

Jornadas “PENSAR EN VENEZUELA”

Colegio de Ingenieros de Venezuela
Caracas, 27 de marzo de 2008

EL CARBON Y LA ENERGIA

Gonzalo J. Morales
Academia Nacional de la Ingeniería y el Hábitat

- El carbón ha estado presente en el desarrollo del hombre desde tiempos inmemoriales. Al substituir al carbón de leña por carbón mineral en el siglo XVIII, éste incidió fundamentalmente en el desarrollo de la bomba de agua, en la producción de acero y en el transporte por ferrocarril, todos integrantes fundamentales de la revolución industrial.

Comparación de diferentes tipos de carbón

Combustible	Conocido como	Energía
Madera (leña)		20 MJ/kg
Turba		21 MJ/kg
Lignito	Brown coal	25 MJ/kg
Sub-bituminoso		27 MJ/kg
Antracita	Hard coal	29 MJ/kg
Bituminoso	Soft coal	31-35 MJ/kg
Grafito Natural		34 MJ/kg

Production*

Million tonnes oil equivalent	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change 2006 over 2005	2006 share of total
USA	571.6	584.9	603.2	584.3	570.1	590.3	570.1	553.6	572.4	580.2	595.1	2.6%	19.3%
Canada	41.6	43.0	40.8	39.2	37.1	37.6	34.9	32.2	34.5	34.0	32.3	-5.0%	1.1%
Mexico	4.6	4.5	4.8	4.9	5.4	5.4	5.2	4.6	4.7	4.8	5.3	11.1%	0.2%
Total North America	617.7	632.4	648.8	628.4	612.6	633.3	610.2	590.5	611.6	619.0	632.8	2.2%	20.5%
Brazil	1.8	2.1	2.0	2.1	2.9	2.1	1.9	1.8	2.0	2.4	2.4	1.1%	0.1%
Colombia	19.5	21.0	21.9	21.3	24.9	28.5	25.7	32.5	34.9	39.4	42.7	8.4%	1.4%
Venezuela	3.1	3.9	4.7	4.8	5.8	5.6	5.9	5.1	5.9	5.9	5.9	-0.6%	0.2%
Other S. & Cent. America	1.2	1.1	0.4	0.5	0.5	0.4	0.3	0.2	0.2	0.4	0.5	22.7%	*
Total S. & Cent. America	25.6	28.1	29.1	28.7	34.0	36.7	33.8	39.7	43.0	48.0	51.4	7.0%	1.7%
Bulgaria	5.2	4.9	5.0	4.2	4.4	4.4	4.4	4.6	4.5	4.4	4.6	4.2%	0.2%
Czech Republic	27.0	27.9	26.0	23.1	25.0	25.4	24.3	24.2	23.5	23.5	23.7	0.7%	0.8%
France	5.2	4.3	3.6	3.3	2.3	1.5	1.1	1.3	0.4	0.2	0.2	-16.7%	*
Germany	70.0	66.9	61.3	59.4	56.5	54.1	55.0	54.1	54.7	53.2	50.3	-5.5%	1.6%
Greece	7.2	7.7	8.1	8.0	8.2	8.5	9.1	9.5	9.6	9.4	9.3	-0.2%	0.3%
Hungary	3.2	3.3	3.0	3.1	2.9	2.9	2.7	2.8	2.4	2.0	2.1	4.0%	0.1%
Kazakhstan	39.3	37.3	36.0	30.0	38.5	40.7	37.8	43.3	44.4	44.2	49.2	11.3%	1.6%
Poland	94.5	92.1	79.6	77.0	71.3	71.7	71.3	71.4	70.5	68.7	67.0	-2.5%	2.2%
Romania	9.6	7.4	5.7	5.1	6.4	7.1	6.6	7.0	6.7	6.6	7.4	11.2%	0.2%
Russian Federation	114.2	109.3	103.9	112.1	116.0	122.6	117.3	127.1	131.7	139.5	144.5	3.6%	4.7%
Spain	10.0	9.8	9.3	8.6	8.0	7.6	7.2	6.8	6.7	6.4	6.1	-4.0%	0.2%
Turkey	12.3	13.1	13.9	13.3	13.9	14.2	11.5	10.5	10.5	12.8	12.6	-1.4%	0.4%
Ukraine	36.4	39.8	39.9	42.3	42.0	43.5	42.8	41.7	42.2	40.9	41.8	2.2%	1.4%
United Kingdom	30.2	29.4	25.0	22.5	19.0	19.4	18.2	17.2	15.3	12.5	11.3	-9.3%	0.4%
Other Europe & Eurasia	13.4	15.9	16.7	13.4	14.0	14.4	15.3	15.8	15.6	14.7	15.7	6.9%	0.5%
Total Europe & Eurasia	477.5	469.2	437.0	425.3	428.6	438.2	424.6	437.1	438.7	438.9	445.7	1.6%	14.5%
Total Middle East	0.7	0.6	0.6	0.7	0.6	0.5	0.4	0.6	0.6	0.6	0.6	-	*
South Africa	116.9	124.6	127.1	125.6	126.6	126.1	124.1	134.1	137.2	137.7	144.8	5.1%	4.7%
Zimbabwe	3.3	3.4	3.5	3.2	2.8	2.9	2.5	1.8	2.4	1.9	1.8	-1.1%	0.1%
Other Africa	1.3	1.2	1.4	1.3	1.2	1.2	1.3	1.2	1.2	1.1	1.1	2.0%	*
Total Africa	121.5	129.2	132.0	130.1	130.7	130.2	128.0	137.1	140.9	140.7	147.8	5.0%	4.8%
Australia	133.9	148.3	149.8	160.8	166.3	179.9	184.5	190.1	198.8	206.5	203.1	-1.6%	6.6%
China	703.2	690.0	628.7	645.9	656.7	697.6	733.6	871.9	1012.1	1119.8	1212.3	8.3%	39.4%
India	145.7	149.6	150.3	147.4	157.0	160.3	168.1	175.9	191.0	200.7	209.7	4.5%	6.8%
Indonesia	31.0	33.7	38.3	45.3	47.4	56.5	63.6	70.3	81.4	90.4	119.9	32.7%	3.9%
Japan	3.6	2.4	2.0	2.2	1.7	1.8	0.8	0.7	0.7	0.6	0.7	20.8%	*
New Zealand	2.2	2.0	2.0	2.1	2.2	2.4	2.7	3.2	3.2	3.2	3.6	10.0%	0.1%
Pakistan	1.5	1.4	1.5	1.5	1.4	1.5	1.6	1.5	1.5	1.6	1.9	23.0%	0.1%
South Korea	2.2	2.0	2.0	1.9	1.9	1.7	1.5	1.5	1.4	1.3	1.3	*	*
Thailand	6.3	6.9	6.1	5.7	5.1	5.6	5.7	5.3	5.6	5.8	5.4	-7.2%	0.2%
Vietnam	4.9	6.4	6.4	4.9	6.5	7.5	9.2	10.8	14.7	18.3	21.8	19.2%	0.7%
Other Asia Pacific	17.9	17.2	15.7	18.0	19.3	19.7	19.0	19.6	20.5	21.3	21.7	2.3%	0.7%
Total Asia Pacific	1052.5	1059.9	1002.7	1035.7	1065.6	1134.5	1190.2	1350.8	1531.0	1669.5	1801.5	7.9%	58.5%
TOTAL WORLD	2295.6	2319.4	2250.3	2249.0	2272.0	2373.4	2387.2	2555.8	2765.8	2916.7	3079.7	5.6%	100.0%
of which: European Union 25	249.2	244.1	218.5	207.4	195.7	193.5	191.6	189.7	185.1	177.7	171.7	-3.3%	5.6%
OECD	1020.3	1043.4	1036.0	1015.2	993.7	1027.0	1003.0	987.0	1012.2	1020.9	1026.2	0.5%	33.3%
Former Soviet Union	190.9	187.6	180.8	185.5	197.4	207.8	198.9	212.8	219.4	225.7	236.7	4.9%	7.7%
Other EMEs	1084.4	1088.4	1033.5	1048.3	1080.9	1138.6	1185.3	1356.0	1534.3	1670.1	1816.8	8.8%	59.0%

*Commercial solid fuels only, i.e. bituminous coal and anthracite (hard coal), and lignite and brown (sub-bituminous) coal.

*Less than 0.05%.

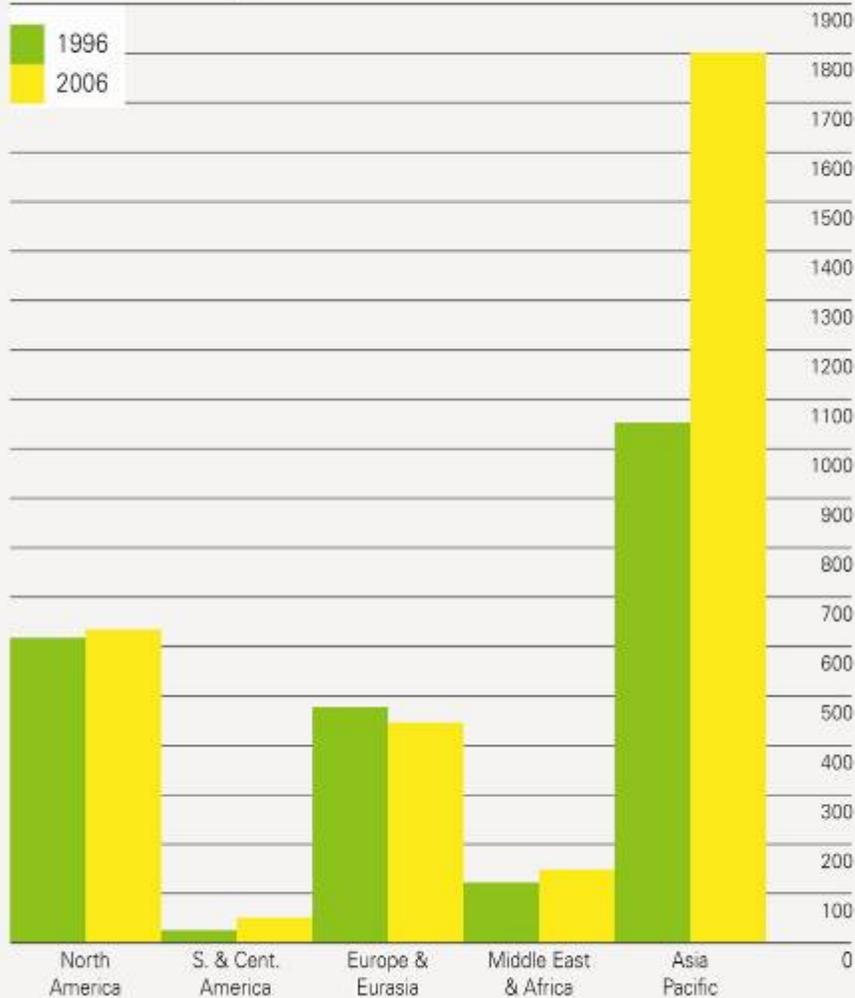
Note: Coal production data expressed in million tonnes is available at www.bp.com/statisticalreview.

Diez mayores productores de carbón mineral (2006)

■ PR China	2482Mt
■ Russia	233Mt
■ USA	990Mt
■ Indonesia	169Mt
■ India	427Mt
■ Poland	95Mt
■ Australia	309Mt
■ Kazakhstan	92Mt
■ South Africa	244Mt
■ Colombia	64Mt

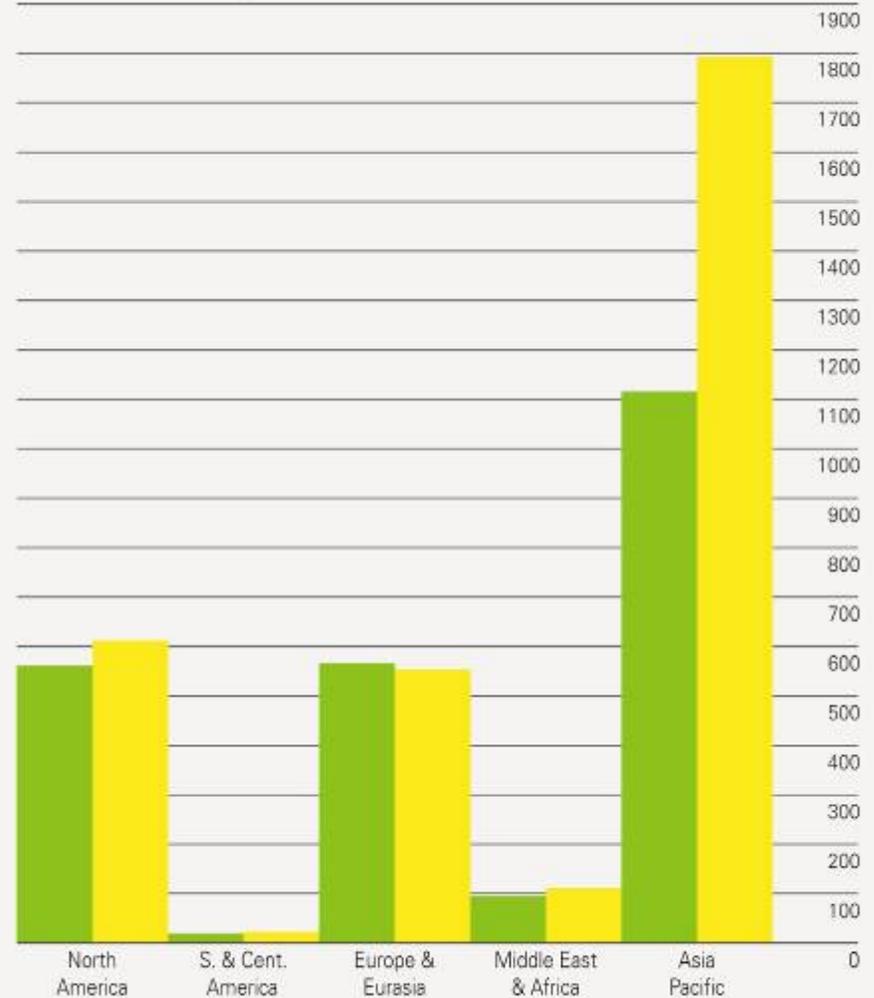
Production

Million tonnes oil equivalent



Consumption

Million tonnes oil equivalent



Coal was again the world's fastest-growing fossil fuel in 2006. Global consumption rose by 4.5% compared with a 10-year average of 2.8%. The Asia Pacific region accounted for nearly 90% of global growth in consumption and 80% of the growth in production.

Consumption*

Million tonnes oil equivalent	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2006 Change 2006 over 2005	2006 share of total
USA	529.2	540.4	545.7	546.0	550.0	552.2	553.0	552.5	566.1	574.2	567.3	-1.2%	18.4%
Canada	25.7	26.8	28.1	27.8	28.4	32.0	31.0	30.8	30.0	32.5	35.0	7.6%	1.1%
Mexico	5.7	5.7	5.9	6.0	6.2	5.8	7.8	8.6	7.0	5.1	9.3	3.0%	0.3%
Total North America	600.6	673.0	679.7	679.6	684.5	691.0	690.6	691.7	603.6	611.7	611.6	-0.7%	18.8%
Argentina	0.8	0.8	0.8	0.8	0.8	0.8	0.5	0.7	0.8	0.8	0.8	10.3%	*
Brazil	11.8	11.5	11.4	11.0	12.5	12.2	11.5	11.8	12.8	12.7	13.1	3.1%	0.4%
Chile	3.2	4.2	3.7	3.9	3.3	2.3	2.4	3.3	2.9	2.8	3.0	9.7%	0.3%
Colombia	2.8	3.0	2.8	2.4	2.7	2.7	2.5	2.4	2.0	2.3	2.4	5.1%	0.3%
Ecuador	-	-	-	-	-	-	-	-	-	-	-	-	-
Peru	0.8	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.7	0.7	0.9	28.5%	*
Venezuela	1	-	1	0.1	1	1	1	1	1	1	1	-	-
Other S. & Cent. America	0.6	0.4	0.5	0.6	0.5	0.7	0.9	1.3	1.4	1.5	1.5	2.9%	*
Total S. & Cent. America	19.1	20.3	19.7	20.2	20.2	19.0	18.2	18.9	20.5	20.7	21.8	5.9%	0.7%
Austria	2.7	3.1	3.0	3.2	3.2	2.8	3.0	2.9	2.9	2.8	3.0	8.2%	0.1%
Azerbaijan	-	-	-	-	-	1	1	1	1	1	1	-	-14.3%
Belarus	0.6	0.8	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.0%	*
Belgium & Luxembourg	7.6	7.5	7.9	8.9	7.8	7.6	6.7	6.5	6.4	6.1	6.1	0.8%	0.2%
Bulgaria	8.4	7.8	8.2	8.6	6.3	5.5	6.5	7.1	6.9	7.2	7.4	1.8%	0.2%
Czech Republic	23.0	22.8	20.5	19.0	21.0	21.2	20.0	20.9	20.0	19.8	19.4	-2.1%	0.6%
Denmark	9.0	6.7	5.6	4.7	4.0	4.2	4.2	5.7	4.6	3.7	5.5	45.8%	3.2%
Finland	4.0	3.5	3.8	3.6	3.5	3.0	3.0	3.0	3.1	3.1	3.2	88.5%	3.1%
France	15.4	13.1	15.1	14.5	15.3	12.1	12.4	13.3	12.5	13.3	13.4	-2.9%	0.4%
Germany	89.9	88.8	84.8	83.2	84.9	85.0	84.6	87.2	85.4	82.1	82.4	0.3%	2.7%
Greece	7.5	7.5	8.8	9.1	5.2	3.3	5.8	9.4	9.0	8.8	8.8	-0.2%	0.3%
Hungary	3.7	3.7	3.4	3.4	3.2	3.4	3.1	3.4	3.1	2.7	2.9	6.5%	0.1%
Iceland	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.5%	*
Republic of Ireland	1.9	2.0	1.9	1.8	1.9	1.9	1.7	1.8	1.8	1.8	1.8	-	0.1%
Italy	11.2	11.0	11.0	11.6	13.0	13.7	14.2	15.3	17.1	17.0	17.4	1.9%	0.6%
Kazakhstan	25.9	22.4	22.9	19.6	23.2	22.5	22.8	25.2	28.5	27.2	29.7	9.0%	1.0%
Lithuania	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	3.7%	*
Netherlands	0.3	0.5	0.4	0.7	0.8	0.5	0.9	0.1	0.1	0.1	0.1	-14.0%	0.2%
Norway	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.6	0.6	0.5	0.4	-16.2%	*
Poland	73.2	70.1	63.8	61.0	57.5	58.0	56.7	57.7	57.3	55.7	58.4	4.8%	1.9%
Portugal	3.9	3.6	3.6	3.6	4.5	3.7	4.1	3.9	3.9	3.8	3.7	-2.7%	0.1%
Romania	9.5	8.4	7.0	6.7	7.0	7.2	7.6	7.8	7.4	7.5	7.6	0.6%	0.2%
Russian Federation	115.7	106.3	100.0	104.1	106.3	109.0	103.9	109.4	105.0	111.5	112.5	0.9%	3.6%
Sweden	5.0	4.7	4.5	4.3	4.9	4.1	4.0	4.2	4.1	3.9	3.8	-2.1%	0.1%
Spain	15.5	17.7	17.7	20.5	21.8	19.5	21.9	20.8	21.0	21.2	18.9	-15.5%	0.6%
Switzerland	2.4	2.1	2.0	2.0	1.9	2.0	2.2	2.2	2.3	2.2	2.2	0.7%	0.1%
Taiwan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	*
Turkey	20.7	22.3	24.0	22.6	25.5	21.6	21.2	21.8	23.0	26.1	28.8	10.1%	0.9%
Turkmenistan	1	-	-	-	-	-	-	-	-	-	-	-	-
Ukraine	33.2	38.0	36.9	38.0	38.9	39.4	38.3	39.0	39.1	37.4	39.6	0.0%	1.3%
United Kingdom	44.4	39.6	39.7	35.6	36.7	40.0	36.6	38.8	38.1	36.7	43.8	10.3%	1.4%
Uzbekistan	1.2	1.2	1.2	0.9	1.0	1.1	1.0	1.0	1.2	1.1	1.1	4.0%	*
Other Europe & Eurasia	18.3	21.3	21.7	17.0	18.0	17.3	18.0	20.0	20.4	20.8	22.0	5.7%	0.7%
Total Europe & Eurasia	664.8	645.8	630.8	609.6	627.3	627.2	620.5	640.5	636.0	636.4	652.9	3.1%	17.9%
Iran	1.2	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	-0.6%	*
Kuwait	-	-	-	-	-	-	-	-	-	-	-	-	-
Qatar	-	-	-	-	-	-	-	-	-	-	-	-	-
Saudi Arabia	-	-	-	-	-	-	-	-	-	-	-	-	-
United Arab Emirates	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Middle East	5.0	5.4	5.8	5.7	6.2	7.2	7.5	7.9	8.0	7.9	7.8	-1.2%	0.3%
Total Middle East	6.1	6.3	6.8	6.7	7.3	8.3	8.7	9.0	9.0	9.0	8.9	-1.1%	0.3%
Algeria	0.6	0.3	0.5	0.5	0.5	0.6	0.9	0.8	0.8	0.8	0.8	-1.6%	*
Egypt	0.5	0.8	0.8	0.6	0.5	0.7	0.7	0.9	0.9	0.9	1.0	7.8%	*
South Africa	81.7	81.3	83.4	82.3	81.9	80.6	83.5	89.3	84.5	91.9	93.8	2.1%	3.0%
Other Africa	0.8	0.8	0.8	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3%	0.2%
Total Africa	89.8	92.3	91.8	89.9	89.4	89.3	92.3	97.5	103.3	100.4	102.8	2.4%	3.3%
Australia	42.6	45.1	47.3	47.9	48.3	49.6	52.3	50.9	52.6	52.5	51.1	-2.7%	1.7%
Bangladesh	0.2	0.3	0.1	1	0.3	0.4	0.4	0.4	0.4	0.4	0.4	-	*
China	720.4	700.2	651.0	658.2	687.4	681.3	713.8	853.1	978.2	1006.3	1191.3	8.7%	38.6%
China Hong Kong SAR	4.2	3.0	4.4	3.9	3.7	4.9	5.4	6.6	6.6	7.2	7.5	6.4%	0.2%
India	154.4	150.2	150.8	158.5	165.1	172.1	181.7	188.4	208.4	222.0	237.7	7.1%	7.7%
Indonesia	5.9	8.2	9.3	11.0	10.7	10.7	10.0	17.9	22.1	23.5	27.7	17.8%	0.8%
Japan	83.3	80.8	88.4	91.5	96.3	103.0	105.6	112.2	120.8	121.3	119.1	-1.8%	3.5%
Malaysia	1.6	1.7	1.8	1.8	1.9	2.0	3.6	4.2	5.7	6.3	6.3	*	0.2%
New Zealand	1.2	1.2	1.1	1.2	1.1	1.3	1.3	1.9	2.0	2.1	2.2	6.5%	0.1%
Pakistan	2.2	2.1	2.1	2.1	2.0	2.1	2.4	2.9	3.6	4.1	4.0	-4.2%	0.1%
Philippines	2.0	2.4	2.7	2.9	4.3	4.5	4.7	4.7	5.0	5.9	6.5	11.1%	0.2%
Singapore	-	-	-	-	-	-	-	-	-	-	-	-	-
South Korea	32.2	34.8	36.1	38.2	43.0	45.7	48.1	51.1	53.1	54.3	54.8	-	1.8%
Taiwan	19.7	21.7	23.8	24.5	26.7	31.6	32.7	35.1	38.6	39.0	39.5	4.0%	1.5%
Thailand	8.7	8.7	7.3	7.9	7.9	8.5	8.2	9.4	10.6	11.2	12.4	10.0%	0.4%
Other Asia Pacific	22.2	22.8	21.5	22.8	25.3	28.3	26.0	26.5	29.5	29.8	31.8	6.7%	1.0%
Total Asia Pacific	1115.3	1162.7	1057.2	1071.7	1115.6	1150.0	1206.9	1365.2	1533.1	1674.8	1792.1	7.0%	68.0%
TOTAL WORLD	2355.8	2340.3	2285.8	2276.8	2364.3	2384.8	2437.2	2632.8	2895.5	2957.0	3090.1	4.5%	100.0%
of which: European Union 25	332.4	318.5	309.5	294.1	302.2	302.6	300.8	310.0	308.3	297.9	305.0	2.6%	8.9%
OECD	1077.2	1083.5	1085.0	1073.1	1122.7	1114.5	1121.1	1148.7	1160.7	1168.7	1171.5	0.2%	37.9%
Former Soviet Union	178.6	171.2	163.2	164.4	169.9	172.7	168.9	175.6	173.7	176.2	183.9	3.2%	8.0%
Other EMAs	1100.0	1086.7	1037.5	1039.2	1071.7	1097.0	1148.2	1308.5	1471.1	1608.1	1734.7	7.8%	55.1%

*Comments at solid face only, i.e. bituminous coal and anthracite (hard coal), and lignite and brown (sub-bituminous) coal.

†Less than 0.05.

*Less than 0.05%.

Prices	Northwest Europe marker price†	US Central Appalachian coal spot price index‡	Japan coking coal import cif price	Japan steam coal import cif price
US dollars per tonne				
1991	42.80	29.01	60.45	50.30
1992	38.53	28.53	57.82	48.45
1993	33.68	29.85	55.26	45.71
1994	37.18	31.72	51.77	43.66
1995	44.50	27.01	54.47	47.58
1996	41.25	29.86	56.68	49.54
1997	38.92	29.76	55.51	45.53
1998	32.00	31.00	50.76	40.51
1999	28.79	31.29	42.83	35.74
2000	35.99	29.90	39.69	34.58
2001	39.29	49.74	41.33	37.96
2002	31.65	32.95	42.01	36.90
2003	42.52	38.48	41.57	34.74
2004	71.90	64.33	60.96	51.34
2005	61.07	70.14	89.33	62.91
2006	63.67	62.98	93.46	63.04

†Source: McCloskey Coal Information Service.

‡Price is for CAPP 12,500Btu, 1.2 SO₂ coal, fob. Source: Platts.

Note: cif = cost+insurance+freight (average prices); fob = free on board.

Coal

Proved reserves at end 2006

Million tonnes	Anthracite and bituminous	Sub-bituminous and lignite	Total	Share of total	R/P ratio
USA	111338	135305	246643	27.1%	234
Canada	3471	3107	6578	0.7%	105
Mexico	860	351	1211	0.1%	109
Total North America	115669	138763	254432	28.0%	226
Brazil	–	10113	10113	1.1%	*
Colombia	6230	381	6611	0.7%	101
Venezuela	479	–	479	0.1%	60
Other S. & Cent. America	992	1698	2690	0.3%	*
Total S. & Cent. America	7701	12192	19893	2.2%	246
Bulgaria	4	2183	2187	0.2%	80
Czech Republic	2094	3458	5552	0.6%	89
France	15	–	15	*	30
Germany	183	6556	6739	0.7%	34
Greece	–	3900	3900	0.4%	55
Hungary	198	3159	3357	0.4%	337
Kazakhstan	28151	3128	31279	3.4%	325
Poland	14000	–	14000	1.5%	90
Romania	22	472	494	0.1%	14
Russian Federation	49088	107922	157010	17.3%	*
Spain	200	330	530	0.1%	29
Turkey	278	3908	4186	0.5%	66
Ukraine	16274	17879	34153	3.8%	424
United Kingdom	220	–	220	*	12
Other Europe & Eurasia	1529	21944	23473	2.6%	352
Total Europe & Eurasia	112256	174839	287095	31.6%	237
South Africa	48750	–	48750	5.4%	190
Zimbabwe	502	–	502	0.1%	178
Other Africa	910	174	1084	0.1%	*
Middle East	419	–	419	*	399
Total Middle East & Africa	50581	174	50755	5.6%	194
Australia	38600	39900	78500	8.6%	210
China	62200	52300	114500	12.6%	48
India	90085	2360	92445	10.2%	207
Indonesia	740	4228	4968	0.5%	25
Japan	359	–	359	*	268
New Zealand	33	538	571	0.1%	99
North Korea	300	300	600	0.1%	20
Pakistan	–	3050	3050	0.3%	*
South Korea	–	80	80	*	28
Thailand	–	1354	1354	0.1%	70
Vietnam	150	–	150	*	4
Other Asia Pacific	97	215	312	*	7
Total Asia Pacific	192564	104325	296889	32.7%	85
TOTAL WORLD	478771	430293	909064	100.0%	147
of which: European Union 25	17424	17938	35362	3.9%	65
OECD	172363	200857	373220	41.1%	177
Former Soviet Union	94513	132741	227254	25.0%	464
Other EMEs	211895	96695	308590	33.9%	86

*More than 500 years.

*Less than 0.05%.

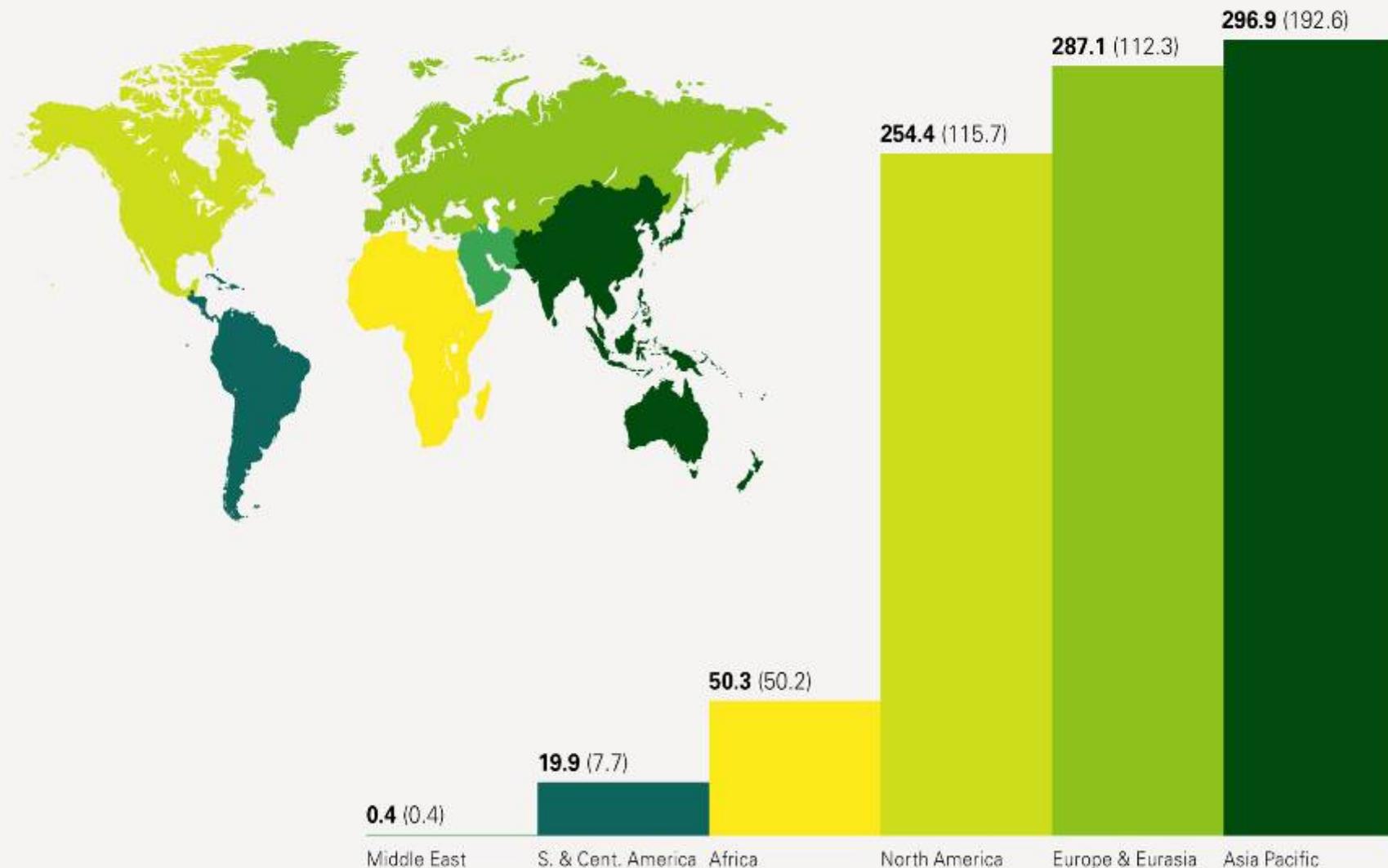
Notes: Proved reserves of coal – Generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known deposits under existing economic and operating conditions.

Reserves-to-production (R/P) ratio – If the reserves remaining at the end of the year are divided by the production in that year, the result is the length of time that those remaining reserves would last if production were to continue at that rate.

Source of reserves data: *Survey of Energy Resources 2004*, World Energy Council.

Proved reserves at end 2006

Thousand million tonnes (share of anthracite and bituminous coal is shown in brackets)



CARACTERISTICAS FISICO-QUIMICAS

CARBÓN DE LA CUENCA GUASARE

Clasificación Internacional632-633

RangoBituminoso: tipos A y B, altos en volátiles.

	PORCENTAJE	
	VARIACION	PROMEDIO
Componentes volátiles	38-40.5	38.5
Carbón Fijo	59-62	60.0
Cenizas	2.1-8	2.5
Humedad	1.2-5.6	2.8
Azufre	0.2-0.9	0.5
Fósforo	0.001-0.015	0.002
Indice hinchamiento	5 - 7	
Poder calorífico neto	7.500 K.Cal/Kgm.	
Molturabilidad (Hardgrove)	47-60 °H	
Reflexión media	0.75	

FUENTE: Eisenbau Essen, 1977, Estudio de Factibilidad. Mina a cielo abierto Paso Diablo. Resumen e investigaciones básicas, v.1 p.154.

RESUMEN DE LOS RECURSOS CARBONÍFEROS DE VENEZUELA
RESERVAS TM.

	Identificadas			Hipotéticas	Total Recursos
	Demostradas		Inferidas		
	Medidas	Indicadas			
ZULIA					
Guasare - Cachimí	353.000.000,00	966.000.000,00	1.117.000.000,00	6.052.000.000,00	8.488.000.000
TÁCHIRA					
Santo Domingo	106.247.407,00	80.207.271,00	50.465.303,00	45.700.467,00	282.620.448
Villa de Capote	512.849,00	233.720,00	1.646.588,00	25.000.000,00	27.393.157
Lobatera	19.047.442,00	5.076.965,00		12.000.000,00	36.124.407
Manifestaciones			18.500.000,00	120.000.000,00	138.500.000
ANZOÁTEGUI					
Naricual	29.952.000,00		10.200.000,00	26.329.600,00	66.481.600
Fila Maestra				30.000.000,00	30.000.000
Manifestaciones				2.510.000,00	2.510.000

Falcón, Lara, Aragua, Guárico, Miranda, Mérida,
Apure

TOTAL RECURSOS	508.759.698,00	1.051.517.956,00	1.197.811.891,00	6.313.540.067,00	9.071.629.612,00
-----------------------	-----------------------	-------------------------	-------------------------	-------------------------	-------------------------

Cuatro Categorías de Tecnologías de carbón limpio

- **Precombustión:** Tecnologías usadas para limpiar al carbón antes de ser quemado. Incluyen limpieza física, o lavado, limpieza química y los nuevos métodos biológicos de limpieza para remover azufre y cenizas. Todos los tipos de limpieza de carbón son llamados, a menudo, “*coal beneficiation*”.

“Coal beneficiation” se ha centrado en dos áreas – física y química. Ahora hay una tercera área – la biológica.

- ***Limpieza Física***
- ***Columna de flotacion***
- ***Limpieza Biologica***

- **Combustión:** Estas son tecnologías utilizadas para limpiar el carbón dentro del horno donde se quema el carbón. Estos nuevos métodos remueven los polutantes tales como el dióxido de azufre y los óxidos de nitrógeno. La **Combustión de Lecho Fluido** es un ejemplo de este tipo de tecnología.

- **Post-Combustion: Las tecnologías de Post-combustion** son aplicadas después que el carbon es quemado. Los gases, o emisiones, liberadas luego del quemado del carbón son “limpiadas” antes de que lleguen a la chimenea e ingresar al aire. Este metodo es usualmente denominado “***aflue gas desulfurization or scrubbing***” y se aplica usando filtros..

- **Conversion:** Las Tecnologías de Conversion convierten al carbón en un gas o liquido que puede ser limpiado y usado como combustible. Una de las mas avanzadas tecnologias de conversión se denominada **ciclo *combinado-de gasification del carbon***.

INVESTIGACIONES SOBRE CARBÓN

Las características, propiedades y usos del carbon son investigadas en muchas universidades e instituciones, tanto en Europa como en los Estados Unidos.

En Venezuela se ha investigado en los laboratorios de materiales de la Universidad Simón Bolívar, en el Centro de Investigaciones del carbón en Maracaibo, CICASI y en otros.