

Apéndice C

RESULTADOS DEL APROVECHAMIENTO DEL COMBUSTIBLE PARA CADA CALDERA

Este apéndice reporta la tabla de resultados de la metodología representada en la figura 7.3 para cada una de las siete calderas a lo largo del año 2011, año en que fueron obtenidos dichos datos.

Tabla C.1. Resultados del % anual de combustible desaprovechado y el gasto que representa dicho combustible para cada caldera en el año 2011

Caldera #1	C (kcal/L)	9041												
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90	
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50	
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40	
	$\dot{m}_{\text{gas}} \text{ (kg/mes)}$	1117965.00	1185980.00	1007120.00	508038.00	479289.00	483884.00	761806.00	959294.00	1117965.00	1185980.00	1007120.00	508038.00	
	$Q_s = \dot{m}_{\text{gas}} \cdot CP_{\text{gas}} \cdot \Delta T \text{ (kcal/mes)}$	96480379.50	98910732.00	84295944.00	40846255.20	41746071.90	42097908.00	69248165.40	87391683.40	96480379.50	98910732.00	84295944.00	40846255.20	
	$\dot{m}_{\text{exc}} \text{ (kg/mes)}$	978904.50	984834.50	847731.00	410555.00	387826.00	408200.00	630609.50	766840.00	978904.50	984834.50	847731.00	410555.00	
	$Q_l = \dot{m}_{\text{exc}} \cdot \lambda_v \text{ (kcal/mes)}$	484264056.15	491284690.33	423780726.90	205482777.50	193346774.04	203757112.00	314384060.13	381878651.60	484264056.15	491284690.33	423780726.90	205482777.50	
	En (kcal/mes)	580744435.65	590195422.33	508076670.90	246329032.70	235092845.94	245855020.00	383632225.53	469270335.00	580744435.65	590195422.33	508076670.90	246329032.70	
	Cn (L/mes)	64234.54	65279.88	56196.96	27245.77	26002.97	27193.34	42432.50	51904.69	64234.54	65279.88	56196.96	27245.77	573,447.80
	Ce (L/mes)	70524.68	73802.42	61731.00	32453.20	30664.57	31250.00	48330.96	57982.28	70524.68	73802.42	61731.00	32453.20	645,250.4
	Cd (L/mes)	6290.14	8522.54	5534.04	5207.43	4661.60	4056.66	5898.47	6077.59	6290.14	8522.54	5534.04	5207.43	71,802.6
	% exc	9.79	13.06	9.85	19.11	17.93	14.92	13.90	11.71	9.79	13.06	9.85	19.11	13.51
	Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04	
	Gc (\$/mes)	36482.84	52072.69	37686.85	36660.29	33060.08	28031.50	41837.81	43637.07	36482.84	52072.69	37686.85	36660.29	\$ 472,371.79

Caldera # 2	C (kcal/L)	9041											
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40
	\dot{m}_{H_2O} (kg/mes)	1845554.00	1613925.00	1580139.00	1077575.00	1579144.00	1119243.00	1571845.00	1818808.00	1845554.00	1613925.00	1580139.00	1077575.00
	$Q_s = \dot{m}_{H_2O} \cdot CP_{H_2O} \cdot \Delta T$ (kcal/mes)	159271310.20	134601345.00	132257634.30	86637030.00	137543442.40	97374141.00	142880710.50	165693408.80	159271310.20	134601345.00	132257634.30	86637030.00
	\dot{m}_{H_2O} (kg/mes)	1542805.25	1281246.75	1269996.00	841586.00	1345219.00	949570.00	1302976.75	1474536.00	1542805.25	1281246.75	1269996.00	841586.00
	$Q_l = \dot{m}_{H_2O} \cdot \lambda \cdot v$ (kcal/mes)	763225757.18	639149941.24	634871000.40	421213793.00	670645480.26	473987361.20	649586028.95	734304182.64	763225757.18	639149941.24	634871000.40	421213793.00
	En (kcal/mes)	922497067.38	773751286.24	767128634.70	507850823.00	808188922.66	571361502.20	792466739.45	899997591.44	922497067.38	773751286.24	767128634.70	507850823.00
	Cn (L/mes)	102034.85	85582.49	84849.98	56171.97	89391.54	63196.72	87652.55	99546.24	102034.85	85582.49	84849.98	56171.97
	Ce (L/mes)	116145.82	100238.13	98856.00	65443.33	102377.31	80274.32	102040.81	115424.94	116145.82	100238.13	98856.00	65443.33
	Cd (L/mes)	14110.97	14655.64	14006.02	9271.36	12985.77	17077.61	14388.25	15878.70	14110.97	14655.64	14006.02	9271.36
	% exc	13.83	17.12	16.51	16.51	14.53	27.02	16.42	15.95	13.83	17.12	16.51	16.51
	Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04
Gc (\$/mes)	81843.61	89545.96	95381.02	65270.36	92095.07	118006.25	102055.87	114009.07	81843.61	89545.96	95381.02	65270.36	\$ 1,090,248.17

Caldera #3	C (kcal/L)	9041											
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40
	\dot{m}_{H_2O} (kg/mes)	489698.00	263561.00	79117.00	248013.00	141781.00	109960.00	92072.00	77830.00	489698.00	263561.00	79117.00	248013.00
	$Q_s = \dot{m}_{H_2O} \cdot CP_{H_2O} \cdot \Delta T$ (kcal/mes)	42260937.40	21980987.40	6622092.90	19940245.20	12349125.10	9566520.00	8369344.80	7090313.00	42260937.40	21980987.40	6622092.90	19940245.20
	\dot{m}_{H_2O} (kg/mes)	368244.36	181388.52	52553.00	194841.00	109104.00	82521.00	62520.32	52257.44	368244.36	181388.52	52553.00	194841.00
	$Q_l = \dot{m}_{H_2O} \cdot \lambda \cdot v$ (kcal/mes)	182170484.89	90485663.20	26271244.70	97517920.50	54392708.16	41191182.36	31168880.33	26023682.55	182170484.89	90485663.20	26271244.70	97517920.50
	En (kcal/mes)	224431422.29	112466650.60	32893337.60	117458165.70	66741833.26	50757702.36	39538225.13	33113995.55	224431422.29	112466650.60	32893337.60	117458165.70
	Cn (L/mes)	24823.74	12439.63	3638.24	12991.72	7382.13	5614.17	4373.21	3662.65	24823.74	12439.63	3638.24	12991.72
	Ce (L/mes)	30390.00	15748.97	4598.00	15406.56	9175.40	9539.12	5888.00	5027.02	30390.00	15748.97	4598.00	15406.56
	Cd (L/mes)	5566.26	3309.34	959.76	2414.84	1793.27	3924.95	1514.79	1364.38	5566.26	3309.34	959.76	2414.84
	% exc	22.42	26.60	26.38	18.59	24.29	69.91	34.64	37.25	22.42	26.60	26.38	18.59
	Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04
Gc (\$/mes)	32284.32	20220.07	6535.96	17000.46	12717.84	27121.39	10744.38	9796.23	32284.32	20220.07	6535.96	17000.46	\$ 212,461.45

Caldera # 4	C(kcal/L)	9041												
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90	
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50	
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40	
	\dot{m}_{reg} (kg/mes)	137826.00	78846.00	75842.00	103702.00	101890.00	228645.00	119172.00	133484.00	137826.00	78846.00	75842.00	103702.00	
	$Q_s = \dot{m}_{reg} \cdot CP_{reg} \cdot \Delta T$ (kcal/mes)	11894383.80	6575756.40	6347975.40	8337640.80	8874619.00	19892115.00	10832734.80	12160392.40	11894383.80	6575756.40	6347975.40	8337640.80	
	\dot{m}_{ves} (kg/mes)	86798.40	41673.64	31253.00	57067.00	38956.00	140170.00	30503.76	48907.60	86798.40	41673.64	31253.00	57067.00	
	$Q_l = \dot{m}_{ves} \cdot \lambda v$ (kcal/mes)	43326289.34	20788895.31	15623374.70	28562033.50	19421124.24	69967257.20	15207344.51	24355495.72	43326289.34	20788895.31	15623374.70	28562033.50	
	En (kcal/mes)	55220673.14	27364651.71	21971350.10	36899674.30	28295743.24	89859372.20	26040079.31	36515888.12	55220673.14	27364651.71	21971350.10	36899674.30	
	Cn (L/mes)	6107.81	3026.73	2430.19	4081.37	3129.71	9939.10	2880.22	4038.92	6107.81	3026.73	2430.19	4081.37	51,280.14
	Ce (L/mes)	8582.10	4066.05	3486.00	5297.00	3045.77	15910.73	2221.00	4083.96	8582.10	4066.05	3486.00	5297.00	68,123.8
	Cd (L/mes)	2474.30	1039.32	1055.81	1215.63	-83.94	5971.64	-659.22	45.03	2474.30	1039.32	1055.81	1215.63	16,843.6
% exc	40.51	34.34	43.45	29.78	-2.68	60.08	-22.89	1.12	40.51	34.34	43.45	29.78	27.65	
Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04		
Gc (\$/mes)	14350.92	6350.26	7190.06	8558.03	-595.31	41264.01	-4675.86	323.35	14350.92	6350.26	7190.06	8558.03	\$ 109,214.73	

Caldera # 5	C(kcal/L)	9041												
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90	
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50	
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40	
	\dot{m}_{reg} (kg/mes)	813162.00	311416.00	450582.00	457361.00	296909.00	453043.00	985188.00	945097.00	813162.00	311416.00	450582.00	457361.00	
	$Q_s = \dot{m}_{reg} \cdot CP_{reg} \cdot \Delta T$ (kcal/mes)	70175880.60	25972094.40	37713713.40	36771824.40	25860773.90	39414741.00	89533589.20	86098336.70	70175880.60	25972094.40	37713713.40	36771824.40	
	\dot{m}_{ves} (kg/mes)	644082.00	235492.60	353394.00	359349.00	241351.00	390194.00	828261.30	779170.00	644082.00	235492.60	353394.00	359349.00	
	$Q_l = \dot{m}_{ves} \cdot \lambda v$ (kcal/mes)	318627365.40	117475483.51	176661660.60	179854174.50	120323127.54	194769237.04	412921388.50	388018868.30	318627365.40	117475483.51	176661660.60	179854174.50	
	En (kcal/mes)	388803246.00	143447577.91	214375374.00	216625998.90	146183901.44	234183978.04	502474977.70	474117205.00	388803246.00	143447577.91	214375374.00	216625998.90	
	Cn (L/mes)	43004.45	15866.34	23711.47	23960.40	16169.00	25902.44	55577.37	52440.79	43004.45	15866.34	23711.47	23960.40	363,174.92
	Ce (L/mes)	51488.08	19412.54	28537.00	29242.05	20056.59	36862.64	64056.23	60539.36	51488.08	19412.54	28537.00	29242.05	438,874.2
	Cd (L/mes)	8483.63	3546.20	4825.53	5281.64	3887.60	10960.20	8478.86	8098.56	8483.63	3546.20	4825.53	5281.64	75,699.5
% exc	19.73	22.35	20.35	22.04	24.04	42.31	15.26	15.44	19.73	22.35	20.35	22.04	22.17	
Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04		
Gc (\$/mes)	49205.07	21667.31	32861.88	37182.77	27570.83	75734.99	60140.58	58147.69	49205.07	21667.31	32861.88	37182.77	\$ 503,428.13	

Caldera #6	C (kcal/L)	9041												
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90	
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50	
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40	
	\dot{m}_{agua} (kg/mes)	19306.00	19418.00	12972.00	10032.00	4530.00	49550.00	0.00	56004.00	19306.00	19418.00	12972.00	10032.00	
	$Q_s = \dot{m}_{\text{agua}} \cdot CP_{\text{agua}} \cdot \Delta T$ (kcal/mes)	1666107.80	1619461.20	1085756.40	806572.80	394563.00	4310850.00	0.00	5101964.40	1666107.80	1619461.20	1085756.40	806572.80	
	\dot{m}_{vapor} (kg/mes)	14383.00	13519.00	10004.00	8733.00	4005.00	49550.00	0.00	45800.00	14383.00	13519.00	10004.00	8733.00	
	$Q_l = \dot{m}_{\text{vapor}} \cdot \lambda_v$ (kcal/mes)	7115270.10	6743953.15	5000999.60	4370866.50	1996652.70	24733378.00	0.00	22807942.00	7115270.10	6743953.15	5000999.60	4370866.50	
	En (kcal/mes)	8781377.90	8363414.35	6086756.00	5177439.30	2391215.70	29044228.00	0.00	27909906.40	8781377.90	8363414.35	6086756.00	5177439.30	
	Cn (L/mes)	971.28	925.05	673.24	572.66	264.49	3212.50	0.00	3087.04	971.28	925.05	673.24	572.66	12,848.50
	Ce (L/mes)	1187.00	1016.00	645.00	630.00	308.18	4920.99	0.00	3645.93	1187.00	1016.00	645.00	630.00	15,831.1
	Cd (L/mes)	215.72	90.95	-28.24	57.34	43.69	1708.49	0.00	558.89	215.72	90.95	-28.24	57.34	2,982.6
% exc	22.21	9.83	-4.19	10.01	16.52	53.18		18.10	22.21	9.83	-4.19	10.01	14.87	
Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04		
Gc (\$/mes)	1251.15	555.68	-192.31	403.66	309.86	11805.63	0.00	4012.83	1251.15	555.68	-192.31	403.66	\$ 20,164.68	

Caldera # 7	C (kcal/L)	9041												
		Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	
	Tv (°C)	163.30	158.00	156.70	155.90	158.40	157.60	158.40	159.10	163.30	158.00	156.70	155.90	
	Ta (°C)	77.00	74.60	73.00	75.50	71.30	70.60	67.50	68.00	77.00	74.60	73.00	75.50	
	ΔT (°C)	86.30	83.40	83.70	80.40	87.10	87.00	90.90	91.10	86.30	83.40	83.70	80.40	
	\dot{m}_{agua} (kg/mes)	1775906	1396762	1802139	1227033	1697424	1202320	1272547	2169712	1775906	1396762	1802139	1227033	
	$Q_s = \dot{m}_{\text{agua}} \cdot CP_{\text{agua}} \cdot \Delta T$ (kcal/mes)	153260687.80	116489950.80	150839034.30	98653453.20	147845630.40	104601840.00	115674522.30	197660763.20	153260687.80	116489950.80	150839034.30	98653453.20	
	\dot{m}_{vapor} (kg/mes)	1491974.67	1151629.56	1510998.00	1054267.00	1449664.00	1043850.00	1073452.24	1836623.13	1491974.67	1151629.56	1510998.00	1054267.00	
	$Q_l = \dot{m}_{\text{vapor}} \cdot \lambda_v$ (kcal/mes)	738079869.25	574490406.01	755347900.20	527660633.50	722715490.56	521048166.00	535158879.73	914619952.51	738079869.25	574490406.01	755347900.20	527660633.50	
	En (kcal/mes)	891340557.05	690980356.81	906186934.50	626314086.70	870561120.96	625650006.00	650833402.03	1112280715.71	891340557.05	690980356.81	906186934.50	626314086.70	
	Cn (L/mes)	98588.71	76427.43	100230.83	69274.87	96290.36	69201.42	71986.88	123026.29	98588.71	76427.43	100230.83	69274.87	1,049,548.62
	Ce (L/mes)	112132.14	87466.25	112697.00	79328.28	110822.18	78857.94	82513.11	137646.51	112132.14	87466.25	112697.00	79328.28	1,193,087.1
	Cd (L/mes)	13543.43	11038.82	12466.17	10053.41	14531.82	9656.52	10526.23	14620.22	13543.43	11038.82	12466.17	10053.41	143,538.4
% exc	13.74	14.44	12.44	14.51	15.09	13.95	14.62	11.88	13.74	14.44	12.44	14.51	13.82	
Pc (\$/L)	5.80	6.11	6.81	7.04	7.09	6.91	7.09	7.18	5.80	6.11	6.81	7.04		
GCd (\$/mes)	78551.87	67447.20	84894.62	70776.02	103059.69	66726.57	74662.52	104973.17	78551.87	67447.20	84894.62	70776.02	\$ 952,761.36	