.

This estimate assumes that the biosolids from Padre Dam and organic waste are similar to industry averages, and also the estimate assumes that organic waste such as a FOG are loaded with the biosolids.

In addition, approximately 6,066 kWh of energy is required to pump one MG of water from the Colorado River. Accordingly, reuse of 15,000 gallons per day (5.48 MG/year or 16.8 AF/year) of brine water will conserve 29,684 kWh of energy annually.

Energy Savings Summary:

- 9,403 MWh per year of energy savings from the generation of electricity to power the WRF. Without the project, this amount of energy would be consumed by the WRF.
- 29,684 kWh of energy annually from imported water savings.



Brown AND Caldwell

PADRE DAM Municipal Water District

Ray Stoyer WRF Energy Recovery Project

Figure 2-1. GHG Emissions

Attachment 2

Water-Energy and Greenhouse Gas Calculations

Attachment 2

Within System (lifetime)		
System Water Savings:	10.124	MG/$M
System, End-Use & EE/RE Savings:	17,399,667	kWh/$M
System, End-Use & EE/RE GHG Emission Reductions:	4,837,107	kg CO_2e/$M

Grand Total (lifetime)		
Water Savings:	164.250	MG
Energy Savings:	283,190,541	kWh
GHG Emissions Reduction:	78,726,971	kg CO_2e

System Summary

	Total Project Cost	Water Savings		Energy Savings		GHG Reduction	
		Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
Project 1	$ 16,224,449	5.475 MG/year	164.250 MG	6,570 kWh/year	197,100 kWh	1,826 kg CO_2e/year	54,794 kg CO_2e
Project 2	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 7	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 9	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 10	$ -	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Total	**$ 16,224,449**	**5.475 MG/year**	**164.250 MG**	**6,570 kWh/year**	**197,100 kWh**	**1,826 kg CO_2e/year**	**54,794 kg CO_2e**

Imported Water Summary

	Energy Savings		GHG Reduction	
	Annual	Lifetime	Annual	Lifetime
Project 1	29,684 kWh/year	890,529 kWh	8,252 kg CO_2e/year	247,567 kg CO_2e
Project 2	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 7	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 9	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 10	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Total	**29,684 kWh/year**	**890,529 kWh**	**8,252 kg CO_2e/year**	**247,567 kg CO_2e**

Hot Water Heating System Summary

	Energy Savings		GHG Reduction	
	Annual	Lifetime	Annual	Lifetime
Project 1	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 2	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e

Project 7	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 9	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 10	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Total	**0 kWh/year**	**0 kWh**	**0 kg CO_2e/year**	**0 kg CO_2e**

Energy Efficiency and Renewable Energy (EE/RE) Summary

	Energy Savings		GHG Reduction	
	Annual	Lifetime	Annual	Lifetime
Project 1	9,403,430 kWh/year	282,102,912 kWh	2,614,154 kg CO_2e/year	78,424,610 kg CO_2e
Project 2	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 7	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 9	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 10	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Total	**9,403,430 kWh/year**	**282,102,912 kWh**	**2,614,154 kg CO_2e/year**	**78,424,610 kg CO_2e**

Total System Summary (System + Water Heating + EE/RE)

	Water Savings		Energy Savings		GHG Reduction	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
Project 1	5.475 MG/year	164.250 MG	9,410,000 kWh/year	282,300,012 kWh	2,615,980 kg CO_2e/year	78,479,403 kg CO_2e
Project 2	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 7	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 9	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 10	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Total	**5.475 MG/year**	**164.250 MG**	**9,410,000 kWh/year**	**282,300,012 kWh**	**2,615,980 kg CO_2e/year**	**78,479,403 kg CO_2e**

Combined Summary (System + Imports + Water Heating + EE/RE)

	Water Savings		Energy Savings		GHG Reduction	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
Project 1	5.475 MG/year	164.250 MG	9,439,685 kWh/year	283,190,541 kWh	2,624,232 kg CO_2e/year	78,726,971 kg CO_2e
Project 2	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 3	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 4	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 5	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 6	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 7	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e
Project 8	0.000 MG/year	0.000 MG	0 kWh/year	0 kWh	0 kg CO_2e/year	0 kg CO_2e

Project 9	0.000	MG/year	0.000	MG	0	kWh/year	0	kWh	0	kg CO_2e/year	0	kg CO_2e
Project 10	0.000	MG/year	0.000	MG	0	kWh/year	0	kWh	0	kg CO_2e/year	0	kg CO_2e
Total	**5.475**	**MG/year**	**164.250**	**MG**	**9,439,685**	**kWh/year**	**283,190,541**	**kWh**	**2,624,232**	**kg CO_2e/year**	**78,726,971**	**kg CO_2e**

Attachment 2

Estimate of Water Savings, Energy Savings, and GHG Emissions Reduction

Project Name: **Ray Stoyer WRF Energy Recovery Project**
Total Project Cost: **$16,224,449**

Project Assumptions			
Step 1:	Enter the baseline (pre-project) volume of water associated with the project	**5.48**	MG/year
Step 2:	Enter the volume of water that will be delivered after the project is implemented.	**0**	MG/year
Step 3:	Enter the volume of hot water saved from the project's electric water heating system (the summation of step 3 and step 4 must not exceed annual volume of water savings). If not applicable, enter "0".	**0**	MG/year
Step 4:	Enter the volume of hot water saved from the project's natural gas water heating system (the summation of step 3 and step 4 must not exceed annual volume of water savings). If not applicable, enter "0".	**0**	MG/year
Step 5:	Enter the useful life in years for the project	**30**	years
Step 6:	Enter the percentage of water that is imported	**89%**	
Step 7:	Enter the Energy Intensity (EI) of the System associated with the project's water savings	**1200**	kWh/MG
Step 8:	Enter the total output emission rate specific to the power supplier or use the default value of 0.278	**0.278**	kg CO_2e/kWh
Step 9:	Enter EI associated with the Supply and Conveyance segment of the imported water or enter "0" if imported water is not applicable	**6066**	kWh/MG
Step 10:	Enter any additional annual energy savings from energy efficiency and renewable energy (EE/RE), etc.	**9403430.4**	kWh/year

*****Note: on a separate sheet provide the basis for the estimates and information sources for factors entered*****

Note: values below are determined from the above Project Assumptions		Units
Water Savings		
1) Annual volume of water savings within System	5.475	MG/year
2) Annual volume of imported water savings	4.893556613	MG/year
3) Annual volume of hot water heating system savings	0	MG/year
4) Lifetime volume of water savings within System	164.25	MG
5) Lifetime volume of imported water savings	146.8066984	MG
6) Lifetime volume of hot water heating system savings	0	MG
Energy Savings		
1) Annual energy savings within System	6,570	kWh/year
2) Annual energy savings from imported water	29,684	kWh/year
3) Annual energy savings from electric hot water heating system	0	kWh/year
4) Annual energy savings from natural gas hot water heating system (used to calculate total energy saving)	0	kWh/year
5) Total annual energy savings from electric and natural gas hot water heating systems	0	kWh/year
6) Annual energy savings from natural gas hot water heating system (used to calculate GHG emmission)	0	therms/year
7) Lifetime energy savings within System	197,100	kWh
8) Lifetime energy savings from imported water	890,529	kWh
9) Lifetime energy savings from electric hot water heating system	0	kWh
10) Lifetime energy savings from natural gas hot water heating system	0	kWh
11) Total lifetime energy savings from electric and natural gas hot water heating systems	0	kWh
12) Lifetime energy savings from natural gas water heating system	0	therms
13) Additional lifetime energy savings from Energy Efficiency and Renewable Energy (EE/RE), etc	282,102,912	kWh
GHG Emission Reductions		
1) Annual GHG emission reductions within System	1,826	kg CO_2e/year
2) Annual imported GHG emission reductions	8,252	kg CO_2e/year
3) Annual GHG emission reductions from electric hot water heating	0	kg CO_2e/year
4) Annual GHG emission reductions from natural gas hot water heating system	0	kg CO_2e/year
5) Total annual GHG reductions from electric and natural gas hot water heating system	0	kg CO_2e/year
6) Lifetime GHG emission reductions within System	54,794	kg CO_2e
7) Lifetime GHG emission reductions from imported water	247,567	kg CO_2e
8) Lifetime GHG emission reductions from electric heating system	0	kg CO_2e
9) Lifetime GHG emission reductions from natural gas water heating system	0	kg CO_2e
10) Total lifetime GHG emission reductions from electric and natural gas hot water heating systems	0	kg CO_2e
11) Additional annual GHG emission reductions from Energy Efficiency and Renewable Energy (EE/RE), etc	2,614,154	kg CO_2e/year
12) Additional lifetime GHG emission reductions from Energy Efficiency and Renewable Energy (EE/RE), etc	78,424,610	kg CO_2e
Project Summary		
Total annual water savings	5.475	MG/year
Total lifetime water savings	164.25	MG
Total annual energy savings	9,439,685	kWh/year
Total lifetime energy savings	283,190,541	kWh
Total annual GHG emission reductions	2,624,232	kg CO_2e/year
Total lifetime GHG emission reductions	78,726,971	kg CO_2e

PROJECT 1 CALCULATIONS

Calculations for Estimate of Water Savings, Energy Savings, and GHG Emissions Reduction

Project Name: **Ray Stoyer WRF Energy Recovery Project**
Total Project Cost: **$16,224,449**

	Project Assumptions			CALCULATIONS
1	Enter the baseline (pre-project) volume of water associated with the project	**5.48**	MG/year	Brine Water (from WRF): 15,000 gallons/day; No. of delivery days: 365 days/year; Pre-Project Volume: 5.48 MG/year
2	Enter the volume of water that will be delivered after the project is implemented.	**0**	MG/year	Brine water replaces water used at landfill for dust control results in a direct replacement.
3	Enter the volume of hot water saved from the project's electric water heating system (the summation of step 3 and step 4 must not exceed annual volume of water savings). If not applicable, enter "0".	**0**	MG/year	No reduction in hot water volume
4	Enter the volume of hot water saved from the project's natural gas water heating system (the summation of step 3 and step 4 must not exceed annual volume of water savings). If not applicable, enter "0".	**0**	MG/year	No reduction in hot water volume
5	Enter the useful life in years for the project	**30**	years	Useful life for the Digester Plant
6	Enter the percentage of water that is imported	**89%**	Imported	PDMWD Imports 15,772 AF of Water and supplies 1,874 AF of Recycled Water. Source is 2010 (UWMP Data).
7	Enter the Energy Intensity (EI) of the System associated with the project's water savings	**1200**	kWh/MG	Source: CA's Water-Energy Relationship, November 2005, CEC CEC-700-2005-011-SF, Table 1-2: Range of Energy Intensities for Water Cycle Segments. http://www.energy.ca.gov/process/water/
8	Enter the total output emission rate specific to the power supplier or use the default value of 0.278	**0.278**	kg CO_2e/kWh	Use default value for California
9	Enter EI associated with the Supply and Conveyance segment of the imported water or enter "0" if imported water is not applicable	**6066**	kWh/MG	Table 6. Energy Intensities for Imported Water (2014 Water Energy Guidelines)
10	Enter any additional annual energy savings from energy efficiency and renewable energy (EE/RE), etc.	**9,403,430**	kWh/year	Plant Capacity*: 1.3 MW; Net Power Output: 92%; Uptime: 90%; Operating hours: 168 hours/week; Annual Operation: 52 weeks/year; Energy Output (MW-hrs/year): 9,403 MWh/year; Energy Output: 9,403,430 kWh/year * Proposed 1400-kW Unit operating at a variable output or load that averages to be 1300 kW