

Emission factor for the Panamanian interconnected grid

Baseline (including imports)	$EF_{OM, simple\ adjusted, y}$ [tCO ₂ /MWh]	Generation [MWh]	λ
2003	0,7770	5.576.603	0,0000
2004	0,7032	5.760.404	0,1050
2005	0,7513	5.826.911	0,0547
	$EF_{OM, simple\ adjusted, y}$ [tCO ₂ /MWh]	$EF_{BM, 2005}$	
	0,7435	0,3752	
	Default weights	Weights	
	$w_{OM} = 0,50$	$w_{OM} = 0,50$	
	$w_{BM} = 0,50$	$w_{BM} = 0,50$	
	Default EF_y [tCO ₂ /MWh]	EF_y [tCO ₂ /MWh]	
	0,5593	0,5593	

Note:

Alternative weights can be used according to the type of the project.

In case of **wind ou solar projects**, it should be used:

$$w_{OM} = 0,75$$

$$w_{BM} = 0,25$$

Operating margin emission factor for the Panamanian interconnected grid

2003	Power plant	Emissions (tCO ₂)	Energy Production (MWh)	λ_{2003}	$EF_{OM, simple\ adjusted, 2003}$ (tCO ₂ /MWh)	Fuel type	Emissions (MtC)	Emissions (tCO ₂)	Energy production (MWh)
	Imports	0	0	0,0000	0,7770	Diesel Liviano	16.996,9	62.322	34.540
	Hydro	0	2.823.375			Diesel Marino	173.089,8	634.663	757.694
	Thermal	2.139.121	2.753.228			Bunker C	393.310,0	1.442.137	1.960.994
	TOTAL	2.139.121	5.576.603			Total thermal	583.396,7	2.139.121	2.753.228
2004	Power plant	Emissions (tCO ₂)	Energy Production (MWh)	λ_{2004}	$EF_{OM, simple\ adjusted, 2003}$ (tCO ₂ /MWh)	Fuel type	Emissions (MtC)	Emissions (tCO ₂)	Energy production (MWh)
	Imports	0	0	0,1050	0,7032	Diesel Liviano	13.821,2	50.678	26.864
	Hydro	0	3.778.454			Diesel Marino	57.506,4	210.857	248.975
	Thermal	1.557.065	1.981.950			Bunker C	353.326,4	1.295.530	1.706.111
	TOTAL	1.557.065	5.760.404			Total thermal	424.654,0	1.557.065	1.981.950
2005	Power plant	Emissions (tCO ₂)	Energy Production (MWh)	λ_{2005}	$EF_{OM, simple\ adjusted, 2003}$ (tCO ₂ /MWh)	Fuel type	Emissions (MtC)	Emissions (tCO ₂)	Energy production (MWh)
	Imports	0	0	0,0547	0,7513	Diesel Liviano	16.403,0	60.144	31.215
	Hydro	0	3.723.732			Diesel Marino	21.394,8	78.448	92.844
	Thermal	1.671.503	2.103.179			Bunker C	418.066,6	1.532.911	1.979.120
	TOTAL	1.671.503	5.826.911			Total thermal	455.864,4	1.671.503	2.103.179

Source

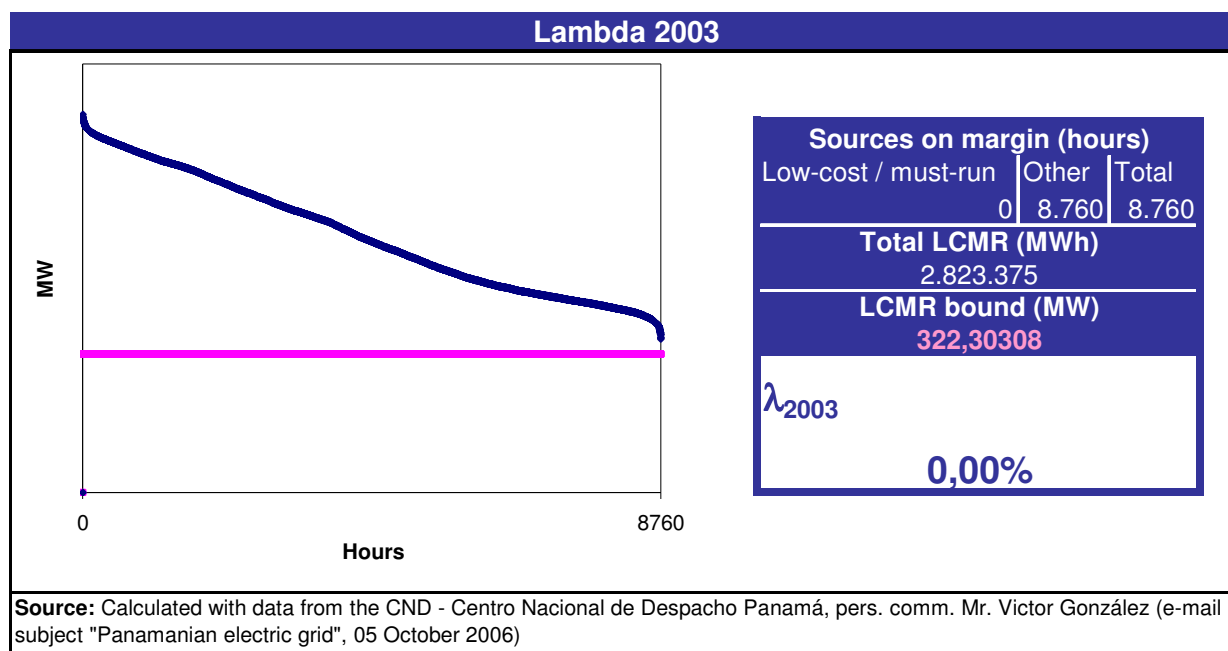
CND - "Centro Nacional de Despacho Panamá": Estadísticas/Comportamiento del Sistema. Available at <http://www.cnd.com.pa>.

COPE - "Comisión de Política Energética": Compendio Estadístico Energético 1970-2004. Available at <http://www.mef.gob.pa/Cope>.

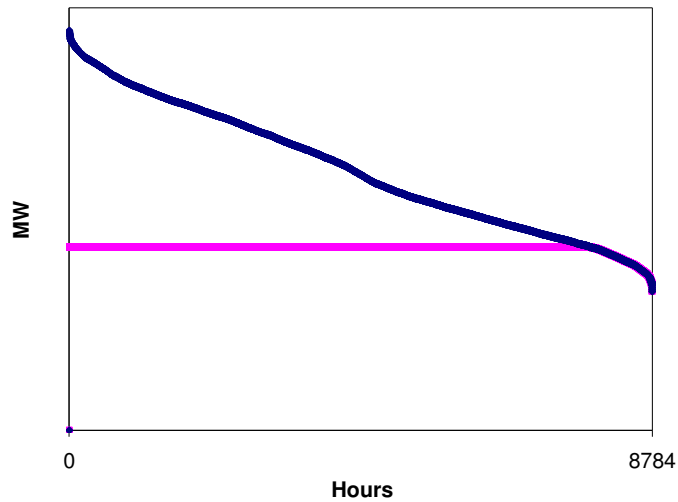
COPE: "Emisiones de CO₂".

Build margin emission factor for the Panamanian interconnected grid								
Power plant	Start year of operation	Energy Production (MWh)	Emissions (MtC)	Emissions (tCO ₂)	Accumulated emissions (tCO ₂)	Accumulated generation (MWh/year)	Accumulated generation (%)	EF _{BM, 5-plants, 2005} (tCO ₂ /MWh)
Imports		0	0	0				0,3752
Hydro		3.723.732	0	0				
Thermal		2.103.179	455.864	1.671.503				
TOTAL		5.826.911	455.864	1.671.503				
1 Pedregal Power	2002	379.494,5	61.823	226.685	226.685	379.494	6,51%	
2 ACP - Autoridad del Canal de Panamá #3,4	2000-2002	395.243,9	107.183	393.005	619.689	774.738	13,30%	0,3752
3 BLM - Central 9 de Enero (JB) No 9	2000	28.889,7	5.020	18.405	638.094	803.628	13,79%	
4 AES Panamá - Estí	2003	660.072,6	0	0	638.094	1.463.701	25,12%	
5 AES Panamá - Bayano Expansion (150MW-->260MW)	2003-2004	236.868,1	0	0	638.094	1.700.569	29,18%	

Source
 CND - "Centro Nacional de Despacho Panamá": Estadísticas\Comportamiento del Sistema. Available at <http://www.cnd.com.pa>.
 COPE - "Comisión de Política Energética": Compendio Estadístico Energético 1970-2004. Available at <http://www.mef.gob.pa/Cope>.
 COPE: "Emisiones de CO₂".



Lambda 2004

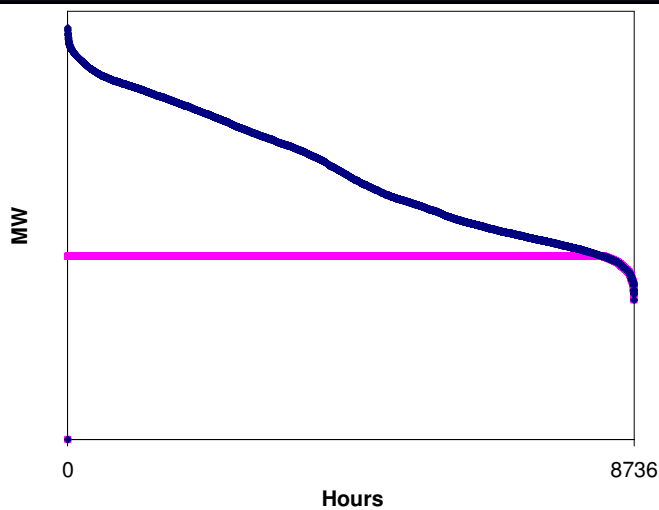


Sources on margin (hours)		
Low-cost / must-run	Other	Total
922	7.862	8.784
Total LCMR (MWh)		
3.778.454		
LCMR bound (MW)		
433,47404		
λ_{2004}		
10,50%		

Source: Calculated with data from the CND - Centro Nacional de Despacho Panamá, pers. comm. Mr. Victor González (e-mail subject "Panamanian electric grid", 05 October 2006)

Note: Leap year

Lambda 2005



Sources on margin (hours)		
Low-cost / must-run	Other	Total
478	8.258	8.736
Total LCMR (MWh)		
3.723.732		
LCMR bound (MW)		
427,46419		
λ_{2005}		
5,47%		

Source: Calculated with data from the CND - Centro Nacional de Despacho Panamá. jan/feb: pers. comm. Mr. Victor González (e-mail subject "Panamanian electric grid", 05 October 2006); mar-dec: "tabla_para_sistema". Available at <http://www.cnd.com.pa> (Estadísticas\Comportamiento del Sistema). Accessed in October 2006.

Note: Data for 31 October 2005 was not available

CO₂ emissions of the Panamanian interconnected grid in 2003

Tipo y Planta	Capacidad Instalada KW	Potencia Firme KW	Energía MWh	Tipo de Combustible	Consumo de Combustible		Barriles por MWh	Contenido de Carbono MTC/GWh	Factor de Emisión MTC/GWh	Emisiones MTC/GWh	Participación Técnica MWh-Téc./MWh-Tot.	Emisiones Técnicas de Carbono MTC/GWh* P.Téc.	Emisiones de CO ₂ MTC/GWh* P.Téc./44(12)
					Galones	Barriles							
Total del Sistema	1,555,710	1,069,278	5,576,883							583,386.7	49.37%	104,610,607	383,588,598
Total Hidro	832,995	536,114	2,823,375							18,998.9		3,047,898	11,179,629
Total Diesel Liviano (DL)	191,975	187,818	34,540							173,889.8		31,832,564	113,808,093
Total Diesel Marino (DM)	160,000	134,883	787,894							393,319.0		70,528,976	258,604,877
Total Bunker C	410,340	332,863	1,560,994								8.09%	13,350,911	49,104,240
1. ACP - Autoridad del Canal de Panamá	175,000	80,000	858,722.20										
Hidroeléctricas - Hidro	60,000		254,230.00										
Miraflores 1 - TG	10,000	6,957	14.00										
Miraflores 2 - TG	10,000	6,957	43.00										
Miraflores 3 - TV	27,000	15,304	18,847.00										
Miraflores 4 - TV	37,000	25,739	191,808.00										
Miraflores 5 - TG	18,000	12,522	52.00										
Miraflores 6 - MD	18,000	12,522	130,930.20										
2. AES Panamá	500,896	286,121	1,074,776.21										
Acero Vieja (Bávaro) - Hidro	248,936	124,000	483,792.24										
Esti - Hidro	120,936	112,000	90,285.88										
La Estrella - Hidro	42,000	15,000	231,555.13										
Los Valles - Hidro	48,000	15,000	266,848.96										
Sistema de Panamá - TG	42,000	25,121	484.00										
3. Arkopal	675	6	2,771.89										
Hidroeléctricas - Hidro	675		2,771.89										
4. BLM Corp.	280,800	213,900	1,815,535.87										
Central 6 de Enero No 2	40,000	27,368	50,907.13										
Central 6 de Enero No 3	40,000	28,168	128,910.29										
Central 6 de Enero No 4	40,000	33,361	78,024.12										
Central 6 de Enero No 5	33,000		152,581.94										
Central 6 de Enero No 6	33,000	124,053	163,692.53										
Central 6 de Enero No 8	34,000		180,636.64										
Central 6 de Enero No 9	90,000		260,785.17										
5. COPESA	48,660	41,462	3,092.53										
Turbina de Gas	48,660	41,462	3,092.53										
6. EDECI - Unión Femená	5,529	1,996	28,484.55										
Diaga (Idroch) - Hidro	3,120	1,100	16,435.00										
Macho Monte (Edechi) - Hidro	2,400	890	12,051.00										
7. EDEMET - Unión Femená	17,660	3,600	41,566.80										
La Yagüeda (Edemet) - Hidro	7,000	3,600	41,213.00										
Copra (Edemet)	5,000		20.00										
Chiré (Edemet)	4,500		267.00										
8. Fortuna	390,000	284,000	1,463,935.99										
Eden Páramo (Fortuna) - Hidro	390,000	284,000	1,463,935.99										
9. Hidro Panamá	1,800	214	8,455.80										
Hidroeléctrica - Hidro	1,800	214	8,455.80										
10. Panamá	96,996	86,634	704,257.00										
Combustión Interna	96,996	86,634	704,257.00										
11. Páramo Power	53,486	45,690	370,695.93										
Combustión Interna	53,486	45,690	370,695.93										
12. Petroeléctrica - PEP	60,000	56,277	283,452.87										
Combustión Interna	60,000	56,277	283,452.87										
13. Sistemas Anclados	19,015	0	36,520.56										
Petroeléctrica	6,720		12,806.00										
Otros Sistemas Anclados	8,455		17,842.00										
Otros Sistemas Anclados	3,840		5,872.56										

Source: COPE

CO₂ emissions of the Panamanian interconnected grid in 2004

Tipo y Planta	Capacidad Instalada KW	Potencia Firme KW	Energía Bruta MWh	Tipo de Combustible	Consumo de Combustible		Bariles por MWh	Contenido de Carbono de Carbono MTC/KJ	Factor de Emisión MTC/GWh	Emisiones MTC/año	Participación Térmica MWh-Tar./MWh-Tot.	Emisiones Térmicas de Carbono MTC/GWh P.Tar.	Emisiones de CO ₂ MTC/GWh P.Tar. % (6/12)
					Galones	Bariles							
Total del Sistema	1,567,218	1,161,378	8,760,468							434,454.0	34.41%	75,710,472.3	270,564,751.7
Total Hidro	844,995	844,114	3,778,454										
Total Diesel Livilano (DL)	191,978	197,018	26,864							13,821.3		2,395,350.4	8,797,618.2
Total Diesel Marino (DM)	160,000	124,563	248,879							57,506.4		8,363,040.7	36,804,682.5
Total Bunker C	410,240	332,063	1,706,111							353,326.4		61,337,081.2	224,902,631.0
1. ACP - Autoridad del Canal de Panamá	175,000	80,090	600,704.20								6.94%	14,894,108.7	54,611,731.8
Hidroeléctrica - Hidro	60,000		303,917.00										
Minaflore 1 - TG	10,000	6,957	42.00										
Minaflore 2 - TG	10,000	6,957	12.00										
Minaflore 3 - TV	22,000	15,394	91,429.60										
Minaflore 4 - TV	37,000	25,739	174,079.00										
Minaflore 5 - TG	18,000	12,322	70.00										
Minaflore 6 - MD	18,000	12,322	121,155.80										
2. AEP Panamá	512,840	338,121	1,646,377.43										
Asiento Viejo (Bayero) - Hidro	280,000	197,000	478,004.80										
Eti - Hidro	120,000	112,000	655,577.70										
La Estrella - Hidro	42,000	15,000	241,940.57										
Los Valles - Hidro	48,000	15,000	280,668.40										
Sustentación Panamá - TG	42,000	30,121	185.93										
3. Arkapell	675	6	1,899.51										
Hidroeléctrica - Hidro	675		1,899.51										
4. BLM Corp.	280,000	213,880	575,995.82										
Central 9 de Enero No 2	40,000	27,358	99,596.99										
Central 9 de Enero No 3	40,000	29,168	155,236.67										
Central 9 de Enero No 4	40,000	33,351	72,217.22										
Central 9 de Enero No 5	33,000		58,204.83										
Central 9 de Enero No 6	33,000	124,083	54,497.25										
Central 9 de Enero No 8	34,000		57,509.87										
Central 9 de Enero No 9	80,000		78,762.95										
5. COPIESA	46,000	41,462	1,243.12										
Turbina de Gas	46,000	41,462	1,243.12										
6. EDECHI - Unión Ferosa	5,526	1,988	26,381.60										
Dolga (Edchi) - Hidro	3,120	1,100	14,607.00										
Macho Morro (Edchi) - Hidro	2,400	800	11,684.00										
7. EDEMET - Unión Ferosa	17,000	3,000	39,597.60										
La Yeguada (Edemet) - Hidro	7,000	3,000	39,594.00										
Capito (Edemet)	5,500		8.00										
Chirig (Edemet)	4,500		55.00										
8. Fortuna	300,000	284,000	1,779,368.23										
Edwin Filágora (Fortuna) - Hidro	300,000	284,000	1,779,368.23										
9. Hidro Panamá	1,800	214	11,242.91										
Hidroeléctrica - Hidro	1,800	214	11,242.91										
10. Panam	99,000	86,634	812,004.00										
Combustión Interna	99,000	86,634	812,004.00										
11. Padregal Power	53,400	45,693	379,838.82										
Combustión Interna	53,400	45,693	379,838.82										
12. Petroeléctrica - PEP	69,000	56,277	4,136.48										
Combustión Interna	69,000	56,277	4,136.48										
13. Sistemas Afiliados	19,615	0	30,667.80										
Petroterminal	6,720		12,504.00										
Otros Sistemas Afiliados	8,455		12,654.00										
Otros Sistemas Afiliados	3,640		10,449.00										

Source: COPE

CO₂ emissions of the Panamanian interconnected grid in 2005

Tipo y Planta	Capacidad	Potencia	Energía	Tipo de Combustible	Heat Rate		Consumo de Combustible		Rentas por MWh	Costo de Carbono	Factor de Emisión	Emisiones	Participación	Emisiones Térmicas	Emisiones de CO ₂
	MW	MW	MWh		BTU/MWh	GJ/MWh	Óxidos	Barriles		MTCO ₂	MTCO ₂ /MWh	MTCO ₂ /GJ	MWh/Day	MWh/Year	MTCO ₂ /P. 1.0
Total del Sistema	1,028,234	1,094,737	5,820,915									450,894.4	36.99%	78,234,317.0	288,859,163.8
Total Hidro	845,995	587,800	3,723,733												
Total Diesel / Mono (DL)	151,999	107,618	31,215									15,803.0		3,810,003.0	15,321,796.2
Total Diesel / Mixto (DM)	168,393	134,083	92,844									31,364.8		3,871,714.6	13,482,093.4
Total Bunker C	396,249	279,785	1,879,328									418,088.8		71,747,007.1	263,874,413.7
1. ACP - Autoridad del Canal de Panamá	175,395	85,898	636,137.00										0.03%	13,6004704	87,3850039
Hidroeléctrica - Hidro	93,000		228,228.00												
Marafinos 1 - TG	10,000	8,657	18,000				2,534.6	62.8	3.3065	0.0002	383.237	7.3	0.0000%	6,031,249.6	6,004,432.0
Marafinos 2 - TG	11,000	14,637	24,120				10,371.4	261.2	3.3065	0.0002	383.237	36.3	0.0010%	6,031,249.6	6,031,931.14
Marafinos - TV	32,000	15,304	74,842.00				8,153,074.0	198,756.9	1.8607	0.0211	255.150	139,047.1	0.2044%	6,031,249.6	12,400,663.9
Marafinos - 4 - TV	37,000	25,726	150,872.00				34,060.0	7,780.7	1.7807	0.0211	241.504	49,051.6	0.3772%	7,933,318	38,518,777.9
Marafinos 3 - TG	18,000	12,592	141,000				15,000.0	18,317.8	368.9	0.0002	319.367	49.0	0.0000%	6,031,249.6	6,031,943.2
Marafinos 6 - MD	18,000	12,592	138,128.00				8,903	8,834	7,832,653.3	181,737.0	1.3157	177,966	0.218456%	15,467,025.8	15,467,025.8
							7,182	7,549	220,000.6	5,452.1	0.0005	6,575	0.3190%	0.1584474	0.3879460
2. AES Panamá	812,836	898,121	1,787,844.80												
Ascarito Villar (Bayano) - Hidro	260,000	157,000	559,875.00												
Esti - Hidro	120,000	112,000	660,072.52												
La Estrella - Hidro	42,000	250,861.25													
Los Valles - Hidro	48,000	15,000	295,978.00												
Subestación Panamá - TG	42,000	39,121	332.00												
3. Arkopal	675	0	1,254.44												
Hidroeléctrica - Hidro	675		1,254.44												
4. BLM Corp.	280,800	243,880	684,637.50												
Central 1 de Erero No 2	45,000	37,368	96,650.10												
Central 1 de Erero No 3	40,000	29,156	194,832.94												
Central 1 de Erero No 4	40,000	33,361	200,811.26												
Central 1 de Erero No 5	33,000		20,807.07												
Central 1 de Erero No 6	33,000		13,666.77												
Central 1 de Erero No 7	34,000		29,185.96												
Central 1 de Erero No 8	30,000		28,886.70												
5. COPESA	46,000	41,462	3,155.57												
Turbinas de Gas	46,000	41,462	3,155.57												
6. EDECOINT - Unión Femenas	5,549		24,746.95												
Colgado (Colchis) - Hidro	3,170	1,150	15,793.00												
Marcho Monte (Colchis) - Hidro	2,400	800	10,953.00												
7. EDECMET - Unión Femenas	47,000	5,846	58,384.80												
La Yaguada (Colchis) - Hidro	7,000	3,850	36,753.00												
Cajete (Colchis)	3,500		130.50												
Chirú (Colchis)	4,500		8.00												
8. Fortuna	399,999	364,806	1,894,316.99												
Flota F. Stronga (Fortuna) - Hidro	399,999	364,806	1,894,316.99												
9. Hidro Femenas	19,200	9	19,206.57												
Hidroeléctrica - Hidro	2,800		19,206.57												
10. Páramo	96,999	88,834	887,867.50												
Combustión Interna	96,999	88,834	887,867.50												
11. Pedregal Power	55,485	45,893	379,494.48												
Combustión Interna	55,485	45,893	379,494.48												
12. Estaciones Aliadas	16,870	0	38,878.85												
Polietileno	5,720		18,883.55												
Otras Estaciones Aliadas	5,479		15,690.55												
Otras Estaciones Aliadas	3,880		11,299.43												
Central 1 de Erero No 2	45,000	37,368	96,650.10												
Central 1 de Erero No 3	40,000	29,156	194,832.94												
Central 1 de Erero No 4	40,000	33,361	200,811.26												
Central 1 de Erero No 5	33,000		20,807.07												
Central 1 de Erero No 6	33,000		13,666.77												
Central 1 de Erero No 7	34,000		29,185.96												
Central 1 de Erero No 8	30,000		28,886.70												
5. COPESA	46,000	41,462	3,155.57												
Turbinas de Gas	46,000	41,462	3,155.57												
6. EDECOINT - Unión Femenas	5,549		24,746.95												
Colgado (Colchis) - Hidro	3,170	1,150	15,793.00												
Marcho Monte (Colchis) - Hidro	2,400	800	10,953.00												
7. EDECMET - Unión Femenas	47,000	5,846	58,384.80												
La Yaguada (Colchis) - Hidro	7,000	3,850	36,753.00												
Cajete (Colchis)	3,500		130.50												
Chirú (Colchis)	4,500		8.00												
8. Fortuna	399,999	364,806	1,894,316.99												
Flota F. Stronga (Fortuna) - Hidro	399,999	364,806	1,894,316.99												
9. Hidro Femenas	19,200	9	19,206.57												
Hidroeléctrica - Hidro	2,800		19,206.57												
10. Páramo	96,999	88,834	887,867.50												
Combustión Interna	96,999	88,834	887,867.50												
11. Pedregal Power	55,485	45,893	379,494.48												
Combustión Interna	55,485	45,893	379,494.48												
12. Estaciones Aliadas	16,870	0	38,878.85												
Polietileno	5,720		18,883.55												
Otras Estaciones Aliadas	5,479		15,690.55												
Otras Estaciones Aliadas	3,880		11,299.43												
Central 1 de Erero No 2	45,000	37,368	96,650.10												
Central 1 de Erero No 3	40,000	29,156	194,832.94												
Central 1 de Erero No 4	40,000	33,361	200,811.26												
Central 1 de Erero No 5	33,000		20,807.07												
Central 1 de Erero No 6	33,000		13,666.77												
Central 1 de Erero No 7	34,000		29,185.96												
Central 1 de Erero No 8	30,000		28,886.70												
5. COPESA	46,000	41,462	3,155.57												
Turbinas de Gas	46,000	41,462	3,155.57												
6. EDECOINT - Unión Femenas	5,549		24,746.95												
Colgado (Colchis) - Hidro	3,170	1,150	15,793.00												
Marcho Monte (Colchis) - Hidro	2,400	800	10,953.00												
7. EDECMET - Unión Femenas	47,000	5,846	58,384.80												
La Yaguada (Colchis) - Hidro	7,000	3,850	36,753.00												
Cajete (Colchis)	3,500		130.50												
Chirú (Colchis)	4,500		8.00												
8. Fortuna	399,999	364,806	1,894,316.99												
Flota F. Stronga (Fortuna) - Hidro	399,999	364,806	1,894,316.99												
9. Hidro Femenas	19,200	9	19,206.57												
Hidroeléctrica - Hidro	2,800		19,206.57												
10. Páramo	96,999	88,834	887,867.50												
Combustión Interna	96,999	88,834	887,867.50												
11. Pedregal Power	55,485	45,893	379,494.48												
Combustión Interna	55,485	45,893	379,494.48												
12. Estaciones Aliadas	16,870	0	38,878.85												
Polietileno	5,720		18,883.55												
Otras Estaciones Aliadas	5,479		15,690.55												
Otras Estaciones Aliadas	3,880		11,299.43												
Central 1 de Erero No 2	45,000	37,368	96,650.10												
Central 1 de Erero No 3	40,000	29,156	194,832.94												
Central 1 de Erero No 4	40,000	33,361	200,811.26												
Central 1 de Erero No 5	33,000		20,807.07												
Central 1 de Erero No 6	33,000		13,666.77												
Central 1 de Erero No 7	34,000		29,185.96												
Central 1 de Erero No 8	30,000		28,886.70												
5. COPESA	46,000	41,462	3,155.57												
Turbinas de Gas	46,000	41,462	3,155.57												
6. EDECOINT - Unión Femenas	5,549		24,746.95												

Source: COPE