Appendix D

Air Quality and Greenhouse Gas Emissions Modeling and Calculations

Placer Biomass Construction CAP Output

Placer-Mountain Counties County, Summer

Project Characteristics

Land Usage

Land Uses	Size	Metric
Parking Lot	8	Space
Other Asphalt Surfaces	2	Acre

Land Uses	Size	Metric
Unrefrigerated Warehouse-No Rail	10.8	1000sqft
General Light Industry	21.78	1000sqft

Other Project Characteristics

Urbanization Urban

Wind Speed (m/s) 2.2

Utility Company Pacific Gas & Electric Company

Climate Zone 14

Precipitation Freq (Days) 74

User Entered Comments

Land Use -
Total Paved Area-2 acres less the parking area: 1.93 acres
Total Parking Spaces-8
The main building is similar to a warehouse in size/shape and material
The storage area would be approximately 1 acre (43,560 SF). This SF was reduced by 50% to represent less construction intensity since the structure would be a barn-style covered storage area

Construction Phase - Construction is assumed to take place for 6 months beginning May.

Grading - Total Disturbed Area-3.7 acres

Trips and VMT - Material hauled would be moved to onsite landfill

Emissions Summary

Overall Construction-Site Prep, Grading, Paving (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2013	4.79	40.24	23.03	0.04	6.26	2.22	8.20	3.32	2.22	5.26	0.00	4,336.39	0.00	0.43	0.00	4,345.39
Total	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Overall Construction-Building Construction, Arch. Coatings (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2013	69.09	17.30	12.37	0.02	0.23	1.07	1.30	0.01	1.07	1.08	0.00	2,222.79	0.00	0.21	0.00	2,227.19
Total	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Construction Detail

Site Preparation - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.14	0.00	0.14	0.01	0.00	0.01						0.00
Off-Road	4.20	34.71	18.00	0.04		1.65	1.65		1.65	1.65		3,917.77		0.37		3,925.62
Total	**4.20**	**34.71**	**18.00**	**0.04**	**0.14**	**1.65**	**1.79**	**0.01**	**1.65**	**1.66**		**3,917.77**		**0.37**		**3,925.62**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.49	5.45	1.99	0.00	0.22	0.06	0.28	0.00	0.06	0.06		340.55		0.02		341.03
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Worker	0.07	0.07	0.70	0.00	0.10	0.00	0.11	0.00	0.00	0.01		78.06		0.01		78.18
Total	**0.56**	**5.52**	**2.69**	**0.00**	**0.32**	**0.06**	**0.39**	**0.00**	**0.06**	**0.07**		**418.61**		**0.03**		**419.21**

Grading - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.13	0.00	6.13	3.31	0.00	3.31						0.00
Off-Road	4.70	37.12	22.15	0.04		1.94	1.94		1.94	1.94		3,827.58		0.42		3,836.44
Total	**4.70**	**37.12**	**22.15**	**0.04**	**6.13**	**1.94**	**8.07**	**3.31**	**1.94**	**5.25**		**3,827.58**		**0.42**		**3,836.44**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Worker	0.09	0.08	0.88	0.00	0.13	0.00	0.13	0.00	0.00	0.01		97.58		0.01		97.73
Total	**0.09**	**0.08**	**0.88**	**0.00**	**0.13**	**0.00**	**0.13**	**0.00**	**0.00**	**0.01**		**97.58**		**0.01**		**97.73**

Paving - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.16	25.92	16.81	0.03		2.21	2.21		2.21	2.21		2,393.42		0.37		2,401.25
Paving	0.23					0.00	0.00		0.00	0.00						0.00
Total	**4.39**	**25.92**	**16.81**	**0.03**		**2.21**	**2.21**		**2.21**	**2.21**		**2,393.42**		**0.37**		**2,401.25**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Worker	0.13	0.12	1.32	0.00	0.20	0.01	0.20	0.01	0.01	0.01		146.37		0.01		146.59
Total	**0.13**	**0.12**	**1.32**	**0.00**	**0.20**	**0.01**	**0.20**	**0.01**	**0.01**	**0.01**		**146.37**		**0.01**		**146.59**

Building Construction - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	2.20	16.33	10.77	0.02		1.04	1.04		1.04	1.04		1,945.40		0.20		1,949.52
Total	**2.20**	**16.33**	**10.77**	**0.02**		**1.04**	**1.04**		**1.04**	**1.04**		**1,945.40**		**0.20**		**1,949.52**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Vendor	0.07	0.86	0.37	0.00	0.05	0.03	0.07	0.00	0.03	0.03		140.79		0.00		140.85
Worker	0.12	0.12	1.23	0.00	0.18	0.01	0.19	0.01	0.01	0.01		136.61		0.01		136.82
Total	**0.19**	**0.98**	**1.60**	**0.00**	**0.23**	**0.04**	**0.26**	**0.01**	**0.04**	**0.04**		**277.40**		**0.01**		**277.67**

Architectural Coating - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	68.58					0.00	0.00		0.00	0.00						0.00
Off-Road	0.49	2.96	1.94	0.00		0.27	0.27		0.27	0.27		281.19		0.04		282.10
Total	**69.07**	**2.96**	**1.94**	**0.00**		**0.27**	**0.27**		**0.27**	**0.27**		**281.19**		**0.04**		**282.10**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00		0.00
Worker	0.03	0.02	0.26	0.00	0.04	0.00	0.04	0.00	0.00	0.00		29.27		0.00		29.32
Total	**0.03**	**0.02**	**0.26**	**0.00**	**0.04**	**0.00**	**0.04**	**0.00**	**0.00**	**0.00**		**29.27**		**0.00**		**29.32**

Summary of Construction CAP Emissions

Construction Phase	NOx (lb/day)	ROG (lb/day	PM10 (lb/day)	PM2.5 (lb/day)	Source
Site Preparation					
Construction On-site	34.71	4.2	1.79	1.66	Constr CAP CalEEMod Output
Construction Off-site	5.52	0.56	0.39	0.07	Constr CAP CalEEMod Output
Phase Total	**40.23**	**4.76**	**2.18**	**1.73**	Summation
Grading					
Construction On-site	37.12	4.7	8.07	5.25	Constr CAP CalEEMod Output
Construction Off-site	0.08	0.09	0.13	0.01	Constr CAP CalEEMod Output
Phase Total	**37.2**	**4.79**	**8.2**	**5.26**	
Paving					
Construction On-site	25.92	4.39	2.21	2.21	Constr CAP CalEEMod Output
Construction Off-site	0.12	0.13	0.2	0.01	Constr CAP CalEEMod Output
Phase Total	**26.04**	**4.52**	**2.41**	**2.22**	Summation
Building Construction					
Construction On-site	16.33	2.2	1.04	1.04	Constr CAP CalEEMod Output
Construction Off-site	0.98	0.19	1.04	0.04	Constr CAP CalEEMod Output
Phase Total	**17.31**	**2.39**	**2.08**	**1.08**	Summation
Architectural Coating					
Construction On-site	2.96	69.07	0.27	0.27	Constr CAP CalEEMod Output
Construction Off-site	0.02	0.03	0.04	0	Constr CAP CalEEMod Output
Phase Total	**2.98**	**69.1**	**0.31**	**0.27**	Summation

	Maximum Emissions (lb/day)				
	NOx	**ROG**	**PM10**	**PM2.5**	
All Phases	40.2	69.1	8.2	5.3	MAX Function

Notes

Construction phases are listed in the order that they would likely occur.
There would be no substantial difference in construction emissions under the gasification alternatives and direct combustion alternative.

2.0 Emissions Summary

Overall Construction-Site Preparation, Grading, Paving

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2013	0.15	1.13	0.69	0.00	0.07	0.06	0.13	0.03	0.06	0.10	0.00	106.88	106.88	0.01	0.00	107.14
Total	**0.15**	**1.13**	**0.69**	**0.00**	**0.07**	**0.06**	**0.13**	**0.03**	**0.06**	**0.10**	**0.00**	**106.88**	**106.88**	**0.01**	**0.00**	**107.14**

Overall Construction-Building Construction, Arch. Coatings

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2013	0.43	0.39	0.28	0.00	0.00	0.02	0.03	0.00	0.02	0.02	0.00	44.68	44.68	0.00	0.00	44.77
Total	**0.43**	**0.39**	**0.28**	**0.00**	**0.00**	**0.02**	**0.03**	**0.00**	**0.02**	**0.02**	**0.00**	**44.68**	**44.68**	**0.00**	**0.00**	**44.77**

3.0 Construction Detail

3.1 Mitigation Measures Construction

Site Preparation - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road	0.05	0.40	0.21	0.00		0.02	0.02		0.02	0.02	0.00	40.86	40.86	0.00	0.00	40.94
Total	**0.05**	**0.40**	**0.21**	**0.00**	**0.00**	**0.02**	**0.02**	**0.00**	**0.02**	**0.02**	**0.00**	**40.86**	**40.86**	**0.00**	**0.00**	**40.94**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.01	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	3.35	0.00	0.00	3.35
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.76	0.00	0.00	0.76
Total	**0.01**	**0.06**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.11**	**4.11**	**0.00**	**0.00**	**4.11**

Grading - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.06	0.00	0.06	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road	0.05	0.37	0.22	0.00		0.02	0.02		0.02	0.02	0.00	34.71	34.71	0.00	0.00	34.79
Total	**0.05**	**0.37**	**0.22**	**0.00**	**0.06**	**0.02**	**0.08**	**0.03**	**0.02**	**0.05**	**0.00**	**34.71**	**34.71**	**0.00**	**0.00**	**34.79**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.82	0.00	0.00	0.82
Total	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.82**	**0.82**	**0.00**	**0.00**	**0.82**

Paving - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.05	0.30	0.19	0.00		0.03	0.03		0.03	0.03	0.00	24.96	24.96	0.00	0.00	25.04
Paving	0.00					0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.05**	**0.30**	**0.19**	**0.00**		**0.03**	**0.03**		**0.03**	**0.03**	**0.00**	**24.96**	**24.96**	**0.00**	**0.00**	**25.04**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42	1.42	0.00	0.00	1.42
Total	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.42**	**1.42**	**0.00**	**0.00**	**1.42**

Building Construction - 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.05	0.35	0.23	0.00		0.02	0.02		0.02	0.02	0.00	37.93	37.93	0.00	0.00	38.01
Total	**0.05**	**0.35**	**0.23**	**0.00**		**0.02**	**0.02**		**0.02**	**0.02**	**0.00**	**37.93**	**37.93**	**0.00**	**0.00**	**38.01**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.73	2.73	0.00	0.00	2.73
Worker	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.48	2.48	0.00	0.00	2.48
Total	**0.00**	**0.02**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.21**	**5.21**	**0.00**	**0.00**	**5.21**

Architectural Coating- 2013

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	0.38					0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Off-Road	0.00	0.02	0.01	0.00		0.00	0.00		0.00	0.00	0.00	1.40	1.40	0.00	0.00	1.41
Total	**0.38**	**0.02**	**0.01**	**0.00**		**0.00**	**0.00**		**0.00**	**0.00**	**0.00**	**1.40**	**1.40**	**0.00**	**0.00**	**1.41**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.14
Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.14**	**0.14**	**0.00**	**0.00**	**0.14**

Summary of Construction GHG Emissions

Construction Phase	CO2e (MT)	Source
Site Preparation		
Construction On-site	40.94	Constr CAP CalEEMod Output
Construction Off-site	4.11	Constr CAP CalEEMod Output
Phase Subtotal	45.05	Summation
Grading		
Construction On-site	34.79	Constr CAP CalEEMod Output
Construction Off-site	0.82	Constr CAP CalEEMod Output
Phase Subtotal	35.61	Summation
Paving		
Construction On-site	25.04	Constr CAP CalEEMod Output
Construction Off-site	1.42	Constr CAP CalEEMod Output
Phase Subtotal	26.46	Summation
Building Construction		
Construction On-site	38.01	Constr CAP CalEEMod Output
Construction Off-site	5.21	Constr CAP CalEEMod Output
Phase Subtotal	43.22	Summation
Architectural Coating		
Construction On-site	1.41	Constr CAP CalEEMod Output
Construction Off-site	0.03	Constr CAP CalEEMod Output
Phase Subtotal	0.14	Summation

	value	units	source
Total CO2e from Construction	150.48	MT	summation
Expected operational life of the plant	30	years	conservative assumption
Amortized CO2e over life of the plant	5	MT/year	amortization calculation

Notes

Construction phases are listed in the order that they would likely occur.

There would be no substantial difference in construction emissions under the gasification alternatives and direct combustion alternative.

Summary of Operational Emissions of Criteria Air Pollutants and Precursors (Maximum Daily [lb/day])

	Gasification Alternatives				Direct Combustion Alternative						Jurisdiction				
	NOx	ROG	PM_{10}	$PM_{2.5}$	NOx	ROG	PM_{10}	$PM_{2.5}$	Source Worksheet	Applicable Note(s)	PCAPCD portion of MCAB	PCAPCD portion of LTAB	EDAPCD portion of LTAB	NSAQMD portion of MCAB	Nevada portion of LTAB
Construction Emissions	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	Construction_Emissions.xlsx		all				
Operational Emissions															
Biomass Combustion by Power Plant	15.4	72.0	14.4	14.4	53.8	5.8	13.4	13.4	Plant CAPs		all	none	none	none	none
Natural Gas Combustion by Power Plant	0.0	0.0	0.0	0.0	0.4	0.01	0.02	0.02	Natural Gas Comb	2, 3	all	none	none	none	none
Chipping Biomass	42.2	4.0	1.4	1.4	49.6	4.7	1.6	1.6	Chipping	2, 4	some	some	some	some	some
Truck Activity at the Plant	0.7	0.01	0.01	0.005	0.8	0.01	0.01	0.005	Truck@Plant		all	none	none	none	none
Loader Activity at the Plant	8.8	0.9	0.3	0.3	8.8	0.9	0.3	0.3	Loader@Plant		all	none	none	none	none
Employee Commute Trips	0.3	0.3	0.004	0.003	0.3	0.3	0.004	0.004	Employee Commute	5	some	some	none	some	none
Trucks Hauling Biomass	9.5	0.2	13.4	1.4	11.1	0.3	15.8	1.7	Trucks Hauling Biomass	6	some	some	some	some	some
Trucks Hauling Biochar or Ash	0.9	0.05	0.01	0.01	0.9	0.05	0.01	0.01	Trucks Hauling Biochar-Ash		some	none	none	some	some
Total Operational Emissions	77.7	77.5	29.5	17.5	125.7	12.1	31.2	17.1	summation		some	some	some	some	some

Air District Thresholds of Significance, Maximum Daily Emissions (lb/day)

PCAPCD	NOx	ROG	PM_{10}	$PM_{2.5}$	NOx	ROG	PM_{10}	$PM_{2.5}$	Source
Construction-Related Emissions	82	82	82	none	82	82	82	none	PCAPCD
Operational Emissions	82	82	82	none	82	82	82	none	PCAPCD
EDCAPCD									
Operational Emissions	82	82	none	none	82	82	none	none	EDCAPCD 2002 (Source 1)
NSAQMD Level									
Level A tier	24	24	79	none	24	24	79	none	NSAQMD 2009 (Source 2)

	NOx	ROG	PM_{10}	$PM_{2.5}$	NOx	ROG	PM_{10}	$PM_{2.5}$	Source Worksheet	Applicable Note(s)	Jurisdiction PCAPCD portion of MCAB	PCAPCD portion of LTAB	EDAPCD portion of LTAB	NSAQMD portion of MCAB	Nevada portion of LTAB
Average Daily Emissions from Open Burning of Forest Thinning Slash (lb/day)	428.2	557.5	917.2	778.3	520.0	677.0	1,113.7	945.1	Open Burn CAPs in Forest	See Note 7	some	some	some	some	some

Notes

1 Avoided emissions are not accounted for in the estimate of the net increase in maximum daily emissions.
2 This activity would occur during the summer period only when biomass is collected from the forests.
3 Natural gas would only be used during start-ups under the direct combustion alternative. On these days, a full-load of biomass fuel would not be combusted. Thus, the maximum daily operational emissions of the plant would not occur on start-up days.
4 Chipping and associated emissions would occur in the forests where the biomass is recovered. Thus, chipping would occur in all the affected air basins and jurisdictions. It is not likely that all the biomass chipped on any particular day would occur in PCAPCD's jurisdiction of the MCAB because most of the biomass would be sourced from other areas.
5 More employees would be employed by the project during the summer period when biomass is being collected from the forests. Thus, emissions associated with employee commuting would be lower during the winter period.
6 Not all truck travel associated with the hauling of biomass to the plant would occur in the jurisdiction of any single air district.
7 This analysis does not account for the reduction in emissions of CAPs and precursors that would occur due to the fact that the biomass recovered from the forests would no longer be piled and burned in the forests. This is because the analysis focuses on the maximum daily net increase in emissions associated with the project and the timing of burning is unknown.

Sources

1 El Dorado County Air Pollution Control District. 2002 (February). Guide to Air Quality Assessment. First Edition. Placerville, CA.
2 Northern Sierra Air Quality Management District. 2009. Guidelines for Assessing and Mitigating Air Quality Impacts of Land Use Projects. A draft last revised on August 18, 2009. Truckee, CA.

Summary of Annual Greenhouse Gas Emissions (MT CO2-e/year)

	Gasification Alternatives	Direct Combustion Alternative	Source Worksheet
Construction Emissions, Amortized	5	5	Construction_Emissions.xlsx
Operational Emissions			
Biomass Combustion by Power Plant	26,526	31,207	Plant GHGs
Support Emissions			
Natural Gas Combustion by Power Plant	0	1	Natural Gas Comb
Chipping Biomass	301	354	Chipping
Trucks Hauling Biomass to the Plant	84	99	Trucks Hauling Biomass
Truck Activity at the Plant	2	2	Truck@Plant
Loader Activity at the Plant	197	197	Loader@Plant
Employee Commute Trips	35	44	Employee Commute
Trucks Hauling Biochar/Ash from the Plant	10	10	Trucks Hauling Biochar-Ash
Electricity Consumption from the Grid	1,134	1,134	Electricity Consumption
Water Consumption	222	355	Water Consumption
Wastewater Treatment	156	250	Wastewater Treatment
Total Operational and Support Emissions	**28,667**	**33,654**	subtotal
Avoided Emissions			
Open Burning of Forest Thinning Slash and Hazardous Fuels	24,858	29,245	Open Burn GHGs in Forests
Net Increase in Emissions	**3,809**	**4,409**	net calculation
Electricity Generated by the Plant (MW/year)	2.0	2.0	Operational Parameters
days of operation per year	365	365	Operational Parameters
Hours of operation per day	24	24	Unit Conversions
MW-hr/year	17,520	17,520	calculation
GHG Efficiency (MT CO2e/MW-hr)	**0.22**	**0.25**	calculation
GHG Efficiency Threshold (MT CO2e/MW-hr)	**0.28**		wksht: GHG TOS
Reduction in net GHGs necessary to reduce the GHG efficiency of the direct combustion alternative to less than the GHG Efficiency Threshold (MT CO2-e/year).		155	calculation
GHG Efficiency under Direct Combustion with mitigation (MT CO2e/MW-hr)		0.24	calculation

GHG Efficiency of Electricity Production

	value	units	source
Projected CO2e from Electricity consumption in 2020 (business as usual)	121.2	MMT/year	Source 1, p. 1
Projected CO2e reductions in 2020 achieved by Renewable Portfolio Standard (20%)	12.0	MMT/year	Source 2, p. 2
Projected CO2e reductions in 2020 achieved by Renewable Electricity Standard (33%)	11.4	MMT/year	Source 2, p. 2
Projected CO2e reductions in 2020 achieved by energy efficiency programs	7.8	MMT/year	Source 2, p. 3; Source 4; See Note 1
Million Solar Roofs	1.1	MMT/year	Source 2, p. 4; See Note 2
Projected GHGs Associated with Electricity Consumption in 2020	88.9	MMT/year	calculation
energy conversion rate	1,000	MWh/GWh	onlineconversion.com
mass conversion rate	1,000,000	MT/MMT	onlineconversion.com
Projected Electricity Demand in 2020	316,280	GWh/year	Source 3, Form 1.1
Projected GHG Efficiency of Electricity Consumption in 2020	0.28	MT CO2e/MW-hr	efficiency calc.

Sources

1. California Air Resources Board (ARB). 2011 (October 26). California Greenhouse Gas Inventory 2000-2009—by Category as Defined in the Scoping Plan. Available: <http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-09_2011-10-26.pdf>. Accessed May 5, 2012.
2. California Air Resources Board (ARB). 2011. Status of Scoping Plan Recommended Measures. Available: <http://www.arb.ca.gov/cc/scopingplan/status_of_scoping_plan_measures.pdf>. Accessed May 5, 2012.
3. Kavalec, Chris and Tom Gorin, 2009. California Energy Demand 2010-2020, Adopted Forecast. Publication Number: CEC-200-2009-012-CMF. See Form 1.1, Total Electricity Consumption by Sector, on the spread sheets. Available: <http://www.energy.ca.gov/2009publications/CEC-200-2009-012/index.html>. Accessed May 5, 2012.

Notes

1. According to Source 2, approximately 11.9 MMT CO2e/year of GHG reductions are expected in 2020 from energy efficiency programs. This is from reduced demand of both electricity and natural gas. According to correspondence with Dave Mehle of ARB (see Source 4), 7.8 MMT CO2e/year would specifically be from associated reduction in demand for electricity and this value is used in this calculation.
2. It is uncertain at this time whether the Million Solar Roofs program will be implemented and fully achieved. Accounting for this measure results in a more conservative estimate of the needed GHG efficiency to be consistent with AB 32 goals.

Methodologies Employed to Estimate Project-Related Emissions

Category and Source	Applicability to Alternatives: Gasification Alternatives	Applicability to Alternatives: Direct Combustion	Model/Protocol/Sources of Emission Factors	Key Input Parameter(s)	Applicable Worksheet(s)
Construction Emissions	Y	Y	CalEEMod	off-road equipment use, ground disturbance	
Operational Emissions					
Syngas or Biomass Combustion by Power Plant	Y	Y	For CAPs, data provided by Technology Providers a	technology type, mass of biomass fuel consum	Plant CAPs; Plant GHGs
Support Emissions					
Natural Gas Combustion by Power Plant	NA	Y	AP 42 Emission Factors for CAPs; For GHGs, ARB's Mandatory Reporting Guidelines	volume of natural gas consumed	Natural Gas Comb
Chipping Biomass	Y	Y	ARB's OFFROAD2007 model, pilot study	diesel equipment use	Chipping
Trucks Hauling Biomass to the Plant	Y	Y	ARB's EMFAC2011 model	VMT	Trucks Hauling Biomass
Truck Activity at the Fuel Yard	Y	Y	ARB's EMFAC2011 model	idle-hours by trucks	Trucks @Fuel Yard
Loader Activity at the Plant and Fuel Yard	Y	Y	ARB's OFFROAD2007 model	time at power plant	Loader @Plant
Employee Commute Trips	Y	Y	ARB's EMFAC2011 model	VMT	Employee Commute
Trucks Hauling Biochar/Ash from the Plant	Y	Y	ARB's EMFAC2011 model	VMT	Trucks Hauling Biochar-Ash
Water Consumption	Y	Y	CEC's electricity consumption rate	water demand, well specifications	Water Consumption
Wastewater Treatment	Y	Y	CalEEMod water module	volume of wastewater	Wastewater Treatment
Avoided Emissions					
Open Burning of Forest Thinning Slash and Hazardous Fuels	Y	Y	ARB's Mandatory Reporting Guidance	mass of biomass, high heating value	Open Burn in Forests

Operational Parameters	Gasification Alternatives	Direct Combustion Alternative	Units	Source
Plant location	Cabin Creek	Cabin	none	Chapter 3, Project Alternatives
Jurisdiction	Placer Co.	Placer Co.	none	Chapter 3, Project Alternatives
Technology	gasification	direct combustion	none	Chapter 3, Project Alternatives
Plant Power Capacity				
Gross	2.0	2.0	MW	Chapter 3, Project Description, p. 3-14
parasitic load, percentage	10%	10%	%	Source 1
Net (export)	1.8	1.8	MW	calculation
Operational Life	30	30	years	conservative assumption
Operational frequency				
annual basis	365	365	days/year	Chapter 3, Project Description, p. 3-14; See Note 1
Earliest operation date	January 2015	January 2015	year on calendar	e-mail from Brett Storey to N. Hansel on 4/4/2012 and forwarded to AJK
Fuel demand of power plant, minimum	14,000	17,000	bdt/year	Project Description and Alternatives; See Note 1
Fuel demand of power plant, maximum	17,000	20,000	bdt/year	Project Description and Alternatives; See Note 1
Moisture content of forest-sourced biomass, maximum	50%	50%	%	Chapter 3, Project Description, p. 3-10
Fuel demand of power plant, annual, Green, minimum	28,000	34,000	grn ton/year	calculation
Fuel demand of power plant, annual, Green, maximum	34,000	40,000	grn ton/year	calculation
Source of biomass fuel				
hazardous fuels reduction	75%	75%	%	Chapter 3, Project Description, p. 3-15
forest thinning	25%	25%	%	Chapter 3, Project Description, p. 3-15
Biochar or ash byproduct	biochar	ash		
Mass of biochar/ash produced annually	850	1,000	tons/year	Chapter 3, Project Description, p. 3-13
High Heat Value of forest-sourced biomass, minimum	8,300	8,300	BTU/dry lb	Chapter 3, Project Description, p. 3-10
Water consumption, Maximum worst-case	14,400	23,040	gal/day	See Note 2
Water source	well	well	NA	Chapter 3, Project Description
Capacity of chip van truck, dry, by mass	12.5	12.5	bdt/load	p. 3-15 of Sec. 3, Project Description

Notes

1 Under the gasification alternatives, the two parallel 1-MW systems would operate, which allows the plant to operate at 50% capacity while one of the systems is undergoing maintenance. If, for some unforseen reason, both systems need to be shut down, then the plant would consume less biomass on an annual basis. Under the direct combustion alternative, the entire plant would be shut down on occasion for maintenance activities, in which case the annual mass of biomass fuel combusted would be lower.

2 The volume of water consumption for the gasification alternatives is stated in Chapter 3, Project Description and is the maximum, worst-case volume of water that could be consumed by a gassification system. Depending on the gasification technology used, substantially less water may be consumed by the plant. The volume consumed under the direct combustion alternative is calculated based on a maximum rate of 8 gal/min/MW * 2 MW * 60 min/hr * 24 hr/day.

Sources

1 Tornatore, Fred. Chief Technical Officer. TSS Consultants, Rancho Cordova, CA. May 8, 2012—telephone conversation with Austin Kerr of Ascent Environmental regarding the quantity of electricity that the biomass plant would consume.

Unit Conversion Rates

Global Warming Potential (rates)

	CO_2	CH_4	N_2O	units
global warming potential	1	21	310	unitless

Source: Table A-1 of Subpart A—Global Warming Potentials (100-YearTime Horizon) from 40 CFR 98 (page 722-723), as required by ARB's Regulation for the Mandatory Reporting of GHGs (http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr_2010_clean.pdf)

Mass Conversion Rates

value	units	source
1,000	kg/MT	onlineconversion.com/weight_common.htm
1,000,000	g/MT	onlineconversion.com/weight_common.htm
2,000	lb/ton	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
453.59	g/lb	onlineconversion.com/weight_common.htm
1.1023	ton/MT	onlineconversion.com/weight_common.htm
2.204622622	lb/kg	onlineconversion.com/weight_common.htm
2,204.62	lb/MT	onlineconversion.com/weight_common.htm
1,000	g/kg	onlineconversion.com/weight_common.htm
907.2	kg/ton	onlineconversion.com/weight_common.htm

Time Conversions Rates

rate	units	source
60	min/hr	definition
365	days/year	definition
7	days/wk	definition
24	hr/day	definition

Energy Conversions Rates

value	units	source
1,000,000	btu/MMbtu	definition

Electricity Conversion Rates

value	units	source
1,000	kW-hr/MW-hr	onlineconversion.com/energy.htm

Volume - Liquid

	units	source
1,000,000	gal/MG	definition
325,851	gal/acre-ft	onlineconversion.com/volume.htm

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- Tornatore, Fred. Chief Technical Officer. TSS Consultants, Rancho Cordova, CA. May 3, 2012—e-mail to Austin Kerr of Ascent Environmental regarding the volume of natural gas that would be consumed by the biomass plant under the gasification and direct combustion alternatives.
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Emissions of CAPs and Precursors from Power Plant Stack (Gasification and Direct Combustion)

	NOx	ROG	PM10	CO	SO2	units	Source(s)
Gasification							
Technology A: Nexterra							
hourly emissions	0.50	3.00	0.60	6.50	0.01	lb/hr	Source 1, p. 12; See Notes 1, 4, 7
daily emissions	12.00	72.00	14.40	156.00	0.24	lb/day	conversion calculation
annual emissions	2.10	11.75	2.41	26.50	0.04	tons/year	Source 1, p. 12 and Table 2-4 on p. 20; See Notes 1, 4, 7
Technology B: Phoenix							
hourly emissions	0.64	0.64	0.3	3.4	0.05	lb/hr	Source 1, p. 13-14; See Notes 2, 4, 7
daily emissions	15.36	15.36	7.20	81.60	1.20	lb/day	conversion calculation
annual emissions	2.58	2.58	1.20	13.39	0.19	tons/year	Source 1, p. 13-14; and Table 2-3 on p. 19; See Notes 2, 4, 7
Max. Annual Emissions	2.58	11.75	2.41	26.50	0.19	tons/year	max calc based on two gasification technologies
Max. Daily Emissions	15.36	72.00	14.40	156.00	1.20	lb/day	max calc based on two gasification technologies
Direct Combustion							
Technology: Envio							
hourly emissions	2.24	0.24	0.56	5.60	0	lb/hr	Source 1, p. 15; See Notes 3, 4, 7
daily emissions	53.76	5.76	13.44	134.40	0.00	lb/day	conversion calculation
annual emissions	9.05	0.96	2.30	22.60	0	tons/year	Source 1, p. 15; See Notes 3, 4, 7

	value	units	source
time conversion rate	24	hr/day	wksht: Unit Conversions

Notes

1 The estimate of NOx emissions assumes the installation of Selective Catalytic Reduction (SCR), which reduces NOx through introduction of ammonia in the presence of a precious metal catalyst at a temperature of approx. 700F, according to

2 The Phoenix unit utilizes a "rich-burn" internal combustion engine, involving minimizing (starving) the air to combust the syngas. This allows for the use of a three-way catalytic converter to reduce NOx, CO, and VOCs, according to TSS & PCAPCD 2011, p. 13. Discussion with Phoenix Energy, Authority to Construct Permit issued by the San Joaquin Air Pollution Control District for Phoenix Facility in Merced, CA.

3 Emission estimates for direct combustion assume the use of a bag house for PM control, and the use of Selective Non-Catalytic Reduction for NOx control, which is commercially available and well demonstrated for NOx control in

4 Reactive Organic Gases (ROG) are a subset of Volatile Organic Compounds (VOCs). However, in order to be conservative it is assumed that all VOCs emitted by the power plant are ROG. PCAPCD staff, including Bruce Springsteen of PCAPCD, agrees with this assumption.

5 The emission estimates for criteria air pollutants and precursors are conservatively high because they assume that the biomass fuel would have a Btu content of 8,000 Btu/dry lb and the actual Btu content of forest-sourced biomass is expected to be 8,300 Btu/dry lb. This means that less biomass would actually be needed due to its higher heat content. Bruce Springsteen of PCAPCD agrees (Springsteen, pers. comm., 2012).

6 It is conservatively assumed that PM2.5 emissions would be equal to PM10 emissions.

7 Emissions estimates shown are based on projected use of best available emissions controls, as would be required by PCAPCD Rule 502, according to Source 3, p. 3.

Source

1 TSS Consultants and Placer County Air Pollution Control District. 2011 (November). *Air/Water Emissions and Carbon Credits/Emissions Offsets.* Prepared for the Placer County Biomass Program.

2 Springsteen, Bruce. Associate Engineer. Placer County Air Pollution Control District, Auburn, CA. May 1, 2012—telephone conversation and e-mail with Austin Kerr of Ascent Environmental regarding methodologies for estimating criteria air

3 Placer County Air Pollution Control District. 2012 (April). New Source Review Permit Analysis for Small-Scale Biomass Combined Heat and Power in the Lake Tahoe Region. Task 6.0 of the U.S. Department of Energy/Placer County Biomass Utilization Pilot Project
DE-FG36-08GO88026. Auburn, CA. Prepared for the Placer County Planning Department.

Annual GHG Emissions from Biomass Power Plant

Key Note: There are typically multiple methodologies, called "tiers," for estimating GHG emissions for different sources. A Tier 1 approach relies on default emission factors and default values for other key input parameters such as the high heating value. The default values used in a Tier 1 methodology are conservative in that they result in a high estimate of GHG emissions. A Tier 2 approach uses project specific emission factors and/or input parameters (e.g., high heating value) that result in a more accurate, and lower estimate of GHG emissions. It is important to note that this analysis is conservative because a Tier 2 method is used to estimate GHG emissions from the gasification or combustion of biomass at the proposed plant and a Tier 1 approach is used to estimate the avoided level of GHG emissions that would be generated by open burning the biomass fuel in the forests.

Plant Specifications	gasification alternatives	direct combustion alternative	units	source/notes
maximum mass of biomass combusted	17,000	20,000	bdt/year	wksht: 3-Operational Parameters; See Note 5

Calculation Parameters	value	units	source/notes
high heat value of biomass, minimum	8,300	btu/dry lb	wksht: 3-Operational Parameters
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions
energy conversion rate	1,000,000	btu/MMbtu	wksht: 20-Unit Conversions

Emission Factor	value	units	source/notes
CO2 emission factor	93.80	kg/MMbtu	See Note 1
CH4 emission factor	0.0032	kg/MMbtu	See Note 2
N2O emission factor	0.00042	kg/MMbtu	See Note 2
Global Warming Potential for Conversion to CO2e			
global warming potential of CH4	21	unitless	wksht: Unit Conversions
global warming potential of N2O	310	unitless	wksht: Unit Conversions
CO2-e Emission Factor	94.00	kg/MMbtu	composite calculation

Conversion Rates	value	units	source/notes
mass conversion rate	1.102	ton/MT	wksht: Unit Conversions
mass conversion rate	1,000	kg/MT	wksht: 20-Unit Conversions

GHG Emissions, maximum annual	gasification alternatives	direct combustion alternative	units	source/notes
Energy Content of Bone Dry Biomass	282,200	332,000	MMbtu/year	calculation; See Note 3
CO2-e emissions, maximum annual	26,526	31,207	MT/year	See Note 3 and Note 4
CO2-e emissions, maximum annual	29,240	34,400	ton/year	conversion calculation

Sources

1 California Air Resources Board. 2012. ARB's Regulation for the Mandatory Reporting of GHGs. Available: <http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr_2010_clean.pdf>, which is hyperlinked to <http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/2010_regulation.htm>. Accessed April 25, 2012. Last updated February 29, 2012.

2 Code of Federal Regulations. Part 98-Mandatory Greenhouse Gas Reporting. Subparts A-C. Available: <http://www.epa.gov/climatechange/emissions/downloads09/RuleParts98SubpartsA-C.pdf>. Accessed April 25, 2012.

3 Tornatore, Fred. Chief Technical Officer. TSS Consultants, Rancho Cordova, CA. May 3—e-mail to Austin Kerr of Ascent Environmental regarding the volume of natural gas that would be consumed by the biomass plant under the gasification and direct combustion alternatives.

Notes

1 Table C-1 to Subpart C - Default CO2 Emission Factors and High Heating Values for Various Types of Fuel from 40 CFR 98 (page 789-790), which is Source 2, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), which is Source 1

2 Table C-2 to Subpart C - Default CH4 and N2O Emission Factors for Various Types of Fuel from 40 CFR 98 (page 790-791), which is Source 2, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), which is Source 1

3 Equations C-2a and C-8 from 40 CFR 98 (page 728), which is Source 2, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), which is Source 1.

4 This methodology for estimating GHG emissions is considered a Tier 2 methodology, as defined on p. 47 of Source 1 (Definition number 358), because it uses the default emission factor and a measured high heat value for the biomass fuel.

5 This calculation is conservative because it assumes that the maximum range of BDT would be consumed by the biomass plant and that all the biomass consumed by the plant would be forest-sourced biomass, which has a higher HHV Btu content than WUI-sourced biomass on an average annual basis.

Combustion of Natural Gas for Start-Ups

Specifications	gasification alternatives	direct combustion alternative	units	source/notes
natural gas used per plant start-up	0	2.35	MMbtu/start-up	Source 2
start-ups per year	12	12	start-ups/year	conservative estimate, See Source 2
annual consumption of natural gas	0	28.20	MMbtu/year	calculation
volume of natural gas per start-up	0	0.0023	MMscf/start-up	conversion calculation
volume of natural gas per year	0	0.0276	MMscf/year	conversion calculation

	value	units	source/notes
energy content of natural gas per volume	1,020	MMbtu/MMscf	Source 1, p. 1.4-6

	NOx	ROG	PM_{10}	$PM_{2.5}$	units	source/notes
CAP Emission Factors	190	5.50	7.6	7.6	lb/MMscf	Source 1; See Note 1
CAP Emissions, Maximum Daily						
Gasification Alternatives	0.00	0.00	0.00	0.00	lb/day	calculation; See Note 2
Direct Combustion Alternative	0.44	0.01	0.02	0.02	lb/day	calculation; See Note 2

GHG Emission Factors	value	units	source/notes
CO2 emission factor	53.02	kg/MMbtu	See Note 3
CH4 emission factor	0.001	kg/MMbtu	See Note 4
N2O emission factor	0.0001	kg/MMbtu	See Note 4
Global Warming Potential for Conversion to CO2e			
CH4	21	unitless	wksht: Unit Conversions
N2O	310	unitless	wksht: Unit Conversions
mass conversion rate	1,000	kg/MT	wksht: 20-Unit Conversions
CO2-e Emission Factor	0.053	MT/MMbtu	composite calculation

	gasification alternatives	direct combustion alternative	units	source/notes
CO2-e Emissions, maximum annual	0.0	1.5	MT/year	calc; See Note 4 and Note 5

Sources

1 U.S. Environmental Protection Agency (EPA). 1998 (July). Emission Factors & AP 42, Compilation of Air Pollutant Emission Factors, Section 1.4, Natural Gas Combustion. From EPA's Technology Transfer Network's Clearinghouse for Inventories and Emission Factors. Available: <http://www.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>. Accessed May 7, 2012.

2 Tornatore, Fred. Chief Technical Officer. TSS Consultants, Rancho Cordova, CA. May 3, 2012—e-mail to Austin Kerr of Ascent Environmental regarding the volume of natural gas that would be consumed by the biomass plant under the gasification and direct combustion alternatives.

3 California Air Resources Board. 2012. ARB's Regulation for the Mandatory Reporting of GHGs. Available: <http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr_2010_clean.pdf>, which is hyperlinked to <http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/2010_regulation.htm>. Accessed April 25, 2012. Last updated February 29, 2012.

4 Code of Federal Regulations. Part 98-Mandatory Greenhouse Gas Reporting. Subparts A-C. Available: <http://www.epa.gov/climatechange/emissions/downloads09/RuleParts98SubpartsA-C.pdf>. Accessed April 25, 2012.

Notes

1 The emission factor for NOx is take from Table 1.4-1 for Large Wall-Fired Boilers, Uncontrolled (Post-NSPS) of Source 1. The emission factors for other pollutants is taken from Table 1.4-2 of the same document. The emission factor for Total PM is used for PM10 and PM2.5 and the emission factor for VOCs is used for ROG. This results in a conservatively high estimate of emissions of PM10, PM2.5, and ROG.

2 Natural gas would only be used during start-ups under the direct combustion alternative. On these days, a full-load of biomass fuel would not be combusted. Thus, the maximum daily operational emissions of the plant would not occur on start-up days.

3 Table C-1 to Subpart C - Default CO2 Emission Factors and High Heating Values for Various Types of Fuel from 40 CFR 98 (page 789-790), which is Source 4, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), which is Source 3.

4 Table C-2 to Subpart C - Default CH4 and N2O Emission Factors for Various Types of Fuel from from 40 CFR 98 (page 790-791), which is Source 4, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), whch is Source 3.

5 Equations C-2a and C-8 from 40 CFR 98 (page 728), which is Source 2, as required by ARB's Regulation for the Mandatory Reporting of GHGs (ARB 2012), which is Source 3.

GHGs Associated with Electricity Consumption by the Plant

The net amount of electricity the plant would export to the grid would be less than 2.0 MW. This is because the plant would need some electricity to power some of its own equipment—this is referred to as the parasitic load. It is conservatively assumed that the plant would purchase non-renewable power from the grid because this would be more cost effective than using its own power that sells at the premium renewable rate.

	Gasification and Direct Combustion Alternatives	units	source
size of proposed plant	2.0	MW	wksht: Operational Parameters
parasitic load, maximum, percentage	10%	%	Source 1
electricity imported from grid	0.2	MW	calculation
operation time of the plant	365	days/year	wksht: Operational Parameters
time conversion rate	24	hr/day	wksht: Unit Conversions
Electricity imported from grid, annually	1,752	MW-hr/year	calculation
GHG Emission Factors			
CO2	1,422.78	lb/MW-hr	Source 2; See Note 1
CH4	0.029	lb/MW-hr	Source 2; See Note 1
N2O	0.011	lb/MW-hr	Source 2; See Note 1
Global warming potential			
CH4	21	unitless	wksht: Unit Conversions
N2O	310	unitless	wksht: Unit Conversions
CO2-e emission factor	1,426.80	lb/MW-hr	composite calculation
Electricity imported from grid, annually	1,752.0	MW-hr/year	above calculation
CO2-e emissions, annual	2,499,752	lb/year	calculation
mass conversion rate	2,204.62	lb/MT	wksht: Unit Conversions
CO2-e emissions, annual	1,134	MT/year	conversion calculation

Notes

1 These are the default GHG emission rates associated with the consumption of electricity produced by Sierra Pacific Power Company, as provided by CalEEMod (listed below). Sierra Pacific's generation and distribution assets are now owned and operated by California Pacific Electric Company (CalPeco).

Sources

1 Tornatore, Fred. Chief Technical Officer. TSS Consultants, Rancho Cordova, CA. May 8, 2012—telephone conversation with Austin Kerr of Ascent Environmental regarding the quantity of electricity that the biomass plant would consume.

2 South Coast Air Quality Management District. 2011. California Emissions Estimator Model (CalEEMod) Version 2011.1.1. Available: <http://www.caleemod.com/>.

Emissions from Employee Commute Trips under the Gasification Alternatives

	gasification alternatives	units	source
Daily VMT by Employees working at the Biomass Plant - Summer and Winter			
Employees at Plant, daily	5	#/day	See Note 2
trip generation rate			
commute	2	trips/employee	Table 8-9 of Section 8, Traffic and Transportation
lunch time trip	2	trips/employee	Table 8-9 of Section 8, Traffic and Transportation
total	4	trips/employee	Table 8-5 of Section 8, Traffic and Transportation
trips	20	trips/day	calculation
commute	10	trips/day	calculation
lunch time trip	10	trips/day	calculation
total	20	trips/day	summation
average trip length			
commute trip, max.			
out-of-Basin	8.2	miles/trip	Table 8-9 of Section 8, Traffic and Transportation
in LTAB	3.5	miles/trip	Table 8-9 of Section 8, Traffic and Transportation
lunch time trip			
out-of-Basin	0.0	miles/trip	Table 8-9 of Section 8, Traffic and Transportation
in LTAB	4.5	miles/trip	Table 8-9 of Section 8, Traffic and Transportation
VMT, daily			
out-of-Basin	82	VMT/day	calculation
in LTAB	80	VMT/day	calculation
total	162	VMT/day	summation
Daily VMT by Employees refining biomass in the forests - Summer Only			
Additional employees	8	#/day	assumption
trip generation rate	4	trips/employee	same as Table 8-5 of Section 8, Traffic and Transportation
trips	32	trips/day	calculation
average trip length			
out-of-Basin	8.2	miles/trip	same trip length used for plant employees
in LTAB	3.5	miles/trip	same trip length used for plant employees
VMT, daily			
out-of-Basin	262	VMT/day	calculation
in LTAB	112	VMT/day	calculation
total	374	VMT/day	summation
Combined VMT by Employees, Maximum Daily			
Daily, in Summer			
out-of-Basin	344	VMT/day	summation
in LTAB	192	VMT/day	summation
total	536	VMT/day	summation; See Note 4
Daily, in Winter			
out-of-Basin	82	VMT/day	summation
in LTAB	80	VMT/day	summation
total	162	VMT/day	summation
Seasonality of Operations			
Employees at Biomass Plant - Summer and Winter	365	days/year	wksht: Operational Parameters
Employees refining biomass in the forests - Summer Only	120	days/year	See Note 1
Combined VMT by Employees, Annual			
total	104,058	VMT/year	summation; See Note 5

Mix of passenger vehicles used in employee commutes

passenger car population in Placer County portion of LTAB	value	units	source
light duty autos - gasoline	3,330	#	wksht: On-Rd Veh Emiss Rates; See Notes 3 and 6
light duty trucks 1 - gasoline	1,034	#	wksht: On-Rd Veh Emiss Rates; See Notes 3 and 6
light duty trucks 2 - gasoline	2,391	#	wksht: On-Rd Veh Emiss Rates; See Notes 3 and 6
Total, all passenger vehicle types - gasoline	6,756	#	summation
relative portion of passenger car population by vehicle type			
light duty autos - gasoline	49%	%	calculation
light duty trucks 1 - gasoline	15%	%	calculation
light duty trucks 2 - gasoline	35%	%	calculation

Emission Rates (running exhaust)	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
Expressed in grams per mile								
light duty autos	0.152	0.181	0.003	0.002	2.347	285.548	g/mile	wksht: On-Rd Veh Emiss Rates; See Note 6
light duty trucks 1	0.364	0.479	0.006	0.005	5.502	337.136	g/mile	wksht: On-Rd Veh Emiss Rates; See Note 6
light duty trucks 2	0.256	0.196	0.002	0.002	2.090	409.022	g/mile	wksht: On-Rd Veh Emiss Rates; See Note 6
* The emission rates for CO2 take into account the requirements of Pavley 1 and the Low Carbon Fuel Standard.								
					Mass Conversion Rate	453.59	g/lb	wksht: Unit Conversions
Expressed in pounds per mile								
light duty autos	0.0003	0.0004	0.00001	0.00001	0.0052	0.6295	lb/mile	conversion calculation
light duty trucks 1	0.0008	0.0011	0.00001	0.00001	0.0121	0.7433	lb/mile	conversion calculation
light duty trucks 2	0.0006	0.0004	0.00001	0.000005	0.0046	0.9017	lb/mile	conversion calculation
Composite emission rates for all passenger vehicle types	0.0005	0.0005	0.0000	0.0000	0.0060	0.7433	lb/mile	weighted average calculation

Maximum Daily Emissions from Employee Commute Trips

	NOx	ROG	PM10	PM2.5	CO	units	source
Total (both in an out of LTAB)	0.26	0.27	0.00	0.00	3.24	lb/day	summation

Annual GHG Emissions from Employee Commute Trips	CO2e	units	source
GHG emissions	77,345	lb/year	CalEEMod runs "employee trips in Placer-Nevada" and "employee trips in LTAB"
mass conversion rate	2,205	lb/MT	wksht: Unit Conversions
GHG emissions	35	MT/year	conversion calculation

Notes

1 In order to estimate the highest potential number of dialy trips, the traffic analysis assumed that most collection and delivery of biomass fuel would occur during a minimum 167-day period between May 1 and October 15 each year, which is the same as the grading season designated by TRPA (TRPA Code of Ordinances, Section 64.2.A, Grading Season), and that fuel collection and hauling would occur 5 days per week. This comes to 120 days, a value that was also used in the traffic analysis (See p. 8-13 of Section 8, Traffic and Transportation).

2 It is assumed that three employees would work during the day shift and only one employee would work during the other two 8-hour shifts.

3 It is assumed that all employee commuter trips are in light duty autos or light duty trucks (i.e., LDA, LDT1, LDT2) and that none of these vehicles are diesel, which have slightly lower emission rates. The EMFAC2011 model run indicates that only a small portion of these vehicle types are diesel-powered.

4 This maximum daily VMT value is used to estimate maximum daily emissions because forest crews are not working during the winter season.

5 This annual VMT value is used to estimate annual emissions.

6 It is assumed that proportions of various vehicle types (i.e., the fleet mix) in the portion of Placer County that is also part of the Lake Tahoe Air Basin are also representative of the fleet mix in other mountainous areas of Placer County and Nevada County, as well other areas in the Lake Tahoe Air Basin that are outside of Placer County.

Emissions from Employee Commute Trips under the Direct Combustion Alternative

Under the direct combustion alternative, more biomass would be consumed by the plant. While the number of employees working at the plant would be the same, more employees would be needed to process and haul biomass from the source. Thus, the amount of VMT associated with these employees is extrapolated based on the relative increase in biomass fuel that would be consumed by the plant.

	value	units	source
Max. mass of biomass consumed by the gassification alts	17,000	bdt/year	wksht: Operational Parameters
Max. mass of biomass consumed by the direct combustion alt	20,000	bdt/year	wksht: Operational Parameters
Ratio of biomass used by the direct combustion to gassification	1.18	ratio	calculation
Daily VMT by Employees working at the Biomass Plant - Summer and Winter			
out-of-Basin	82	VMT/day	same as for gasification above
in LTAB	80	VMT/day	same as for gasification above
total	162	VMT/day	same as for gasification above
Daily VMT by Employees refining biomass in the forests - Summer Only			
out-of-Basin	309	VMT/day	extrapolation calculation
in LTAB	132	VMT/day	extrapolation calculation
total	440	VMT/day	summation
Combined Daily VMT by Employees, Maximum Daily			
Daily, in Summer			
out-of-Basin	391	VMT/day	summation
in LTAB	212	VMT/day	summation
total	602	VMT/day	summation
Daily, in Winter			
out-of-Basin	82	VMT/day	same as for gasification above
in LTAB	80	VMT/day	same as for gasification above
total	162	VMT/day	summation
Combined VMT by Employees, Annual			
out-of-Basin	76,815	VMT/year	calculation
in LTAB	54,612	VMT/year	calculation
total	131,426	VMT/year	summation; See Note 5

The ratio of VMT associated with employee commute trips under the direct combustion alternative and the gasification alternative is used to estimate associated emissions.

Maximum Daily Emissions from Employee Commute Trips	NOx	ROG	PM10	PM2.5	CO	units	source
Total (both in an out of LTAB)	0.29	0.31	0.004	0.004	3.64	lb/day	summation

	value	units	source
Ratio of Annual VMT under direct combustion vs. gasification	1.26	ratio	calculation

	CO2e	units	source
Annual GHG Emissions from Employee Commute Trips	44	MT/year	calculation

On-Site Truck Emissions at the Plant Site

Truck Fleet Mix by Proportion of Biomass Hauled	value	units	source
chip vans	50%	%	Estimate based on project description
medium trucks	25%	%	Estimate based on project description
small trucks	25%	%	Estimate based on project description
Haul capacity	12.5	bdt/load	wksht: Operational Parameters
Work days per collection season, minimum	120	days/season	wksht: Employee Commute; See Note 1
Vehicle Category in EMFAC2011 for chip vans	T6 instate construction heavy	class	wksht: THB Exhaust
Vehicle Class in EMFAC2011 model	T6	type	Source 1
Time spent idling or maneuvering at plant	0.167	hr/delivery	assumption (10 minutes)

	gasification alternatives	direct combustion alternative	units	source
mass of biomass consumed by power plant, max.	17,000	20,000	bdt/year	wksht: Operational Parameters
Number of biomass deliveries, annual	1,360	1,600	visits/year	calculation
Max. daily biomass truck deliveries to plant	13	14	visits/day	calculation, rounded up; See Note 2
Number of biochar/ash departures, annual	213	185	visits/day	wksht: Trucks Hauling Biochar-Ash
Max. daily biochar/ash departures	1	1	visits/day	wksht: Trucks Hauling Biochar-Ash
Total Annual truck visits	1,573	1,785	visits/year	summation
Total Max. Daily truck visits	14	15	visits/day	summation

	NOx	ROG	PM10	PM2.5	CO	CO2**	units	source
Idling Emission Factors								
chip vans hauling biomass	138.2	2.3	1.0	0.9	35.0	6836.5	g/veh-hr	row 4846 of Idle_ER_Other_Area of Source 1

* It is assumed that idling emission rates for the smaller trucks that would haul away biochar/ash would be the same as, if not less than, the idling emission rates for the chip vans that would deliver biomass.

** The emission rates for CO2 take into account the requirements of Pavley 1 and the Low Carbon Fuel Standard.

	value	units	source
mass conversion rate	453.59	g/lb	wksht: Unit Conversions
mass conversion rate	1,000,000	g/MT	wksht: Unit Conversions

Emissions	NOx	ROG	PM10	PM2.5	CO	CO2	units	source
Gasification Alternatives								
Maximum Daily Emissions	0.7	0.01	0.01	0.005	0.2	32.7	lb/day	calculation w/conversions
Annual Emissions						1.8	MT/year	calculation w/conversions
Direct Combustion Alternative								
Maximum Daily Emissions	0.8	0.01	0.01	0.005	0.2	35.2	lb/day	calculation w/conversions
Annual Emissions						2.0	MT/year	summation

Notes

1 In order to estimate the highest potential number of dialy trips, the traffic analysis assumed that most collection and delivery of biomass fuel would occur during a minimum 167-day period between May 1 and October 15 each year, which is the same as the grading season designated by TRPA (TRPA Code of Ordinances, Section 64.2.A, Grading Season), and that fuel collection and hauling would occur 5 days per week. This comes to 120 days, a value that was also used in the traffic analysis (See p. 8-13 of Section 8, Traffic and Transportation).

Sources

1 California Air Resources Board. 2012 (February 8) (last updated). EMFAC2011 Idling Emission Rates. Available: <http://www.arb.ca.gov/msei/modeling.htm>. Accessed May 3, 2012.

Truck Hauling Biomass

Maximum Daily Emissions

	NOx	ROG	PM10	PM2.5	CO	CO2	units	source
Gasification Alternatives								
Exhaust Emissions	9.5	0.2	0.1	0.1	0.8	1,549	lb/day	wksht: THB Exhaust
Fugitive Dust Emissions	—	—	13.3	1.3	—	—	lb/day	wksht: THB Dust
Total	9.5	0.2	13.4	1.4	0.8	1,549	lb/day	summation
Direct Combustion Alternative								
Exhaust Emissions	11.1	0.3	0.1	0.1	0.9	1,823	lb/day	wksht: THB Exhaust
Fugitive Dust Emissions	—	—	15.6	1.6	—	—	lb/day	wksht: THB Dust
Total	11.1	0.3	15.8	1.7	0.9	1,823	lb/day	summation

Annual GHG Emissions	CO2	units	source
Gasification Alternatives	84	MT/year	wksht: THB Exhaust
Direct Combustion Alternative	99	MT/year	extrapolation calc

Emissions from Trucks Hauling Biomass under Gasification Alternatives

Vehicle Miles Traveled by Trucks Hauling Biomass under the Gasification Alternatives

	gasification alternatives	units	source
Max. fuel demand of power plant, annual range	17,000	BDT	wksht: Operational Parameters
If all Biomass would be hauled in Chip Vans			
Daily Fuel Deliveries			
Capacity of chip van truck, dry, by mass	12.5	bdt/load	wksht: Operational Parameters
Loads of biomass to be hauled, annually	1,360	loads/year	calculation, and Table 6-7 of Sec 6, Traffic and Transportation
Number of trips, max. daily - Summer Only	22	trips/day	Table 8-8 of Section 8, Traffic and Transportation
Moisture content of biomass	50%	%	wksht: Operational Parameters
Capacity of chip van truck, green	18.75	grn tons/load	calculation
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions
Capacity of chip van truck, green	37,500	grn lb/load	conversion calculation
Vehicle Category in EMFAC2011 model	T6 instate construction heavy	class	EMFAC2011; See Note 1
VMT, daily			
out-of-LTAB	309	VMT/day	Table 8-9 of Section 6, Traffic and Transportation
in LTAB	292	VMT/day	Table 8-9 of Section 6, Traffic and Transportation
VMT, annual			
out-of-LTAB	37,080	VMT/year	Table 8-9 of Section 6, Traffic and Transportation
in LTAB	35,040	VMT/year	Table 8-9 of Section 6, Traffic and Transportation

EMISSIONS SUMMARY

Emission Rates (running exhaust)	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
Chip Vans, Expressed in grams per mile	7.145	0.187	0.088	0.081	0.587	1,169	g/mile	wksht: On-Rd Veh Emiss Rates
Chip Vans, Expressed in pounds per mile	0.0158	0.0004	0.0002	0.0002	0.0013	2.5777	lb/mile	conversion calculation

* The emission rates for CO2 take into account the requirements of Pavley 1 and the Low Carbon Fuel Standard.

Emissions, Maximum Daily	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
out-of-LTAB	4.9	0.1	0.1	0.1	0.4	796.5	lb/day	calculation
in LTAB	4.6	0.1	0.1	0.1	0.4	752.7	lb/day	calculation
Total	9.5	0.2	0.1	0.1	0.8	1,549.2	lb/day	summation
Emissions, Annual								
out-of-LTAB	584.1	15.3	7.2	6.6	48.0	95,581	lb/year	calculation
in LTAB	551.9	14.4	6.8	6.2	45.3	90,323	lb/year	calculation
Total	1,136.0	29.7	13.9	12.8	93.3	185,904	lb/year	summation
					Annual Total - expressed in MT/year	84.3	MT/year	conversion calculation

	value	units	source
Mass Conversion Rate	453.59	g/lb	wksht: Unit Conversions
Mass Conversion Rate	2,204.62	lb/MT	wksht: Unit Conversions

Emissions from Trucks Hauling Biomass under Direct Combustion Alternatives

Emissions generated by trucks hauling biomass under the direct combustion alternatives are estimated based proportionally according to the ratio of the annual mass biomass consumed by the two different technologies.

Ratio of Biomass Consumption by Direct Combustion vs. Gasification	value	units	source
Max. fuel demand of power plant, annually, under the direct combustion alternative	20,000	BDT/year	wksht: 3-Operational Parameters
Max. fuel demand of power plant, annually, under the gasification alternatives	17,000	BDT/year	wksht: 3-Operational Parameters
Ratio of biomass fuel consumption	1.18	ratio	calculation

Emissions, Maximum Daily	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
out-of-LTAB	5.7	0.1	0.1	0.1	0.5	937	lb/day	calculation
in LTAB	5.4	0.1	0.1	0.1	0.4	886	lb/day	calculation
Total	11.1	0.3	0.1	0.1	0.9	1,822.6	lb/day	summation
Emissions, Annual								
out-of-LTAB	687.1	18.0	8.4	7.8	56.5	112,449	lb/year	calculation
in LTAB	649.3	17.0	8.0	7.3	53.3	106,262	lb/year	calculation
Total	1,336.4	35.0	16.4	15.1	109.8	218,711	lb/year	summation
					Annual Total - expressed in MT/year	99.2	MT/year	conversion calculation

Notes

1 The vehicle class in EMFAC2011 is based on the mass of the haul load.

Dust Emissions from Trucks Hauling Biomass on Unpaved Roadways under the Gasification Alternatives

Emission Factor (EF) Calculation for Truck Travel on Unpaved Roads

	value	units	source
Truck Type	T6 heavy	NA	EMFAC2011
green biomass capacity	37,500	lb/load	wksht: THB Exhaust
truck curb weight	10,000	lb	EMFAC2011
truck total weight	47,500	lb	summation
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions
truck total weight	23.75	tons/truck	conversion calculation

Emission Factor Calculation (Based on formula 1a in AP-42 Section 13.2.2., EPA 2006)

Variables	PM10 EF Calc	PM2.5 EF Calc	Unit	Source
a	0.9	0.9	constant	Source 1, Table 13.2.2-2 Constants for Equations 1a and 1b AP-42 Section 13.2.2
b	0.45	0.45	constant	
k	1.5	0.15	constant (lbs/VMT)	
s	8.5%	8.5%	surface material silt content (%)	CalEEMod
W	23.75	23.75	mean vehicle weight (tons)	Calc'ed above based on truck size anticipated for project
Emission Factor	0.044	0.0044	lbs/VMT	

Maximum Daily VMT by Surface Type

	in LTAB	out of LTAB	Total	units	source
Max Daily VMT	309	292	601	VMT/day	wksht: Truck Hauling Biomass
Portion of truck travel on unpaved roads			50%	%	assumption
Truck VMT on unpaved roads, max. daily			301	VMT/day	calculation

	PM10	PM2.5	units	source
Fugitive Dust Emissions	13.3	1.3	lb/day	calc using emission factor

Dust Emissions from Trucks Hauling Biomass under Direct Combustion Alternatives

Emissions generated by trucks hauling biomass under the direct combustion alternatives are estimated based proportionally according to the ratio of the annual mass biomass consumed by the two different technologies.

Ratio of Biomass Consumption by Direct Combustion vs. Gasification	value	units	source
Max. fuel demand of power plant, annually, under the direct combustion alternative	20,000	BDT/year	wksht: 3-Operational Parameters
Max. fuel demand of power plant, annually, under the gasification alternatives	17,000	BDT/year	wksht: 3-Operational Parameters
Ratio of biomass fuel consumption	1.18	ratio	calculation

	PM10	PM2.5	units	source
Fugitive Dust Emissions	15.6	1.6	lb/day	calc using emission factor

Sources

1 U.S. Environmental Protection Agency 2006 (November). Emission Factors & AP 42, Compilation of Air Pollutant Emission Factors-Section 13.2.2 Unpaved Roads. Available http://www.epa.gov/ttnchie1/ap42/. Accessed May 5, 2012

Emissions from Trucks Hauling Biochar/Ash

Vehicle Miles Traveled

	gasification alternatives	direct combustion alternative	units	source
type of waste product produced	biochar	ash	none	wksht: 3-Operational Parameters
maximum mass of biochar/ash per year	850	1,000	tons/year	Project Description, pg. 3-13
mass conversion rate	2,000	2,000	lb/ton	wksht: Unit Conversions
maximum mass of biochar/ash per year	1,700,000	2,000,000	lb/year	conversion calculation
density of biochar/ash	800	1,080	lb/cu. Yd.	Project Description, pg. 3-13
minimum truck capacity, by volume	10	10	cu. Yd/load	Project Description, pg. 3-13
minimum truck capacity, by mass	8,000	10,800	lb/load	calculation
Truck Class in EMFAC2011 model	LHD2	LHD2	class	EMFAC2011; See Note 1
truck loads hauled annually	213	185	trips/year	calculation
maximum loads hauled daily	1	1	trips/day	See Note 2
Trip length in	53.4	53.4	miles/trip	See Note 3
Trip length out	53.5	53.5	miles/trip	See Note 3
Combined round trip length	106.9	106.9	miles/trip	summation
Maximum daily VMT by biochar haul truck	106.9	106.9	VMT/day	calculation
Maximum Annual VMT	22,716	19,796	trips/year	calculation; See Note 4.

Emission Rates (running exhaust)	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
Expressed in grams per mile (LHD2)	3.893	0.202	0.046	0.043	1.060	510	g/mile	wksht: On-Rd Veh Emiss Rates
* The emission rates for CO2 take into account the requirements of Pavley 1 and the Low Carbon Fuel Standard.								
			Mass Conversion Rate			453.59	g/lb	wksht: Unit Conversions
Expressed in pounds per mile	0.0086	0.0004	0.0001	0.0001	0.0023	1.13	lb/mile	conversion calculation

Emissions	NOx	ROG	PM10	PM2.5	CO	CO2*	units	source
Gasification Alternatives								
Maximum Daily Emissions	0.92	0.05	0.01	0.01	0.25	120	lb/day	calculation
Annual Emissions	195.0	10.1	2.3	2.1	53.1	25,565	lb/year	calculation
			Annual Total - expressed in MT/year			11.6	MT/year	
Direct Combustion Alternative								
Maximum Daily Emissions	0.92	0.05	0.01	0.01	0.25	120	lb/day	calculation
Annual Emissions	169.9	8.8	2.0	1.9	46.2	22,279	lb/year	calculation
			Annual Total - expressed in MT/year			10.1	MT/year	

	rate	units	source
Mass Conversion Rate	2,204.62	lb/MT	wksht: Unit Conversions

Notes

1 The vehicle class in EMFAC2011 is based on the mass of the haul load.

2 It is assumed that no more than one load of biochar or ash would be hauled per day given that the project description states that biochar/ash would be hauled away once or twice each week.

3 Trip lengths for the hauling of biochar are provided in Table 6-9 of Section 6, Traffic and Transportation and assume that biochar would be hauled to the Lockwood Regional Landfill southeast of Sparks, NV via Interstate 80. Thus, all related VMT would be outside of the Lake Tahoe Air Basin. Information about the landfill is available at http://ndep.nv.gov/bwm/landfill_lockwood.htm. However, the biochar and ash may be may also be used as a soil amendment in landscaping or agriculture.

4 A conservative (i.e., higher) estimate for annual VMT associated with the hauling of biochar under the gasification alternatives is provided in Table 6-9 of Section 6, Traffic and Transportation. The traffic analysis estimated 12,840 VMT during the summer period and 12,305 during the winter period, which comes to a total of 25,145 VMT/year. An estimate of VMT associated with the hauling of ash under the direct combustion alternative could be estimated based on the ration of truck loads needed for ash vs. biochar, resulting in 21,913 VMT/year. The estimates for annual VMT provided above are used because they are directly based on the maximum volume of biochar or ash that would be generated under the respective alternatives, as provided on p. 3-13 of the project description.

5 Because biochar is highly resistant to decomposition (See p. 2.42 of IPCC 2006), therefore the biochar sent to Lockwood Regional Landfill is not anticipated to generate subsequent GHGs.

Running Exhaust Emission Rates for On-Road Vehicles

Source: These emission rates were provided by the California Air Resources Board's Mobile Source Emissions Inventory (EMFAC2011), which is available at http://www.arb.ca.gov/msei/modeling.htm.
It is assumed that emission rates for vehicles in the portion of Placer County that is also part of the Lake Tahoe Air Basin are also representative of emission rates in other mountainous areas of Placer County and Nevada County, as well other areas in the Lake Tahoe Air Basin that are outside of Placer County.

EMFAC 2011
2015 Estimated Annual Emission Rates
EMFAC 2011 Vehicle Categories
Placer COUNTY
Lake Tahoe AIR BASIN
Placer County APCD

Area	CalYr	Season	Veh	Fuel	Population	Speed	ROG_RUNEX	ROG_IDLEX	ROG_RUNLS	CO_RUNEX	CO_IDLEX	NOX_RUNEX	NOX_IDLEX	CO2_RUNEX (Pavley I+LCFS)	CO2_IDLEX(Pavley I+LCFS)	PM10_RUNEX	PM10_IDLEX	PM2_5_RUNEX	PM2_5_IDLEX	SOX_RUNEX	SOX_IDLEX
						(Miles/hr)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/vehicle/day)	(gms/mile)	(gms/vehicle/day)
Placer (LT)	2015	Annual	LDA	GAS	3,330	AllSpeeds	0.081	0	0.100	2.347	0	0.152	0	285.548	0	0.003	0	0.002	0	0.003	0
Placer (LT)	2015	Annual	LDA	DSL	24	AllSpeeds	0.055	0	0	0.239	0	0.489	0	259.166	0	0.042	0	0.038	0	0.003	0
Placer (LT)	2015	Annual	LDT1	GAS	1,034	AllSpeeds	0.175	0	0.304	5.502	0	0.364	0	337.136	0	0.006	0	0.005	0	0.004	0
Placer (LT)	2015	Annual	LDT1	DSL	0	AllSpeeds	0.075	0	0	0.267	0	0.576	0	265.727	0	0.062	0	0.057	0	0.003	0
Placer (LT)	2015	Annual	LDT2	GAS	2,391	AllSpeeds	0.053	0	0.143	2.090	0	0.256	0	409.022	0	0.002	0	0.002	0	0.005	0
Placer (LT)	2015	Annual	LDT2	DSL	0	AllSpeeds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Placer (LT)	2015	Annual	T6 instate construction heavy	DSL	36	AllSpeeds	0.18690843	0.146263997	0	0.587	1.535	7.145	9.017	1169.227	701.333	0.088	0.027	0.081	0.025	0.011	0.007
Placer (LT)	2015	Annual	LHD2	DSL	12	AllSpeeds	0.20164507	0.109759108	0	1.060	0.910	3.893	2.596	510.485	138.210	0.046	0.029	0.043	0.027	0.005	0.001

EMFAC2011 only provides idling exhaust emissions for large trucks, but no passenger vehicles.

EMFAC 2011
2015 Estimated Annual Emission Rates
EMFAC 2011 Vehicle Categories
Placer COUNTY
Lake Tahoe AIR BASIN
Placer County APCD

Area	CalYr	Season	Veh	Fuel	MdlYr	Speed (Miles/hr)	Pop (Vehicles)	VMT (Miles/day)	Trips (Trips/day)	ROG_RUNEX (gms/mile)	ROG_IDLEX (gms/vehicle/day)	ROG_STREX (gms/vehicle/day)	ROG_DIURN (gms/vehicle/day)	ROG_HTSK (gms/vehicle/day)	ROG_RUNLS (gms/mile)	ROG_RESTL (gms/vehicle/day)
Placer (LT)	2015	Annual	LDA	GAS	AllMYr	AllSpeeds	3330.483	110294.5	20755.42	0.080560553	0	2.539139699	0.226505178	1.150414816	0.100044872	0.124522259
Placer (LT)	2015	Annual	LDA	DSL	AllMYr	AllSpeeds	24.47696	758.0702	142.3505	0.054870937	0	0	0	0	0	0
Placer (LT)	2015	Annual	LDT1	GAS	AllMYr	AllSpeeds	1034.443	32579.83	6164.704	0.174985174	0	5.219016393	0.541994862	2.264322031	0.303724386	0.278301764
Placer (LT)	2015	Annual	LDT1	DSL	AllMYr	AllSpeeds	7.73E-04	0.022656	0.004092	0.075126906	0	0	0	0	0	0
Placer (LT)	2015	Annual	LDT2	GAS	AllMYr	AllSpeeds	2391.427	83204.37	14975.22	0.053370698	0	3.066381419	0.230477669	1.166504241	0.1426122	0.124225209
Placer (LT)	2015	Annual	LDT2	DSL	AllMYr	AllSpeeds	0	0	0	0	0	0	0	0	0	0
Placer (LT)	2015	Annual	LHD2	GAS	AllMYr	AllSpeeds	36.12349	1308.196	538.1861	0.263630098	0.538890089	13.67830471	0.026193781	1.747550291	0.378340063	0.010969868
Placer (LT)	2015	Annual	LHD2	DSL	AllMYr	AllSpeeds	95.30488	3459.012	1198.815	0.201645067	0.109759108	0	0	0	0	0
Placer (LT)	2015	Annual	T6 instate c	DSL	AllMYr	AllSpeeds	12.27172	617.6325	0	0.186908426	0.146263997	0	0	0	0	0
Placer (LT)	2015	Annual	T6 instate c	DSL	AllMYr	AllSpeeds	23.57266	1516.642	0	0.256977925	0.230147582	0	0	0	0	0

Veh	Fuel	TOG_RUNE (gms/mile)	TOG_IDLEX (gms/vehi cle/day)	TOG_STRE (gms/vehi cle/day)	TOG_DIURI (gms/vehi cle/day)	TOG_HTSK (gms/vehi cle/day)	TOG_RUNL (gms/mile)	TOG_RESTI (gms/vehi cle/day)	CO_RUNEX (gms/mile)	CO_IDLEX (gms/vehi cle/day)	CO_STREX (gms/vehi cle/day)	NOX_RUNEX (gms/mile)	NOX_IDLEX (gms/vehicle/day)	NOX_STREX (gms/vehicle/day)
LDA	GAS	0.098643	0	2.716162	0.226505	1.150415	0.100045	0.124522	2.346525	0	29.40047	0.15222997	0	1.407328955
LDA	DSL	0.062467	0	0	0	0	0	0	0.238695	0	0	0.489383034	0	0
LDT1	GAS	0.209604	0	5.58044	0.541995	2.264322	0.303724	0.278302	5.501677	0	66.56665	0.364069887	0	2.406068381
LDT1	DSL	0.085527	0	0	0	0	0	0	0.267248	0	0	0.576433004	0	0
LDT2	GAS	0.073776	0	3.275674	0.230478	1.166504	0.142612	0.124225	2.089983	0	38.78615	0.255690542	0	2.658779704
LDT2	DSL	0	0	0	0	0	0	0	0	0	0	0	0	0
LHD2	GAS	0.300084	0.570003	14.63195	0.026194	1.74755	0.37834	0.01097	5.760854	3.29732	199.6931	0.466928213	0.034377786	26.55947231
LHD2	DSL	0.229559	0.124953	0	0	0	0	0	1.059623	0.90974	0	3.893080766	2.596080142	0
T6 instate c	DSL	0.212781	0.16651	0	0	0	0	0	0.586963	1.535372	0	7.144611728	9.017227945	0
T6 instate c	DSL	0.29255	0.262006	0	0	0	0	0	0.839255	2.598325	0	3.9038983	7.051017965	0

Veh	Fuel	CO2_RUNE (gms/mile)	CO2_IDLEX (gms/vehi cle/day)	CO2_STRE (gms/vehi cle/day)	CO2_RUNE (gms/mile)	CO2_IDLEX (gms/vehi cle/day)	CO2_STRE (gms/vehi cle/day)	PM10_RUN (gms/mile)	PM10_IDLE (gms/vehi cle/day)	PM10_STRI (gms/vehi cle/day)	PM10_PM1 (gms/mile)	PM10_PME (gms/mile)	PM2_5_RU (gms/mile)	PM2_5_IDI (gms/vehi cle/day)	PM2_5_STI (gms/vehi cle/day)	PM2_5_PN (gms/mile)	PM2_5_PN (gms/mile)	SOX_RUNE (gms/mile)	SOX_IDLEX (gms/vehi cle/day)	SOX_STREX (gms/vehi cle/day)
LDA	GAS	339.7213	0	463.5827	285.5477	0	402.9852	0.002716	0	0.026371	0.008	0.03675	0.002463	0	0.023908	0.002	0.01575	0.003431	0	0.005169
LDA	DSL	308.6688	0	0	259.1663	0	0	0.041712	0	0	0.008	0.03675	0.038375	0	0	0.002	0.01575	0.002947	0	0
LDT1	GAS	392.8097	0	511.6937	337.1357	0	456.0379	0.00552	0	0.045136	0.008	0.03675	0.005025	0	0.040983	0.002	0.01575	0.004013	0	0.006318
LDT1	DSL	319.8629	0	0	265.7267	0	0	0.062146	0	0	0.008	0.03675	0.057174	0	0	0.002	0.01575	0.003054	0	0
LDT2	GAS	462.1309	0	627.7749	409.0215	0	568.9758	0.002331	0	0.021371	0.008	0.03675	0.002145	0	0.019647	0.002	0.01575	0.004648	0	0.006972
LDT2	DSL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LHD2	GAS	969.216	116.3645	884.2904	944.9856	113.4553	862.1832	0.003487	0	0.035344	0.008	0.03675	0.003162	0	0.031131	0.002	0.01575	0.009774	0.00123	0.012394
LHD2	DSL	523.5747	141.7534	0	510.4853	138.2096	0	0.04627	0.028982	0	0.012	0.08918	0.042568	0.026663	0	0.003	0.03822	0.004998	0.001353	0
T6 instate c	DSL	1199.207	719.3155	0	1169.227	701.3326	0	0.087722	0.026971	0	0.012	0.130339	0.080704	0.024813	0	0.003	0.05586	0.011441	0.006863	0
T6 instate c	DSL	1188.223	734.7692	0	1158.517	716.4	0	0.139343	0.040651	0	0.012	0.130339	0.128196	0.037399	0	0.003	0.05586	0.011336	0.00701	0

Exhaust Emissions of Loader at Plant and Fuel Storage Area

Equipment Operation Parameters	gasification and direct combustion alternatives	units	source
number of loaders	1	#	assumption
hours of operation	8	hours/day	conservative assumption; See Note 3
days per week	7	days/week	conservative assumption
operational frequency, annual basis	365	days/year	wksht: Operational Parameters
year of fleet	January 2015	year on calendar	wksht: Operational Parameters
hours operated annually	2,920	hours/year	calculation

	NO_X	ROG	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4	units	sources/notes
Emission factors for Rubber Tired Loader	1.10	0.12	0.04	0.04	0.35	148.84	0.01	lb/hr	wksht: Offroad emfacs
Maximum Daily Emissions	8.79	0.95	0.30	0.30	2.84	1190.74	0.09	lb/day	calculation

	CO_2	CH_4	units	sources/notes
Annual GHG Emissions	434,621	31	lb/year	calculation; See Note 2
global warming potential	1	21	unitless	wksht: Unit Conversions

	value	units	source
Annual CO2-e emissions	435,278	lb/year	calculation
mass conversion rate	2,204.62	lb/MT	wksht: Unit Conversions
Annual CO2-e emissions	197	MT/year	conversion calculation

Notes

1 Estimates do not include any fugitive PM dust emissions generated by operation of the loader. This is because the loader would not engage in earth disturbance and would operate in areas that consists of asphalt, compacted soils, and/or gravel.
2 According to the model run in OFFROAD2007, the loader would not generate any emissions of N2O.
3 Emissions from loaders in future years would be lower due to anticipated improvements in fuel efficiency and emissions controls.
4 It is conservatively assumed that the loader would be operated 8 hours per day, 7 days per year, all year. However, it is more likely that it would be operated no more than 4 hours per day, 5 days per week.

Off-Road Equipment Use for Chipping of Forest-Source Biomass

Data in the following shaded table was provided in Appendix C to the following study: Sierra Nevada Conservancy. 2008 (November 17). *Forest Biomass Removal on National Forest Lands: First Progress Report* . Prepared by Placer County Chief Executive Office and TSS Consultants.

Date	Chip Van Loads	Chip Production		Equipment Operation hours	Total Diesel Fuel Usage (gal)	Diesel Fuel Usage by Equipment Type (gal)			Green Tons/ operating hour
		BDT	green tons			Grinder	Loader	Excavator	
4/14/2008	2	23.5	43.3	2.5	93.5	75	6.5	12	17.3
4/15/2008	5	57.6	116.5	11.8	0				9.9
4/16/2008	6	80.1	148.7	2.8	105	84	7	14	53.1
4/17/2008	7	84.9	162.9	5.8	218	174	15	29	28.1
4/18/2008	1	12.9	23						
4/21/2008	1	13.7	24.5						
4/22/2008	5	73.2	124	1.8	68	54	5	9	68.9
4/23/2008	1	13	22.9	2.3	86	69	6	11	9.9
4/24/2008				3.3	124	99	9	16	0
4/25/2008	3	35.6	74.5						
4/28/2008	1	13.4	25.4						
5/5/2008	4	54.5	120.2	3.1	116	93	8	15	38.8
5/6/2008	8	123.6	195.8	2.2	83	66	6	11	89
5/7/2008	10	135.9	253.9	3.1	116	93	8	15	81.9
5/8/2008	8	103.4	211.6	2.6	98	78	7	13	81.4
5/9/2008	9	130	217.8	2.8	105	84	7	14	77.8
5/12/2008	7	107.7	166.5	3.5	132	105	9	18	47.6
5/13/2008	6	83.7	149.5	1.9	71	57	5	9	78.7
5/27/2008	4	71.1	102.4	1.7	63	51	4	8	60.2
5/28/2008	3	30.9	69.2	0.7	26	21	2	3	98.9
5/29/2008	8	118	213.4	4.8	180	144	12	24	44.4
5/30/2008	9	119.4	225.2	2	75	60	5	10	112.6
6/2/2008	8	102.9	185.3	3.1	116	93	8	15	59.8
6/3/2008	7	79	157.4	4.8	180	144	12	24	32.8
6/4/2008	1	11.7	21.3						
6/5/2008	8	112.5	192.4	4.5	169	135	12	22	42.8
6/6/2008	7	91.4	183.3	5.1	191	153	13	25	35.9
6/9/2008	11	131.8	244.5	5.5	206	165	14	27	44.4
6/10/2008	6	83.8	138	4.3	161	129	11	21	32.1
6/11/2008	10	152.6	234.4	5.2	196	156	14	26	45.1
6/12/2008	8	108.9	198.9	5.5	206	165	14	27	36.2
6/13/2008	7	110	170.4	4.7	176	141	12	23	36.2
6/16/2008	7	95.4	158.6	3.5	131	105	9	17	45.3
6/17/2008	7	96.3	156.8	5.4	203	162	14	27	29
6/18/2008	8	109.6	178.8	3.3	124	99	9	16	54.2
6/20/2008	5	73.7	104.1	6.3	236	189	16	31	16.5
6/23/2008	8	107.2	187.6	6.1	229	183	16	30	30.7
6/24/2008	2	29	47.2	3.4	128	102	9	17	13.9
6/25/2008	10	144.9	253.9	4.3	161	129	11	21	59.1
6/26/2008	8	116.1	196.4	5.6	211	168	15	28	35.1
6/27/2008	9	127.8	227.8	3.7	139	111	10	18	61.6
7/9/2008	5	62.9	91.4	5	188	150	13	25	18.3
7/10/2008	8	114.8	169.6	4.9	184	147	13	24	34.6
7/11/2008	9	124.6	208.8	4.9	184	147	13	24	42.6
7/16/2008	7	116	152	5.5	206	165	14	27	27.6
7/17/2008	8	133.8	180.7	5.8	218	174	15	29	31.2
7/18/2008	5	78	107.2	4.5	169	135	12	22	23.8
7/21/2008	2	29.8	45.4						
7/22/2008	4	76.9	99.6	2.1	78	63	5	10	47.4
7/23/2008	4	84.2	106.2	2.5	93	75	6	12	42.5

The following metrics provide the amount of commitment use per green ton of biomass recovered.

	Chip Van Loads		Equipment Operation		Diesel Fuel Usage byEquipment Type (gal)		
	BDT	green tons	hours	Diesel Fuel Usag	Grinder	Loader	Excavator
Total	3,833	6,423	148	5,548	4,437	383	728
Rate			0.02	0.86	0.69	0.06	0.11
(units)			hr/green ton	gal/grn ton	gal/grn ton	gal/grn ton	gal/grn ton

	gasification alternatives	direct combustion alternative	units	source
mass of biomass recovered	34,000	40,000	grn ton/year	wksht: Operational Parameters
equipment-hours per season that chipping would occur	783	921	hr/season	calculation using above operation rate
work days during chipping season, minimum	120	120	days/season	See Note 2
max. equipment-hours per day operated	6.5	7.7	hr/day	See Note 2
days per season that chipping would occur	120	120	days/season	calculation for crosscheck, See Note 2

Emission factors from offroad equip. used in chipping	NO_x	ROG	PM_{10}	$PM_{2.5}$	CO	CO_2	units	sources/notes
Excavators	1.01	0.12	0.03	0.03	0.35	158.54	lb/hr	wksht: Offroad emfacs; See Note 4
Rubber Tired Loaders	1.10	0.12	0.04	0.04	0.35	148.84	lb/hr	
Chippers/Stump Grinders	3.78	0.32	0.12	0.12	1.23	594.49	lb/hr	
Shredders	0.58	0.06	0.02	0.02	0.35	70.16	lb/hr	
composite emission factor, all equip. combined	6.47	0.61	0.21	0.21	2.28	972.04	lb/hr	summation

Maximum daily emissions from chipping equipment	NO_x	ROG	PM_{10}	$PM_{2.5}$	CO	CO_2	units	sources/notes
gasification alternatives	42.2	4.0	1.4	1.4	14.9	6,341	lb/day	calculation
direct combustion alternative	49.6	4.7	1.6	1.6	17.5	7,460	lb/day	calculation

GHG emissions from chipping equipment were estimated based on fuel consumption measured during the pilot project presented in he following study: Sierra Nevada Conservancy. 2008 (November 17). Forest Biomass Removal on National Forest Lands: First Progress Report. *Prepared by Placer County Chief Executive Office and TSS Consultants. This method was also chosen instead of using exhaust emission factors for offroad equipment from ARB because the GHG emission factors in OFFROAD2007 are not consistent with ARB's official GHG inventory, as noted at http://www.arb.ca.gov/msei/offroad/offroad.htm.*

CO2-e Emission Factor for Diesel Fuel Consumption	value	units	source
GHG emission factors for diesel fuel consumption			
CO2	10.15	kg/gal	Ref. 3, Table C.3 on p. 96
CH4	0.74	g/gal	Ref. 3, Table C.6 on p. 100
N2O	0.26	g/gal	Ref. 3, Table C.6 on p. 100
mass conversion rate	1,000	g/kg	wksht: Unit Conversions
global warming potential of GHGs			
CH4	21	ratio	wksht: Unit Conversions
N2O	310	ratio	wksht: Unit Conversions
CO2-e emissions emission factor	10.25	kg/gal	calculation
mass conversion rate	1,000	kg/MT	wksht: Unit Conversions
CO2-e emissions emission factor	0.01025	MT/gal	conversion calculation

	gasification alternatives	direct combustion alternative	units	source
diesel fuel consumed by chipping	29,366	34,549	gal/year	calculation
CO2-e emissions	301	354	MT/year	calculation
Crosscheck using Emission Rates based on OFFROAD model run				
	760,967	895,256	lb/season	calculation based on emfac
	2,204.62	2,204.62	lb/MT	wksht: Unit Conversions
	345	406	MT/year	conversion calculation; See Note 3

Notes

1 It is assumed that all offroad equipment used for chipping biomass is powered by diesel fuel.

2 The maximum number of equipment-hours per day is based on the fact that biomass would be recovered during the 167-day period between May 1 and October 15 each year, which is the same as the grading season designated by TRPA (TRPA Code of Ordinances, Section 64.2.A, Grading Season), and that fuel collection and hauling would occur 5 days per week. This comes to 120 days, a value that was also used in the traffic analysis (See Table 6-9 of Section 6, Traffic and Transportation). Thus, the maximum number of equipment-hours per day is estimated based on the amount of biomass fuel needed by the plant and the 120-days when the fuel would be collected.

3 As a crosscheck, annual CO2 emissions were also estimated using the lb/hr emission factors based on the OFFROAD2007 model run. This crosscheck does not account for emissions of other GHGs (i.e., CH4 and N2O). The annual estimate of CO2 is not substantially different from the estimate based on fuel consumption.

4 The emission rate for PM2.5 exhaust is assumed to be the same as for PM10 exhaust because diesel PM is less than 2.5 microns in aerodynamic diameter.

5 Emission rates for PM10 and PM2.5 are exhaust only and do not include fugitive PM emissions associated with operation of chipping-related equipment.

Emission Factors for Off Road Equipment

Select Output Data from OFFROAD2007 Model Run

Equipment	MaxHP	Population	Activity	Consumption	NOX Exhaust	ROG Exhaust	PM Exhaust	CO Exhaust	SO2 Exhaust	CO2 Exhaust	N2O Exhaust	CH4 Exhaust
Units	hp	#	equip-hr/day	gal/day (diesel)	ton/day	ton/day	ton/day	ton/day	ton/day	ton/day	ton/day	ton/day
Excavators	250	2.32E-01	1.03E+00	7.39E+00	5.20E-04	6.07E-05	1.72E-05	1.79E-04	9.17E-07	8.15E-02	0.00E+00	5.47E-06
Rubber Tired Loaders	250	3.24E-01	9.85E-01	6.65E+00	5.41E-04	5.84E-05	1.85E-05	1.75E-04	8.25E-07	7.33E-02	0.00E+00	5.27E-06
Chippers/Stump Grinders	750	3.04E-02	4.24E-02	1.14E+00	8.01E-05	6.76E-06	2.46E-06	2.61E-05	1.27E-07	1.26E-02	0.00E+00	6.10E-07
Shredders	175	1.23E-03	4.59E-04	1.47E-03	1.33E-07	1.30E-08	5.63E-09	7.97E-08	1.81E-10	1.61E-05	0.00E+00	1.17E-09

	value	units	source
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions

Exhaust Emission Factors

	NOx	ROG	PM_{10}	$PM_{2.5}$	CO	CO2	CH4	units	source
Excavators	1.01	0.12	0.03	0.03	0.35	158.54	0.01	lb/hr	calculation and conversion
Rubber Tired Loaders	1.10	0.12	0.04	0.04	0.35	148.84	0.01	lb/hr	calculation and conversion
Chippers/Stump Grinders	3.78	0.32	0.12	0.12	1.23	594.49	0.03	lb/hr	calculation and conversion
Shredders	0.58	0.06	0.02	0.02	0.35	70.16	0.01	lb/hr	calculation and conversion

Output from OFFROAD2007 Model

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	Population	Activity	Consumpti	ROG Exhau	CO Exhaus	NOX Exhau	CO2 Exhau	SO2 Exhau	PM Exhaus	N2O Exhau	CH4 Exhaus
2014	Summer	Mon-Fri	2.27E+09	Pavers	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	5.00E-02	1.30E-01	7.60E-01	1.10E-05	5.02E-05	8.50E-05	8.32E-03	9.36E-08	4.69E-06	0.00E+00	9.95E-07
2014	Summer	Mon-Fri	2.27E+09	Pavers	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.02E-03	1.56E-02	1.38E-01	1.53E-06	4.54E-06	1.42E-05	1.52E-03	1.71E-08	5.44E-07	0.00E+00	1.38E-07
2014	Summer	Mon-Fri	2.27E+09	Pavers	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.18E-03	1.60E-02	1.70E-01	1.73E-06	6.91E-06	1.57E-05	1.87E-03	1.84E-08	6.05E-07	0.00E+00	1.57E-07
2014	Summer	Mon-Fri	2.27E+09	Rollers	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.33E-01	2.91E-01	1.43E+00	1.72E-05	8.98E-05	1.39E-04	1.57E-02	1.77E-07	7.43E-06	0.00E+00	1.55E-06
2014	Summer	Mon-Fri	2.27E+09	Rollers	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.88E-02	4.12E-02	2.86E-01	2.43E-06	7.65E-06	2.48E-05	3.15E-03	3.55E-08	8.40E-07	0.00E+00	2.20E-07
2014	Summer	Mon-Fri	2.27E+09	Rollers	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.32E-02	2.89E-02	2.87E-01	2.25E-06	8.55E-06	2.22E-05	3.16E-03	3.11E-08	7.76E-07	0.00E+00	2.03E-07
2014	Summer	Mon-Fri	2.27E+09	Scrapers	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	2.79E-02	9.68E-02	6.54E-01	9.57E-06	4.38E-05	7.15E-05	7.16E-03	8.05E-08	4.00E-06	0.00E+00	8.63E-07
2014	Summer	Mon-Fri	2.27E+09	Scrapers	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.72E-02	9.43E-02	8.97E-01	1.01E-05	2.89E-05	8.94E-05	9.87E-03	1.11E-07	3.42E-06	0.00E+00	9.08E-07
2014	Summer	Mon-Fri	2.27E+09	Scrapers	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	7.49E-02	2.60E-01	3.79E+00	3.93E-05	1.47E-04	3.39E-04	4.17E-02	4.09E-07	1.31E-05	0.00E+00	3.55E-06
2014	Summer	Mon-Fri	2.27E+09	Scrapers	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.38E-01	1.17E+00	2.95E+01	3.08E-04	1.14E-03	2.70E-03	3.25E-01	3.27E-06	1.03E-04	0.00E+00	2.78E-05
2014	Summer	Mon-Fri	2.27E+09	Paving Equ	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.16E-02	3.04E-02	1.40E-01	2.01E-06	9.18E-06	1.56E-05	1.53E-03	1.73E-08	8.60E-07	0.00E+00	1.82E-07
2014	Summer	Mon-Fri	2.27E+09	Paving Equ	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.28E-03	8.56E-03	4.75E-02	5.16E-07	1.54E-06	4.86E-06	5.23E-04	5.89E-09	1.84E-07	0.00E+00	4.66E-08
2014	Summer	Mon-Fri	2.27E+09	Surfacing E	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	2.35E-04	3.31E-04	1.29E-03	1.40E-08	7.80E-08	1.21E-07	1.42E-05	1.60E-10	6.02E-09	0.00E+00	1.26E-09
2014	Summer	Mon-Fri	2.27E+09	Surfacing E	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	4.69E-04	6.62E-04	4.04E-03	3.16E-08	1.07E-07	3.39E-07	4.46E-05	5.02E-10	1.13E-08	0.00E+00	2.85E-09
2014	Summer	Mon-Fri	2.27E+09	Surfacing E	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.91E-03	5.52E-03	5.53E-02	3.95E-07	1.67E-06	4.18E-06	6.10E-04	5.99E-09	1.42E-07	0.00E+00	3.56E-08
2014	Summer	Mon-Fri	2.27E+09	Surfacing E	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.46E-02	9.11E-02	1.43E+00	1.04E-05	4.33E-05	1.11E-04	1.58E-02	1.59E-07	3.73E-06	0.00E+00	9.38E-07
2014	Summer	Mon-Fri	2.27E+09	Signal Boar	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.11E-02	1.85E-02	1.30E-01	1.32E-06	7.70E-06	1.16E-05	1.43E-03	1.61E-08	5.78E-07	0.00E+00	1.19E-07
2014	Summer	Mon-Fri	2.27E+09	Signal Boar	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.35E-03	3.92E-03	4.52E-02	2.98E-07	1.02E-06	3.54E-06	4.99E-04	5.62E-09	1.03E-07	0.00E+00	2.69E-08
2014	Summer	Mon-Fri	2.27E+09	Trenchers	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	3.49E-02	6.86E-02	4.50E-01	6.41E-06	2.94E-05	5.07E-05	4.93E-03	5.55E-08	2.74E-06	0.00E+00	5.78E-07
2014	Summer	Mon-Fri	2.27E+09	Trenchers	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.13E-03	6.15E-03	6.22E-02	6.84E-07	2.08E-06	6.44E-06	6.85E-04	7.71E-09	2.50E-07	0.00E+00	6.17E-08
2014	Summer	Mon-Fri	2.27E+09	Trenchers	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.99E-03	7.84E-03	1.11E-01	1.11E-06	4.73E-06	1.04E-05	1.22E-03	1.20E-08	4.00E-07	0.00E+00	1.00E-07
2014	Summer	Mon-Fri	2.27E+09	Trenchers	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.29E-02	2.54E-02	6.77E-01	6.82E-06	2.89E-05	6.46E-05	7.44E-03	7.49E-08	2.47E-06	0.00E+00	6.15E-07
2014	Summer	Mon-Fri	2.27E+09	Bore/Drill I	D	175	Constructi	U	P	NHH	P	Placer	LT	PLA	7.27E-03	1.91E-02	1.23E-01	6.41E-07	7.20E-06	6.23E-06	1.35E-03	1.52E-08	2.35E-07	0.00E+00	5.78E-08
2014	Summer	Mon-Fri	2.27E+09	Bore/Drill I	D	250	Constructi	U	N	NHH	P	Placer	LT	PLA	6.25E-03	1.64E-02	1.40E-01	6.05E-07	2.81E-06	5.04E-06	1.54E-03	1.74E-08	1.47E-07	0.00E+00	5.46E-08
2014	Summer	Mon-Fri	2.27E+09	Bore/Drill I	D	500	Constructi	U	N	NHH	P	Placer	LT	PLA	1.39E-02	3.66E-02	5.14E-01	2.20E-06	1.01E-05	1.74E-05	5.69E-03	5.58E-08	5.36E-07	0.00E+00	1.99E-07
2014	Summer	Mon-Fri	2.27E+09	Bore/Drill I	D	750	Constructi	U	N	NHH	P	Placer	LT	PLA	2.00E-01	5.26E-01	1.46E+01	6.27E-05	2.86E-04	4.99E-04	1.62E-01	1.63E-06	1.53E-05	0.00E+00	5.66E-06
2014	Summer	Mon-Fri	2.27E+09	Bore/Drill I	D	1000	Constructi	U	N	NHH	P	Placer	LT	PLA	3.36E-01	5.97E-01	2.51E+01	1.16E-04	4.95E-04	1.61E-03	2.77E-01	2.78E-06	4.21E-05	0.00E+00	1.05E-05
2014	Summer	Mon-Fri	2.27E+09	Excavators	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	5.71E-01	2.53E+00	1.29E+01	1.44E-04	8.41E-04	1.05E-03	1.42E-01	1.59E-06	5.80E-05	0.00E+00	1.30E-05
2014	Summer	Mon-Fri	2.27E+09	Excavators	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.32E-01	1.03E+00	7.39E+00	6.07E-05	1.79E-04	5.20E-04	8.15E-02	9.17E-07	1.72E-05	0.00E+00	5.47E-06
2014	Summer	Mon-Fri	2.27E+09	Excavators	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.67E-01	7.42E-01	7.85E+00	6.14E-05	1.89E-04	4.87E-04	8.66E-02	8.50E-07	1.72E-05	0.00E+00	5.54E-06
2014	Summer	Mon-Fri	2.27E+09	Excavators	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.01E-01	4.48E-01	7.86E+00	6.19E-05	1.89E-04	5.04E-04	8.67E-02	8.72E-07	1.75E-05	0.00E+00	5.58E-06
2014	Summer	Mon-Fri	2.27E+09	Concrete/I	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.56E-04	2.83E-04	2.06E-03	2.07E-08	1.23E-07	1.81E-07	2.26E-05	2.55E-10	9.16E-09	0.00E+00	1.87E-09
2014	Summer	Mon-Fri	2.27E+09	Cranes	D	175	Constructi	U	P	NHH	P	Placer	LT	PLA	2.92E-02	1.16E-01	4.27E-01	5.70E-06	2.80E-05	4.26E-05	4.67E-03	5.26E-08	2.40E-06	0.00E+00	5.15E-07
2014	Summer	Mon-Fri	2.27E+09	Cranes	D	250	Constructi	U	N	NHH	P	Placer	LT	PLA	5.65E-02	2.26E-01	1.15E+00	1.11E-05	3.17E-05	1.03E-04	1.26E-02	1.42E-07	3.57E-06	0.00E+00	9.97E-07
2014	Summer	Mon-Fri	2.27E+09	Cranes	D	500	Constructi	U	N	NHH	P	Placer	LT	PLA	2.07E-02	8.27E-02	6.76E-01	6.07E-06	2.04E-05	5.37E-05	7.44E-03	7.31E-08	1.94E-06	0.00E+00	5.47E-07
2014	Summer	Mon-Fri	2.27E+09	Cranes	D	750	Constructi	U	N	NHH	P	Placer	LT	PLA	4.20E-01	1.68E+00	2.30E+01	2.08E-04	6.96E-04	1.88E-03	2.54E-01	2.55E-06	6.72E-05	0.00E+00	1.88E-05
2014	Summer	Mon-Fri	2.27E+09	Cranes	D	9999	Constructi	U	N	NHH	P	Placer	LT	PLA	5.27E-01	1.43E+00	6.28E+01	6.49E-04	2.21E-03	6.98E-03	6.91E-01	6.95E-06	2.14E-04	0.00E+00	5.86E-05
2014	Summer	Mon-Fri	2.27E+09	Graders	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	2.49E-01	7.39E-01	4.18E+00	5.14E-05	2.71E-04	3.89E-04	4.58E-02	5.15E-07	2.14E-05	0.00E+00	4.64E-06
2014	Summer	Mon-Fri	2.27E+09	Graders	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.55E-01	4.59E-01	3.58E+00	3.23E-05	9.57E-05	2.95E-04	3.95E-02	4.44E-07	1.02E-05	0.00E+00	2.91E-06
2014	Summer	Mon-Fri	2.27E+09	Graders	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	4.38E-03	1.30E-02	1.35E-01	1.14E-06	3.88E-06	9.90E-06	1.49E-03	1.46E-08	3.56E-07	0.00E+00	1.03E-07
2014	Summer	Mon-Fri	2.27E+09	Graders	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.46E-03	1.91E-02	4.21E-01	3.58E-06	1.21E-05	3.18E-05	4.64E-03	4.67E-08	1.13E-06	0.00E+00	3.23E-07
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	5.08E-03	3.15E-02	1.80E-01	2.14E-06	1.19E-05	1.52E-05	1.97E-03	2.21E-08	8.51E-07	0.00E+00	1.93E-07
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.75E-02	2.33E-01	1.75E+00	1.54E-05	4.37E-05	1.29E-04	1.93E-02	2.18E-07	4.29E-06	0.00E+00	1.39E-06
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	5.28E-02	3.28E-01	4.04E+00	3.38E-05	1.00E-04	2.61E-04	4.46E-02	4.37E-07	9.29E-06	0.00E+00	3.05E-06
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.35E+00	8.39E+00	1.68E+02	1.41E-03	4.17E-03	1.12E-02	1.85E+00	1.86E-05	3.93E-04	0.00E+00	1.27E-04
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	1000	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.35E-01	2.66E+00	7.54E+01	6.90E-04	2.08E-03	7.43E-03	8.31E-01	8.36E-06	2.21E-04	0.00E+00	6.23E-05
2014	Summer	Mon-Fri	2.27E+09	Crushing/P	D	175	Constructi	U	P	NHH	P	Placer	LT	PLA	1.49E-02	4.45E-02	3.39E-01	4.02E-06	2.13E-05	3.16E-05	3.72E-03	4.18E-08	1.75E-06	0.00E+00	3.63E-07
2014	Summer	Mon-Fri	2.27E+09	Crushing/P	D	250	Constructi	U	N	NHH	P	Placer	LT	PLA	1.49E-03	4.43E-03	4.90E-02	3.86E-07	1.17E-06	4.05E-06	5.41E-04	6.08E-09	1.24E-07	0.00E+00	3.49E-08
2014	Summer	Mon-Fri	2.27E+09	Crushing/P	D	500	Constructi	U	N	NHH	P	Placer	LT	PLA	8.36E-03	2.49E-02	4.22E-01	3.09E-06	1.01E-05	3.04E-05	4.65E-03	4.57E-08	9.98E-07	0.00E+00	2.79E-07
2014	Summer	Mon-Fri	2.27E+09	Crushing/P	D	750	Constructi	U	N	NHH	P	Placer	LT	PLA	1.08E-02	3.21E-02	8.54E-01	6.29E-06	2.02E-05	6.39E-05	9.43E-03	9.48E-08	2.05E-06	0.00E+00	5.68E-07

2014	Summer	Mon-Fri	2.27E+09	Crushing/P	D	9999	Constructi	U	N	NHH	P	Placer	LT	PLA	1.08E-02	3.21E-02	1.90E+00	1.68E-05	5.38E-05	1.99E-04	2.09E-02	2.11E-07	5.72E-06	0.00E+00	1.52E-06
2014	Summer	Mon-Fri	2.27E+09	Rough Terr	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	5.32E-02	1.88E-01	1.07E+00	1.19E-05	6.81E-05	9.19E-05	1.17E-02	1.32E-07	5.04E-06	0.00E+00	1.08E-06
2014	Summer	Mon-Fri	2.27E+09	Rough Terr	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.97E-03	1.05E-02	8.11E-02	6.46E-07	1.95E-06	6.12E-06	8.95E-04	1.01E-08	1.97E-07	0.00E+00	5.83E-08
2014	Summer	Mon-Fri	2.27E+09	Rough Terr	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.95E-03	6.90E-03	8.01E-02	6.02E-07	1.90E-06	5.29E-06	8.85E-04	8.68E-09	1.83E-07	0.00E+00	5.43E-08
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	3.26E-01	9.91E-01	4.80E+00	5.81E-05	3.10E-04	4.43E-04	5.26E-02	5.92E-07	2.43E-05	0.00E+00	5.24E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.24E-01	9.85E-01	6.65E+00	5.84E-05	1.75E-04	5.41E-04	7.33E-02	8.25E-07	1.85E-05	0.00E+00	5.27E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.35E-01	4.10E-01	4.40E+00	3.63E-05	1.24E-04	3.18E-04	4.85E-02	4.77E-07	1.13E-05	0.00E+00	3.27E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.60E-01	7.92E-01	1.74E+01	1.44E-04	4.92E-04	1.29E-03	1.92E-01	1.93E-06	4.56E-05	0.00E+00	1.30E-05
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	1000	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.80E-02	5.76E-02	1.55E+00	1.42E-05	4.99E-05	1.62E-04	1.71E-02	1.72E-07	4.85E-06	0.00E+00	1.28E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	7.82E-04	3.97E-03	2.35E-02	4.04E-07	1.66E-06	2.95E-06	2.57E-04	2.89E-09	1.67E-07	0.00E+00	3.65E-08
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.92E-02	9.72E-02	8.11E-01	1.13E-05	3.18E-05	9.49E-05	8.91E-03	1.00E-07	3.98E-06	0.00E+00	1.02E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.95E-02	1.50E-01	1.81E+00	2.29E-05	9.91E-05	1.91E-04	1.98E-02	1.94E-07	7.89E-06	0.00E+00	2.07E-06
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	2.86E-01	1.45E+00	2.64E+01	3.36E-04	1.45E-03	2.84E-03	2.89E-01	2.91E-06	1.16E-04	0.00E+00	3.03E-05
2014	Summer	Mon-Fri	2.27E+09	Rubber Tir	D	1000	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.94E-02	6.65E-02	1.80E+00	2.39E-05	1.07E-04	2.37E-04	1.97E-02	1.98E-07	8.17E-06	0.00E+00	2.16E-06
2014	Summer	Mon-Fri	2.27E+09	Tractors/Lo	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.31E-01	3.96E-01	1.83E+00	1.84E-05	1.16E-04	1.42E-04	2.00E-02	2.26E-07	7.55E-06	0.00E+00	1.66E-06
2014	Summer	Mon-Fri	2.27E+09	Tractors/Lo	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	4.25E-02	1.28E-01	9.95E-01	7.31E-06	2.31E-05	6.61E-05	1.10E-02	1.24E-07	2.12E-06	0.00E+00	6.60E-07
2014	Summer	Mon-Fri	2.27E+09	Tractors/Lo	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	6.86E-02	2.07E-01	3.22E+00	2.26E-05	7.48E-05	1.89E-04	3.56E-02	4.01E-07	6.48E-06	0.00E+00	2.04E-06
2014	Summer	Mon-Fri	2.27E+09	Tractors/Lo	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.30E+00	3.92E+00	9.17E+01	6.47E-04	2.13E-03	5.54E-03	1.01E+00	1.14E-05	1.88E-04	0.00E+00	5.84E-05
2014	Summer	Mon-Fri	2.27E+09	Crawler Tra	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	2.10E-01	6.85E-01	3.79E+00	5.48E-05	2.54E-04	4.07E-04	4.15E-02	4.67E-07	2.28E-05	0.00E+00	4.94E-06
2014	Summer	Mon-Fri	2.27E+09	Crawler Tra	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.81E-01	5.89E-01	4.44E+00	4.92E-05	1.41E-04	4.34E-04	4.89E-02	5.50E-07	1.65E-05	0.00E+00	4.44E-06
2014	Summer	Mon-Fri	2.27E+09	Crawler Tra	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.24E-01	4.04E-01	4.75E+00	4.88E-05	1.79E-04	4.17E-04	5.23E-02	5.13E-07	1.61E-05	0.00E+00	4.40E-06
2014	Summer	Mon-Fri	2.27E+09	Crawler Tra	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.72E-01	5.62E-01	1.18E+01	1.22E-04	4.46E-04	1.06E-03	1.30E-01	1.31E-06	4.06E-05	0.00E+00	1.10E-05
2014	Summer	Mon-Fri	2.27E+09	Crawler Tra	D	1000	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.72E-01	3.80E-01	1.14E+01	1.25E-04	4.78E-04	1.33E-03	1.25E-01	1.26E-06	4.23E-05	0.00E+00	1.13E-05
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	9.56E-02	3.33E-01	1.98E+00	3.27E-05	1.38E-04	2.43E-04	2.17E-02	2.44E-07	1.37E-05	0.00E+00	2.95E-06
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	250	Constructi	U	N	NHH	NP	Placer	LT	PLA	9.04E-02	3.15E-01	1.86E+00	2.46E-05	7.05E-05	2.13E-04	2.05E-02	2.31E-07	8.78E-06	0.00E+00	2.22E-06
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	750	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.08E+00	3.76E+00	9.73E+01	1.17E-03	5.05E-03	1.02E-02	1.07E+00	1.07E-05	4.13E-04	0.00E+00	1.06E-04
2014	Summer	Mon-Fri	2.27E+09	Off-Highwa	D	1000	Constructi	U	N	NHH	NP	Placer	LT	PLA	1.14E-01	2.69E-01	9.97E+00	1.26E-04	5.65E-04	1.29E-03	1.09E-01	1.10E-06	4.37E-05	0.00E+00	1.14E-05
2014	Summer	Mon-Fri	2.27E+09	Other Cons	D	175	Constructi	U	P	NHH	NP	Placer	LT	PLA	1.53E-02	3.35E-02	1.63E-01	1.46E-06	9.83E-06	1.26E-05	1.78E-03	2.01E-08	6.30E-07	0.00E+00	1.32E-07
2014	Summer	Mon-Fri	2.27E+09	Other Cons	D	500	Constructi	U	N	NHH	NP	Placer	LT	PLA	3.56E-02	7.78E-02	8.95E-01	5.37E-06	1.97E-05	5.24E-05	9.88E-03	9.70E-08	1.71E-06	0.00E+00	4.84E-07
2014	Summer	Mon-Fri	2.27E+09	Aerial Lifts	D	500	Industrial E	U	N	NHH	NP	Placer	LT	PLA	2.81E-01	3.36E-01	3.24E+00	1.86E-05	7.37E-05	2.35E-04	3.58E-02	3.51E-07	7.13E-06	0.00E+00	1.68E-06
2014	Summer	Mon-Fri	2.27E+09	Aerial Lifts	D	750	Industrial E	U	N	NHH	NP	Placer	LT	PLA	2.26E-02	2.71E-02	4.71E-01	2.80E-06	1.07E-05	3.54E-05	5.20E-03	5.23E-08	1.06E-06	0.00E+00	2.52E-07
2014	Summer	Mon-Fri	2.27E+09	Forklifts	D	175	Industrial E	U	P	NHH	NP	Placer	LT	PLA	1.18E+00	6.63E+00	1.70E+01	1.78E-04	1.11E-03	1.30E-03	1.86E-01	2.09E-06	7.38E-05	0.00E+00	1.60E-05
2014	Summer	Mon-Fri	2.27E+09	Forklifts	D	250	Industrial E	U	N	NHH	NP	Placer	LT	PLA	1.17E+00	6.58E+00	2.30E+01	1.86E-04	5.28E-04	1.57E-03	2.54E-01	2.85E-06	5.26E-05	0.00E+00	1.68E-05
2014	Summer	Mon-Fri	2.27E+09	Forklifts	D	500	Industrial E	U	N	NHH	NP	Placer	LT	PLA	5.02E-01	2.82E+00	1.42E+01	1.11E-04	3.09E-04	8.47E-04	1.56E-01	1.53E-06	3.12E-05	0.00E+00	9.98E-06
2014	Summer	Mon-Fri	2.27E+09	Sweepers/S	D	175	Industrial E	U	N	NHH	NP	Placer	LT	PLA	8.16E-01	3.11E+00	1.97E+01	2.09E-04	1.25E-03	1.61E-03	2.16E-01	2.43E-06	9.04E-05	0.00E+00	1.88E-05
2014	Summer	Mon-Fri	2.27E+09	Sweepers/S	D	250	Industrial E	U	N	NHH	NP	Placer	LT	PLA	1.31E-01	4.97E-01	3.65E+00	2.81E-05	8.30E-05	2.67E-04	4.02E-02	4.53E-07	8.60E-06	0.00E+00	2.53E-06
2014	Summer	Mon-Fri	2.27E+09	Other Gen	D	175	Industrial E	U	N	NHH	NP	Placer	LT	PLA	9.61E-01	4.27E+00	1.87E+01	2.53E-04	1.23E-03	1.86E-03	2.05E-01	2.30E-06	1.09E-04	0.00E+00	2.29E-05
2014	Summer	Mon-Fri	2.27E+09	Other Gen	D	250	Industrial E	U	N	NHH	NP	Placer	LT	PLA	9.57E-01	4.26E+00	2.61E+01	2.44E-04	6.56E-04	2.37E-03	2.88E-01	3.24E-06	7.69E-05	0.00E+00	2.20E-05
2014	Summer	Mon-Fri	2.27E+09	Other Gen	D	500	Industrial E	U	N	NHH	NP	Placer	LT	PLA	9.55E-01	4.25E+00	5.11E+01	4.46E-04	1.28E-03	4.01E-03	5.63E-01	5.53E-06	1.40E-04	0.00E+00	4.02E-05
2014	Summer	Mon-Fri	2.27E+09	Other Gen	D	750	Industrial E	U	N	NHH	NP	Placer	LT	PLA	2.39E-01	1.06E+00	2.10E+01	1.85E-04	5.26E-04	1.71E-03	2.32E-01	2.33E-06	5.90E-05	0.00E+00	1.67E-05
2014	Summer	Mon-Fri	2.27E+09	Other Gen	D	1000	Industrial E	U	N	NHH	NP	Placer	LT	PLA	1.45E-01	4.37E-01	1.11E+01	1.10E-04	3.27E-04	1.26E-03	1.22E-01	1.23E-06	3.72E-05	0.00E+00	9.88E-06
2014	Summer	Mon-Fri	2.27E+09	Other Mat	D	175	Industrial E	U	N	NHH	NP	Placer	LT	PLA	4.42E-02	1.82E-01	1.01E+00	1.36E-05	6.62E-05	1.00E-04	1.11E-02	1.25E-07	5.87E-06	0.00E+00	1.22E-06
2014	Summer	Mon-Fri	2.27E+09	Other Mat	D	250	Industrial E	U	N	NHH	NP	Placer	LT	PLA	1.05E-01	4.32E-01	2.84E+00	2.61E-05	7.09E-05	2.57E-04	3.13E-02	3.52E-07	8.30E-06	0.00E+00	2.35E-06
2014	Summer	Mon-Fri	2.27E+09	Other Mat	D	500	Industrial E	U	N	NHH	NP	Placer	LT	PLA	1.96E-02	8.08E-02	7.01E-01	6.03E-06	1.75E-05	5.49E-05	7.73E-03	7.59E-08	1.91E-06	0.00E+00	5.44E-07
2014	Summer	Mon-Fri	2.27E+09	Other Mat	D	9999	Industrial E	U	N	NHH	NP	Placer	LT	PLA	5.89E-03	2.42E-02	8.14E-01	8.12E-06	2.39E-05	9.22E-05	8.97E-03	8.81E-08	2.71E-06	0.00E+00	7.32E-07
2014	Summer	Mon-Fri	2.27E+09	Leaf Blowe	D	250	Lawn and (	U	N	NHH	P	Placer	LT	PLA	1.45E-03	5.21E-04	2.36E-03	1.13E-08	4.90E-08	1.67E-07	2.61E-05	2.94E-10	4.31E-09	0.00E+00	1.02E-09
2014	Summer	Mon-Fri	2.27E+09	Snowblow	D	175	Lawn and (	U	P	NHH	P	Placer	LT	PLA	5.61E-03	2.38E-04	1.44E-03	1.29E-08	8.24E-08	1.21E-07	1.58E-05	1.78E-10	5.71E-09	0.00E+00	1.17E-09
2014	Summer	Mon-Fri	2.27E+09	Snowblow	D	250	Lawn and (	U	N	NHH	P	Placer	LT	PLA	9.54E-02	4.04E-03	3.70E-02	2.24E-07	8.25E-07	2.76E-06	4.08E-04	4.59E-09	8.04E-08	0.00E+00	2.02E-08
2014	Summer	Mon-Fri	2.27E+09	Snowblow	D	500	Lawn and (	U	N	NHH	P	Placer	LT	PLA	2.86E-01	1.21E-02	1.64E-01	9.09E-07	3.66E-06	1.10E-05	1.81E-03	1.78E-08	3.36E-07	0.00E+00	8.20E-08
2014	Summer	Mon-Fri	2.27E+09	Chippers/S	D	175	Lawn and (	U	P	NHH	P	Placer	LT	PLA	1.23E-02	1.72E-02	1.03E-01	9.67E-07	6.00E-06	8.86E-06	1.13E-03	1.27E-08	4.29E-07	0.00E+00	8.73E-08
2014	Summer	Mon-Fri	2.27E+09	Chippers/S	D	250	Lawn and (	U	N	NHH	P	Placer	LT	PLA	2.89E-03	4.04E-03	4.07E-02	2.58E-07	9.19E-07	3.11E-06	4.49E-04	5.05E-09	9.21E-08	0.00E+00	2.33E-08
2014	Summer	Mon-Fri	2.27E+09	Chippers/S	D	500	Lawn and (	U	N	NHH	P	Placer	LT	PLA	2.67E-02	3.74E-02	4.18E-01	2.41E-06	9.57E-06	2.83E-05	4.62E-03	4.53E-08	8.83E-07	0.00E+00	2.17E-07
2014	Summer	Mon-Fri	2.27E+09	Chippers/S	D	750	Lawn and (	U	N	NHH	P	Placer	LT	PLA	3.04E-02	4.24E-02	1.14E+00	6.76E-06	2.61E-05	8.01E-05	1.26E-02	1.27E-07	2.46E-06	0.00E+00	6.10E-07

2014	Summer	Mon-Fri	2.27E+09	Chippers/S	D	1000	Lawn and (	U	N	NHH	P	Placer	LT	PLA	5.78E-02	6.37E-02	2.44E+00	1.79E-05	6.42E-05	2.43E-04	2.70E-02	2.71E-07	6.54E-06	0.00E+00	1.62E-06
2014	Summer	Mon-Fri	2.27E+09	Generator	D	175	Light Comr	U	N	NHH	P	Placer	LT	PLA	2.30E-01	1.84E-01	1.19E+00	1.13E-05	6.79E-05	1.06E-04	1.31E-02	1.47E-07	5.05E-06	0.00E+00	1.02E-06
2014	Summer	Mon-Fri	2.27E+09	Generator	D	250	Light Comr	U	N	NHH	P	Placer	LT	PLA	1.28E-01	1.03E-01	9.89E-01	6.11E-06	2.17E-05	8.02E-05	1.09E-02	1.23E-07	2.26E-06	0.00E+00	5.51E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	500	Light Comr	U	N	NHH	P	Placer	LT	PLA	2.86E-01	2.29E-01	3.49E+00	1.93E-05	7.81E-05	2.51E-04	3.85E-02	3.78E-07	7.49E-06	0.00E+00	1.74E-06
2014	Summer	Mon-Fri	2.27E+09	Generator	D	750	Light Comr	U	N	NHH	P	Placer	LT	PLA	1.78E-01	1.42E-01	3.50E+00	2.01E-05	7.83E-05	2.61E-04	3.86E-02	3.88E-07	7.67E-06	0.00E+00	1.81E-06
2014	Summer	Mon-Fri	2.27E+09	Generator	D	9999	Light Comr	U	N	NHH	P	Placer	LT	PLA	4.62E-02	3.70E-02	1.76E+00	1.34E-05	4.65E-05	1.82E-04	1.94E-02	1.95E-07	4.84E-06	0.00E+00	1.21E-06
2014	Summer	Mon-Fri	2.27E+09	Pumps	D	175	Light Comr	U	P	NHH	P	Placer	LT	PLA	2.38E-01	2.27E-01	1.45E+00	1.44E-05	8.39E-05	1.31E-04	1.59E-02	1.79E-07	6.44E-06	0.00E+00	1.30E-06
2014	Summer	Mon-Fri	2.27E+09	Pumps	D	250	Light Comr	U	N	NHH	P	Placer	LT	PLA	1.71E-01	1.64E-01	1.49E+00	9.68E-06	3.32E-05	1.23E-04	1.65E-02	1.85E-07	3.54E-06	0.00E+00	8.73E-07
2014	Summer	Mon-Fri	2.27E+09	Pumps	D	500	Light Comr	U	N	NHH	P	Placer	LT	PLA	3.38E-03	3.23E-03	5.04E-02	2.95E-07	1.15E-06	3.68E-06	5.57E-04	5.47E-09	1.12E-07	0.00E+00	2.66E-08
2014	Summer	Mon-Fri	2.27E+09	Pumps	D	750	Light Comr	U	N	NHH	P	Placer	LT	PLA	5.64E-04	5.38E-04	1.39E-02	8.38E-08	3.18E-07	1.05E-06	1.53E-04	1.54E-09	3.16E-08	0.00E+00	7.56E-09
2014	Summer	Mon-Fri	2.27E+09	Pumps	D	9999	Light Comr	U	N	NHH	P	Placer	LT	PLA	1.24E-02	1.18E-02	7.27E-01	5.72E-06	1.96E-05	7.59E-05	8.02E-03	8.06E-08	2.04E-06	0.00E+00	5.16E-07
2014	Summer	Mon-Fri	2.27E+09	Air Compre	D	175	Light Comr	U	P	NHH	P	Placer	LT	PLA	1.33E-01	2.57E-01	1.04E+00	1.27E-05	6.49E-05	1.01E-04	1.14E-02	1.28E-07	5.64E-06	0.00E+00	1.14E-06
2014	Summer	Mon-Fri	2.27E+09	Air Compre	D	250	Light Comr	U	N	NHH	P	Placer	LT	PLA	1.87E-01	3.61E-01	2.15E+00	1.74E-05	5.16E-05	1.90E-04	2.37E-02	2.67E-07	5.93E-06	0.00E+00	1.57E-06
2014	Summer	Mon-Fri	2.27E+09	Air Compre	D	500	Light Comr	U	N	NHH	P	Placer	LT	PLA	2.44E-01	4.71E-01	4.94E+00	3.71E-05	1.20E-04	3.81E-04	5.46E-02	5.36E-07	1.28E-05	0.00E+00	3.34E-06
2014	Summer	Mon-Fri	2.27E+09	Air Compre	D	750	Light Comr	U	N	NHH	P	Placer	LT	PLA	9.13E-02	1.76E-01	2.86E+00	2.17E-05	6.92E-05	2.28E-04	3.16E-02	3.17E-07	7.53E-06	0.00E+00	1.96E-06
2014	Summer	Mon-Fri	2.27E+09	Air Compre	D	1000	Light Comr	U	N	NHH	P	Placer	LT	PLA	2.25E-03	4.35E-03	9.60E-02	8.54E-07	2.76E-06	1.06E-05	1.06E-03	1.06E-08	3.01E-07	0.00E+00	7.71E-08
2014	Summer	Mon-Fri	2.27E+09	Welders	D	175	Light Comr	U	P	NHH	P	Placer	LT	PLA	1.01E-02	1.55E-02	6.92E-02	7.88E-07	4.21E-06	6.56E-06	7.58E-04	8.53E-09	3.52E-07	0.00E+00	7.11E-08
2014	Summer	Mon-Fri	2.27E+09	Welders	D	250	Light Comr	U	N	NHH	P	Placer	LT	PLA	2.25E-03	3.44E-03	1.85E-02	1.39E-07	4.34E-07	1.60E-06	2.04E-04	2.30E-09	4.88E-08	0.00E+00	1.26E-08
2014	Summer	Mon-Fri	2.27E+09	Welders	D	500	Light Comr	U	N	NHH	P	Placer	LT	PLA	5.64E-03	8.59E-03	6.51E-02	4.47E-07	1.55E-06	4.93E-06	7.19E-04	7.06E-09	1.60E-07	0.00E+00	4.04E-08
2014	Summer	Mon-Fri	2.27E+09	Shredders	D	175	Logging Eq	U	P	NHH	NP	Placer	LT	PLA	1.23E-03	4.59E-04	1.47E-03	1.30E-08	7.97E-08	1.33E-07	1.61E-05	1.81E-10	5.63E-09	0.00E+00	1.17E-09
2014	Summer	Mon-Fri	2.27E+09	Skidders	D	175	Logging Eq	U	P	NHH	NP	Placer	LT	PLA	5.33E-01	2.40E+00	1.53E+01	1.30E-04	9.69E-04	1.01E-03	1.68E-01	1.89E-06	5.41E-05	0.00E+00	1.18E-05
2014	Summer	Mon-Fri	2.27E+09	Skidders	D	250	Logging Eq	U	N	NHH	NP	Placer	LT	PLA	1.96E-01	8.82E-01	8.40E+00	5.75E-05	1.83E-04	4.78E-04	9.28E-02	1.04E-06	1.60E-05	0.00E+00	5.18E-06
2014	Summer	Mon-Fri	2.27E+09	Skidders	D	500	Logging Eq	U	N	NHH	NP	Placer	LT	PLA	1.10E-02	4.96E-02	5.62E-01	3.76E-06	1.17E-05	2.83E-05	6.21E-03	6.09E-08	1.05E-06	0.00E+00	3.39E-07
2014	Summer	Mon-Fri	2.27E+09	Fellers/Bur	D	175	Logging Eq	U	P	NHH	NP	Placer	LT	PLA	8.95E-01	3.57E+00	2.20E+01	1.79E-04	1.37E-03	1.44E-03	2.41E-01	2.71E-06	7.58E-05	0.00E+00	1.62E-05
2014	Summer	Mon-Fri	2.27E+09	Fellers/Bur	D	250	Logging Eq	U	N	NHH	NP	Placer	LT	PLA	5.46E-01	2.18E+00	1.92E+01	1.25E-04	4.11E-04	1.08E-03	2.12E-01	2.38E-06	3.57E-05	0.00E+00	1.13E-05
2014	Summer	Mon-Fri	2.27E+09	Fellers/Bur	D	500	Logging Eq	U	N	NHH	NP	Placer	LT	PLA	1.60E-01	6.39E-01	8.46E+00	5.38E-05	1.74E-04	4.24E-04	9.35E-02	9.18E-07	1.54E-05	0.00E+00	4.85E-06
2014	Summer	Mon-Fri	2.27E+09	Fellers/Bur	D	750	Logging Eq	U	N	NHH	NP	Placer	LT	PLA	1.23E-02	4.88E-02	1.28E+00	8.17E-06	2.64E-05	6.54E-05	1.42E-02	1.42E-07	2.36E-06	0.00E+00	7.37E-07
2014	Summer	Mon-Fri	2.27E+09	Misc Porta	D	175	Other Port	U	P	NHH	P	Placer	LT	PLA	2.18E-01	2.51E-01	1.08E+00	1.11E-05	6.37E-05	9.84E-05	1.19E-02	1.33E-07	4.89E-06	0.00E+00	1.00E-06
2014	Summer	Mon-Fri	2.27E+09	Misc Porta	D	250	Other Port	U	N	NHH	P	Placer	LT	PLA	4.68E-02	5.37E-02	3.86E-01	2.69E-06	9.15E-06	3.15E-05	4.26E-03	4.79E-08	9.62E-07	0.00E+00	2.43E-07
2014	Summer	Mon-Fri	2.27E+09	Misc Porta	D	500	Other Port	U	N	NHH	P	Placer	LT	PLA	1.72E-01	1.97E-01	2.64E+00	1.67E-05	6.45E-05	1.92E-04	2.91E-02	2.86E-07	6.12E-06	0.00E+00	1.51E-06
2014	Summer	Mon-Fri	2.27E+09	Misc Porta	D	750	Other Port	U	N	NHH	P	Placer	LT	PLA	7.80E-02	8.95E-02	1.71E+00	1.11E-05	4.17E-05	1.28E-04	1.88E-02	1.89E-07	4.03E-06	0.00E+00	9.97E-07
2014	Summer	Mon-Fri	2.27E+09	Misc Porta	D	1000	Other Port	U	N	NHH	P	Placer	LT	PLA	3.12E-02	3.58E-02	9.11E-01	7.13E-06	2.57E-05	9.37E-05	1.00E-02	1.01E-07	2.57E-06	0.00E+00	6.43E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	175	Entertainm	U	N	NHH	P	Placer	LT	PLA	3.90E-02	2.78E-02	1.89E-01	1.76E-06	1.08E-05	1.66E-05	2.08E-03	2.34E-08	7.75E-07	0.00E+00	1.59E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	250	Entertainm	U	N	NHH	P	Placer	LT	PLA	6.01E-02	4.29E-02	3.84E-01	2.41E-06	8.78E-06	3.03E-05	4.24E-03	4.77E-08	8.79E-07	0.00E+00	2.18E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	500	Entertainm	U	N	NHH	P	Placer	LT	PLA	9.33E-02	6.66E-02	8.33E-01	4.72E-06	1.96E-05	5.89E-05	9.20E-03	9.03E-08	1.79E-06	0.00E+00	4.26E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	750	Entertainm	U	N	NHH	P	Placer	LT	PLA	1.64E-02	1.17E-02	2.87E-01	1.68E-06	6.74E-06	2.09E-05	3.17E-03	3.18E-08	6.25E-07	0.00E+00	1.51E-07
2014	Summer	Mon-Fri	2.27E+09	Generator	D	9999	Entertainm	U	N	NHH	P	Placer	LT	PLA	2.40E-03	1.72E-03	7.50E-02	5.68E-07	2.04E-06	7.53E-06	8.28E-04	8.32E-09	2.03E-07	0.00E+00	5.13E-08
2014	Summer	Mon-Fri	2.27E+09	Crane (Rail	D	175	Railyard O	U	P	NHH	P	Placer	LT	PLA	1.44E-03	1.03E-03	3.21E-03	2.99E-08	1.83E-07	2.82E-07	3.52E-05	3.96E-10	1.32E-08	0.00E+00	2.70E-09
2014	Summer	Mon-Fri	2.27E+09	Generator	D	175	Railyard O	U	P	NHH	P	Placer	LT	PLA	4.81E-04	3.43E-04	2.18E-03	2.03E-08	1.24E-07	1.91E-07	2.39E-05	2.69E-10	8.91E-09	0.00E+00	1.83E-09
2014	Summer	Mon-Fri	2.27E+09	Generator	D	9999	Railyard O	U	N	NHH	P	Placer	LT	PLA	4.81E-04	3.43E-04	1.37E-02	1.03E-07	3.71E-07	1.37E-06	1.51E-04	1.52E-09	3.70E-08	0.00E+00	9.34E-09
2014	Summer	Mon-Fri	2.28E+09	Vessels w/	D	250	Pleasure C	U	N	NHH	NP	Placer	LT	PLA	2.74E+01	9.10E+00	4.54E+01	2.68E-03	4.03E-03	9.17E-03	4.87E-01	5.48E-06	2.35E-04	0.00E+00	2.42E-04

GHGs Associated with Water Consumption

	gasification alternatives	direct combustion alternative	units	sources/notes
water consumption	14,400	23,040	gal/day	wksht: Operational Parameters
days of operation per year	365	365	days/year	wksht: Operational Parameters
annual water consumption	126,144,000	201,830,400	gal/year	calculation
annual water consumption	126	202	MG/year	conversion calculation
Annual electricity consumption	342,418	547,869	kW-hr/year	calculation
Annual electricity consumption	342	548	MW-hr	conversion calculation
CO_2-e Emissions, annual	222	355	MT/year	calculation

Calculation Inputs

	value	units	source
time conversion rate	24	hr/day	wksht: Unit Conversions
volume conversion rate	1,000,000	gal/MG	wksht: Unit Conversions
depth of well(s)	610	feet	Source 2, p. 3-1
electricity consumption rate	4.45	kW-hr/MG/foot (depth)	Source 1, p. 40
electricity conversion rate	1,000	kW-hr/MW-hr	wksht: Unit Conversions
local electric utility	Sierra Pacific Power	none	assumption based on recent merger activity
GHG Emission Rates			
CO_2	1,422.78	lb/MW-hr	Source 3; See Note 1
CH_4	0.029	lb/MW-hr	Source 3; See Note 1
N_2O	0.011	lb/MW-hr	Source 3; See Note 1
Global warming potential			
CH_4	21	unitless	wksht: Unit Conversions
N_2O	310	unitless	wksht: Unit Conversions
CO_2-e emission factor	1,426.80	lb/MW-hr	composite calculation
mass conversion rate	2,204.62	lb/MT	wksht: Unit Conversions

Notes

1 These are the default GHG emission rates associated with the consumption of electricity produced by Sierra Pacific Power Company, as provided by CalEEMod (listed below). Sierra Pacific's generation and distribution assets are now owned and operated by California Pacific Electric Company (CalPeco).

Source

1 California Energy Commission. 2006 (December). Refining Estimates of Water-Related Energy Use in California. Sacramento, CA. CEC-500-2006-118. Available: <http://www.energy.ca.gov/pier/project_reports/CEC-500-2006-118.html>. Accessed May 3, 2012.

2 Placer County Facility Services. 2003. Eastern Regional Landfill Water System Operation and Maintenance Manual.

3 South Coast Air Quality Management District. 2011. California Emissions Estimator Model (CalEEMod) Version 2011.1.1. Available: <http://www.caleemod.com/>.

GHGs Associated with Treatment of Wastewater Generated by the Plant

	gasification alternatives	direct combustion alternative	units	sources/notes
wastewater generation	126	202	MG/year	wksht: Water Consumption; See Note 1
Annual electricity consumption	241,061	385,698	kW-hr/year	calculation
Annual electricity consumption	241	386	MW-hr	conversion calculation
CO2-e Emissions, annual	156	250	MT/year	calculation

Calculation Inputs	value	units	source
electricity consumption rate	1,911	kW-hr/MG	Source 1, Operational - Water and Wastewater module
electricity conversion rate	1,000	kW-hr/MW-hr	wksht: Unit Conversions
local electric utility	Sierra Pacific Power	none	assumption based on recent merger activity
GHG Emission Rates			
CO2	1,422.78	lb/MW-hr	Source 1; See Note 2
CH4	0.029	lb/MW-hr	Source 1; See Note 2
N2O	0.011	lb/MW-hr	Source 1; See Note 2
Global warming potential			
CH4	21	unitless	wksht: Unit Conversions
N2O	310	unitless	wksht: Unit Conversions
CO2-e emission factor	1,426.80	lb/MW-hr	composite calculation
mass conversion rate	2,204.62	lb/MT	wksht: Unit Conversions

Notes

1 It is conservatively assumed that the volume of wastewater generated by the plant would be equal to the volume of water consumed by the plant.

2 These are the default GHG emission rates associated with the consumption of electricity produced by Sierra Pacific Power Company. Sierra Pacific's generation and distribution assets are now owned and operated by California Pacific Electric Company (CalPeco).

Source

1 South Coast Air Quality Management District. 2011. California Emissions Estimator Model (CalEEMod) Version 2011.1.1. Available: <http://www.caleemod.com/>.

Avoided GHG Emissions from Forest Slash Burning

Methodology: *This worksheet estimates the level of GHG emissions that would be avoided if biomass is consumed by the biomass plant instead of piled and burned by crews performing forest thinning and hazardous fuels reduction in the forests. Communications with Scott Conway of the Tahoe National Forest and Dave Fournier of the USFS Lake Tahoe Basin Management Unit indicate that all of the biomass consumed by the plant would otherwise be piled and burned in the forest. In some cases, biomass material is masticated (or chipped) and spread of the forest floor to achieve other forest management goals, which would result in GHG emissions associated with the decomposition of that material.*

Key Note: *There are typically multiple methodologies, called "tiers," for estimating GHG emissions for different sources. A Tier 1 approach relies on default emission factors and default values for other key input parameters such as the high heating value. The default values used in a Tier 1 methodology are conservative in that they result in a high estimate of GHG emissions. A Tier 2 approach uses project specific emission factors and/or input parameters (e.g., high heating value) that result in a more accurate, and lower estimate of GHG emissions. It is important to note that this analysis is conservative because a Tier 2 method is used to estimate GHG emissions from the gasification or combustion of biomass at the proposed plant and a Tier 1 approach is used to estimate the avoided level of GHG emissions that would be generated by open burning the biomass fuel in the forests.*

Annual Consumption of Forest Thinning Biomass by the Plant

	gasification alternatives	direct combustion alternative	units	source
biomass consumed, maximum annually	17,000	20,000	bdt/year	wksht: Operational Parameters
portion sourced from hazardous fuels reduction in forests	75%	75%	%	wksht: Operational Parameters
portion sourced from forest thinning residuals	25%	25%	%	wksht: Operational Parameters
portion sourced from haz fuels reduction or thinning	100.0%	100.0%	%	summation
forest-sourced biomass, maximum annually	17,000	20,000	bdt/year	calculation
mass conversation rate	907.2	907.2	kg/ton	wksht: Unit Conversions
biomass consumed, maximum annually	15,422,141	18,143,695	kg/year	conversion calculation

	value	units	source
Combustion Factor	95%	%	assumption, See Note 1 and Note 4

Emission Factors (per unit of dry matter burned)	value	units	source
CO_2	1,550	g/kg dry biomass	Table 2.5 of Source 1
CH_4	6.1	g/kg dry biomass	Table 2.5 of Source 1
N_2O	0.06	g/kg dry biomass	Table 2.5 of Source 1
Global Warming Potential for Conversion to CO2e			
global warming potential of CH4	21	unitless	wksht: Unit Conversions
global warming potential of N2O	310	unitless	wksht: Unit Conversions
CO2-e Emission Factor	1,697	g/kg dry biomass	calculation

	value	units	source
mass conversation rate	1,000,000	g/MT	wksht: Unit Conversions

Emissions, Annual	gasification alternatives	direct combustion alternative	units	source
CO2-e Emissions	24,858	29,245	MT/year	calc w/CO2-e emiss factor; See Note 4

Notes
1. It is assumed that forest contractors who burn their piles of forest slash seek to burn off as much of the waste as possible.
2. This calculation methodology is consistent with ARB's methodology for estimating its GHG inventory (see http://www.arb.ca.gov/cc/inventory/data/data.htm), which his consistent with 2006 IPCC guidelines.
3. PCAPCD staff agrees that the same ARB-recommended methodology be used to estimate GHG emissions from direct combustion and gasification and that the only difference would be that gasification technologies require less BDT of biomass fuel to produce the same amount of electricity. In short, gasification technologies are more efficient than direct combustion technologies.
4. None of the biomass consumed by the plant would be urban-sourced (e.g., construction and demolition debris, tree clippings and pine needles from developed land uses).

Sources

1. Intergovernmental Panel on Climate Change (IPCC). 2006. *Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use* . Hayama, Kanagawa, Japan. Available: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf>. Accessed June 2010.

Emissions of CAPs and Precursors from Forest Slash Burning

Emission Rates of Forest Fuel Types Likely to Be Included in Burn Piles from Forest Thinning, Moderate Moisture (lb/ton of fuel burned)

Fuel Component	NO_x	ROG	PM_{10}	$PM_{2.5}$	CO	SO_2	burn efficiency
Litter, wood 0-1 in	8.2	3.7	9.3	7.9	52.4	2.5	90%
Wood 1-3 in	8.0	7.8	14.0	11.9	111.4	2.5	65%
Wood 3+ in	7.6	14.4	21.6	18.3	205.8	2.3	65%
Herb, shrub, regen	7.4	17.4	25.1	21.3	249.2	2.3	65%
Average Emission Rate	5.6	7.3	12.0	10.1	103.8	1.7	—

Source: California Air Resources Board. 2006 (May). *Emissions Inventory Default Methodology for Wildland Fire Use.* (Areawide Sources / Miscellaneous Processes / Wildland Fire Use (WFU) Fires. Emissions Inventory Code 670-667-0200-0000. Available: <http://www.arb.ca.gov/ei/areasrc/distmiscprocwstburndis.htm>. Last Updated October 8, 2008. Accessed June 13, 2010.

	gasification alternatives	direct combustion alternative	units	source/notes
green tons of forest residuals used by biomass plant, minimum	28,000	34,000	ton/year	wksht: Operational Parameters

Emissions from Burning Forest Thinning Slash

	NO_x	ROG	PM_{10}	$PM_{2.5}$	CO	SO_2	units	source/notes
Gasification Alternatives								
Open Burning of Forest-Sourced Biomass								
Annual Emissions	156,310	203,490	334,775	284,095	2,907,240	48,055	lb/year	calculation
Annual Emissions	78	102	167	142	1,454	24	tons/year	conversion calculation
Average Daily Emissions	428.2	557.5	917.2	778.3	7,965.0	131.7	lb/day	conversion calculation
Direct Combustion Alternative								
Open Burning of Forest-Sourced Biomass							tons/year	
Annual Emissions	189,805	247,095	406,513	344,973	3,530,220	58,353	lb/year	calculation
Annual Emissions	95	124	203	172	1,765	29		conversion calculation
Average Daily Emissions	520.0	677.0	1,113.7	945.1	9,671.8	159.9	lb/day	conversion calculation

	value	units	source/notes
mass conversion rate	2,000	lb/ton	wksht: Unit Conversions
burn day frequency	365	days/year	assumption; See Note 3

Notes
1 Duff and Canopy Fuels are fuel types likely not to be included in burn piles from forest thinning.
2 It is assumed that emission rates for ROG are the same as TNMHC.
3 For the estimation of average daily emissions from open pile burning it is assumed that burning would occur most days of the year.
4 It is assumed that the burn efficiencies of "Wood 3+ inches," and "Herb, shrub, regen" are 65%, which is the same as "Wood 1-3 in."