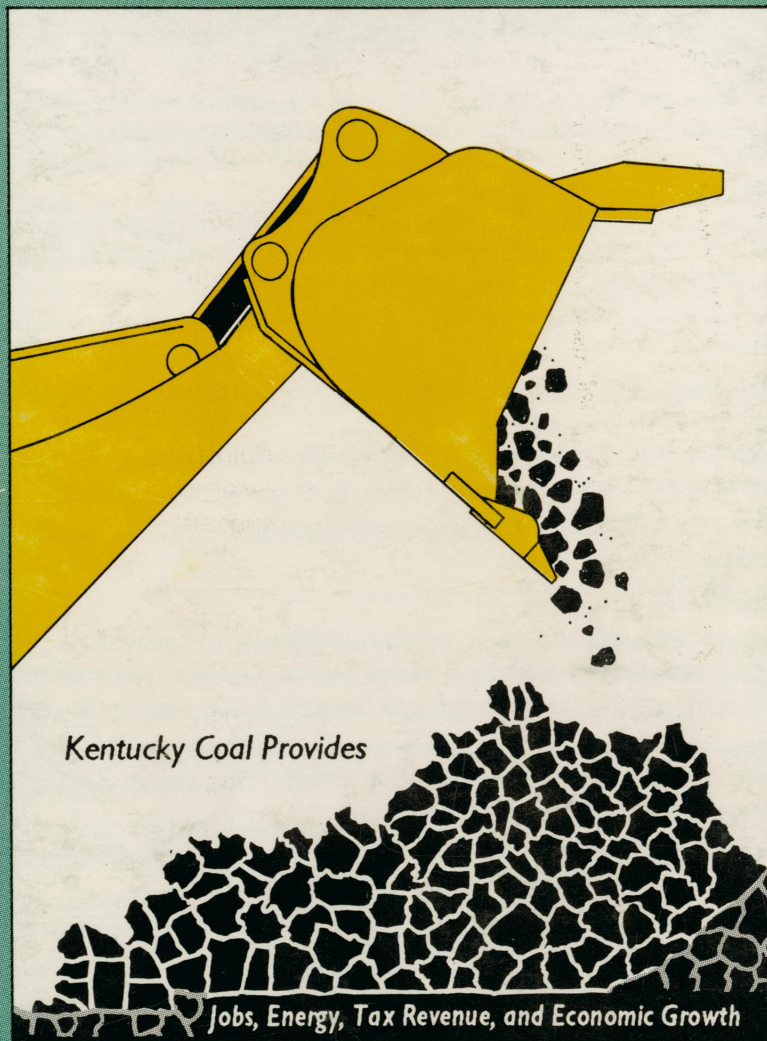


1993 - 1994 POCKET GUIDE

KENTUCKY COAL FACTS



Kentucky Coal Provides

Jobs, Energy, Tax Revenue, and Economic Growth

Prepared by the
**Kentucky Coal Marketing
and Export Council**
Cabinet for Economic Development
and the
Kentucky Coal Association

Highlights

Production

Kentucky produced 174.3 million tons of coal in 1992, compared to the record of 179.4 million tons set in 1990.

Kentucky was the nation's number one coal producer from 1973 to 1987, was number three in 1992, behind Wyoming, and has retaken from West Virginia the number two spot during 1993. Kentucky has been one of the top three producers in the United States for the last 47 years.

Employment

The Kentucky coal industry directly employed 25,722 persons and indirectly provided an additional 75,000 jobs in 1992.

The Kentucky coal industry paid almost \$1 billion in direct wages in 1992.

Economy

The Kentucky coal industry brought \$3.3 billion into Kentucky from out-of-state during fiscal year 1992-1993 through coal sales to customers in 29 other states and foreign countries.

Kentucky coal companies paid \$179.6 million in coal severance taxes in Fiscal Year 1992-1993 and induced economic activity leading to approximately \$530 million in revenues in state taxes.

Coal Markets

Electric utilities are the major market for Kentucky coal, accounting for 77% of the Kentucky coal sold.

Over 80% of Kentucky's coal is sold in other states or exported.

Almost all (95%) of Kentucky's electricity is generated from coal.

There are 20 major coal-burning electric utility plants in Kentucky.

Environment

All surface-mined land today is reclaimed equal to or better than it was prior to mining. Kentucky received three of twelve national reclamation awards in 1992 for surface mining; totaling 7 awards in the past three years.

Coal mining creates valuable lands such as wetlands, wildlife habitats, flat mountaintops and industrial sites where only steep, unproductive hillsides had once existed.

Kentucky operators have paid over \$544 million into a federal fund since 1977 to reclaim abandoned, unreclaimed coal mines.

From the mining to the burning of coal, our environment is protected by stringent environmental performance standards.

Coal Resources

Kentucky has two distinct coal fields, one in Western Kentucky and one in Eastern Kentucky.

Kentucky's 91.1 billion tons of coal resources remaining represent 87% of the original resource.

Unmined mineral taxes contributed \$10.2 million to state (23%) and local (77%) revenues during 1990 and will continue to be paid yearly.

December 1993

This publication is for informational use only. It includes some extrapolative second and third party data as well as some broad estimates, and should not necessarily be construed as official source data or be construed as advocating or necessarily reflecting any policy position of the Kentucky Coal Marketing and Export Council or the Kentucky Coal Association.

As we head rapidly toward the turn of the century, the immense changes in the coal industry give credence to its promise as the premier fuel of the 21st century. During the past two decades, coal has become the nation's primary source of energy production, and U.S. coal has played an increasing role in both domestic and worldwide energy consumption. While events in the world oil industry have captured the headlines, dramatic changes in the coal industry often have gone unnoticed.

Coal provided about one-fourth of the energy in the U.S. in 1990 compared with less than one-fifth in 1970. Total domestic coal production increased 71 percent over the two decades. Electric utility consumption rose at twice that rate, as the economy grew and became increasingly electrified, particularly in the west and the south. The coal industry adapted to these changes with remarkable flexibility, and the Kentucky coal industry played a large part in those changes. What will the future hold, and what trends are emerging? For a sample of those trends, this booklet offers the following information:

The amount of sulfur dioxide emitted from each ton of coal has been reduced by more than 1/2 during the last 20 years, and the trend is continuing to decrease. *(see page 32)*

Post mining land use changes are providing long term economic, social, and environmental benefits to Kentucky, and the benefits are increasing. *(page 31)*

WHAT CHANGES ARE OCCURRING?

92% of Kentucky's coal rail shipments are by unit trains, and the trend is expected to continue. *(page 29)*

Met coal's share of U.S. coal exports dropped to 58%, and the trend is continuing to decline. *(see page 27)*

Kentucky ships over 5 times as much coal to its neighboring states as it receives from them. *(see page 24)*

Natural Gas costs jumped while coal costs continued to decrease. *(page 19)*

IS THERE A TREND?

More of the coal severance tax money is being returned to the coal counties for economic development. *(see page 17)*

Direct mining employment continues to decrease in Kentucky. *(Page 10, 14)*

Productivity in the coal industry continues to increase. *(see page 11)*

The average mine size by production in Kentucky has almost tripled over the last 15 years. *(see page 8)*

Underground mine safety in Kentucky continues to show steady improvement while maintaining 60% of Kentucky's production. *(see page 12)*

\$3.3 billion continues to be brought into Kentucky each year from coal sales to other states and foreign countries. *(see page 17)*

The number of successful mining reclamation-primacy bond releases in Kentucky continue to grow each year. *(see page 30)*

CHANGES IN THE FUTURE?

The amount of coal needed to produce a unit of electricity continues to decrease, while the amount of light enjoyed from one unit of electricity continues to grow. *(see page 33)*

The AML reclamation accomplishments in Kentucky during the last 15 years are impressive and more continues to be completed yearly. *(see page 35)*

The new products being developed from coal combustion by-products are amazing. *(see page 34)*

45% of Eastern Kentucky's Demonstrated Reserve Base continues to be low sulfur coal. *(see page 39)*

Coal Education will determine coal's future. *(see page 44)*

Source: U.S. DOE - Energy Information Administration. The U.S. Coal Industry, 1970-1990: Two Decades Of Change. November 1992 (For other sources see individual reference pages as listed.)

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 1024 Capital Center Dr. - Frankfort, KY, 40601 Fax: 502-564-2512

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 Lexington, KY 40512-4080

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 228 Mining and Mineral Resources Building
 Lexington, KY 40506-0107

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 Division of Field Services Phone: 502-564-2141
 Division of Permits Phone: 502-564-2340
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 Division of Environmental Protection Fax: 502-564-5848
 Division of Waste Management Phone: 502-564-3035
 Division of Water Phone: 502-564-6716
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 Division of Air Quality Control Phone: 502-564-3382
 316 St. Clair Street - Frankfort, KY 40601

Revenue Cabinet Phone: 502-564-3226
 Department of Administrative Services Phone: 502-564-6866
 Division of Severance Tax Phone: 502-564-6734
 Capitol Annex - 4th Floor - Frankfort, KY 40620 Fax: 502-564-3875

Department of Property Taxation Phone: 502-564-8334
 Mineral Valuation Section Fax: 502-564-3875
 592 East Main St. - Frankfort, KY 40620

Transportation Cabinet Phone: 502-564-7183
 Coal Haul Highway Section
 419 Ann Street - Frankfort, KY 40622

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 3572 Ironworks Pike - Lexington, KY 40511-8433 Fax: 606-257-0220

United States Department of Energy Phone: 202-586-8800
 National Energy Information Center, EI-231
 Forrestal Bldg. - Rm. 1F-048 - Washington, DC 20585

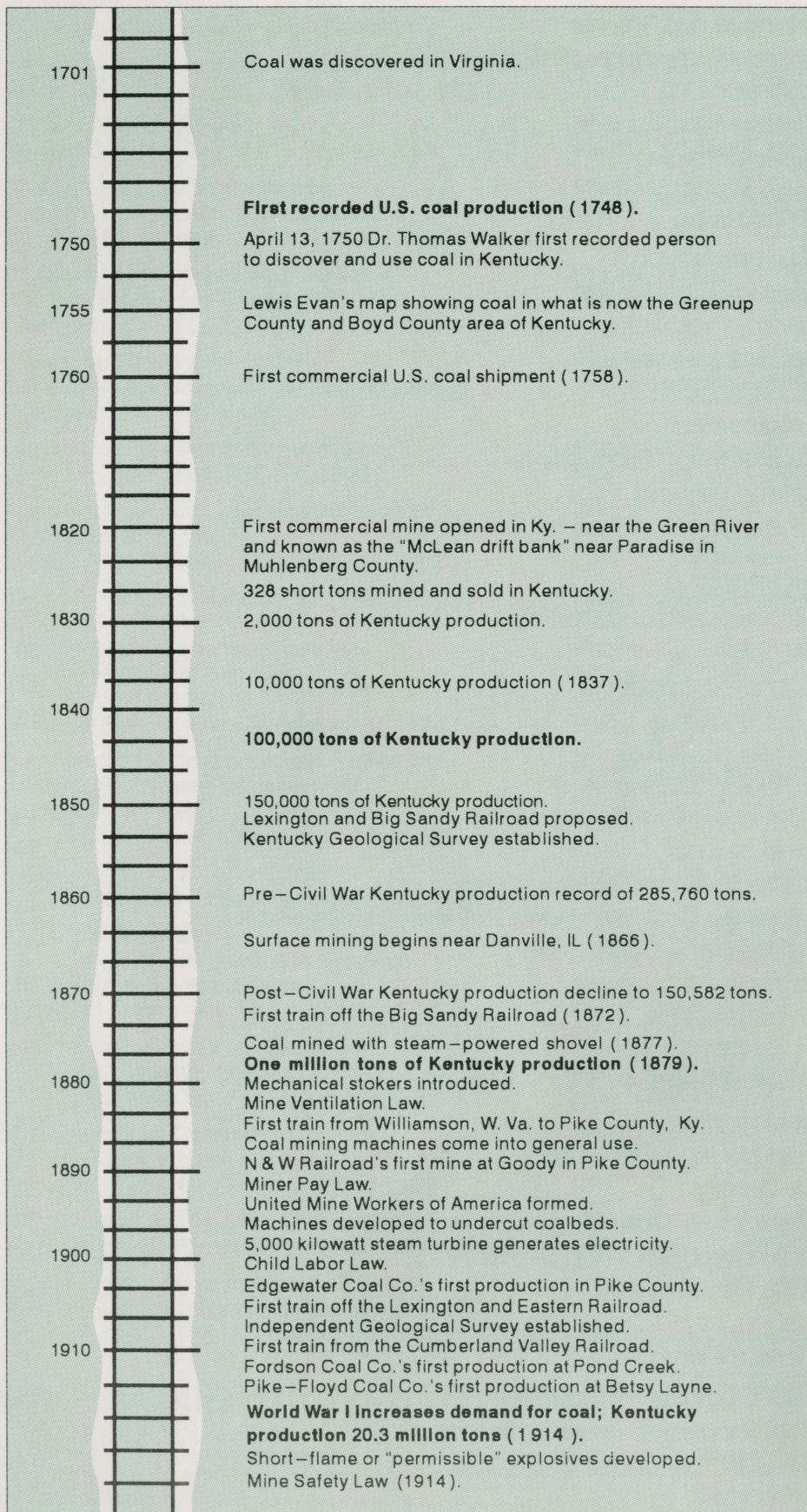
Other Contributors

CSX Transportation, Inc.	Norfolk Southern Corporation
U.S. Army Corps of Engineers	Paducah and Louisville Railway

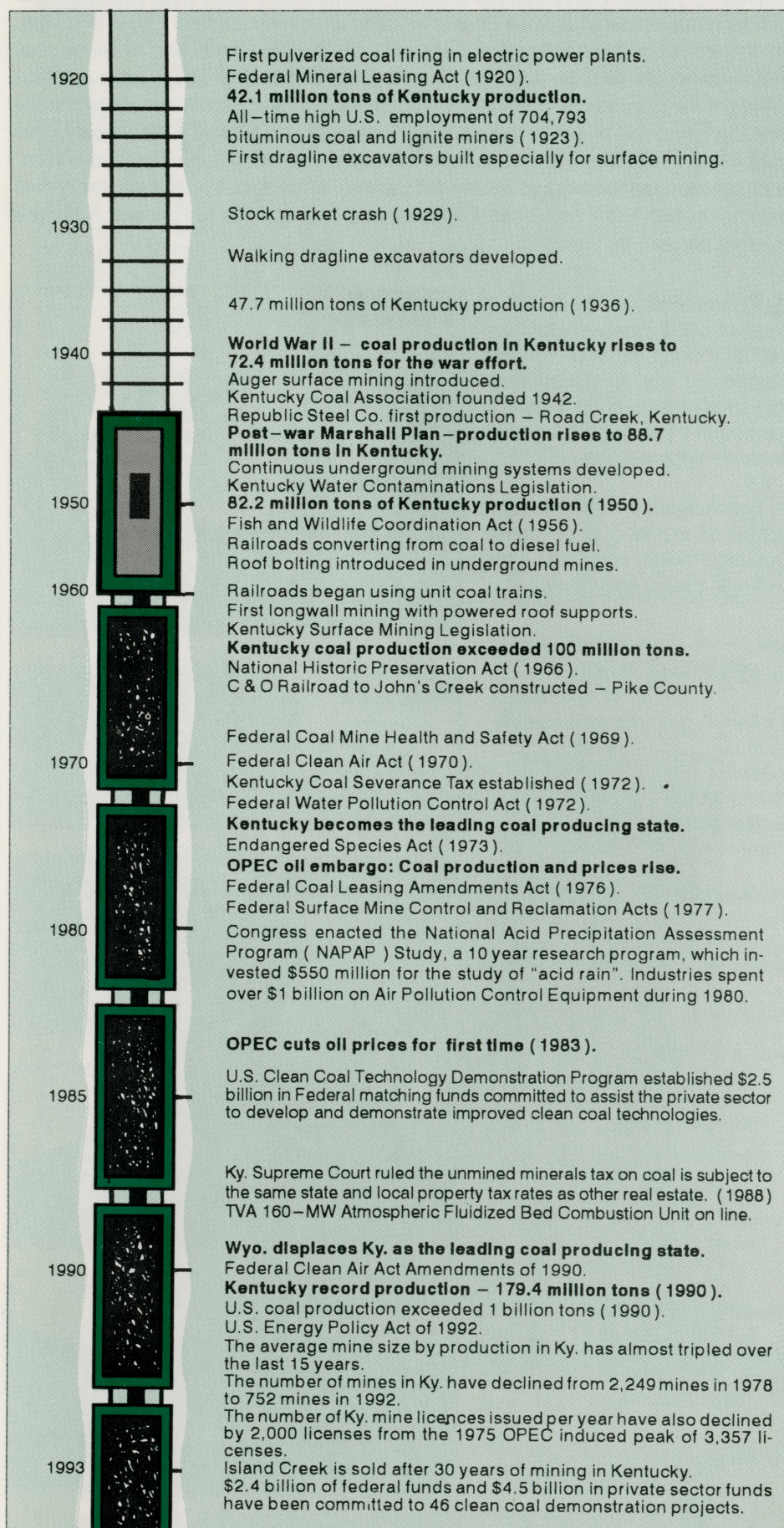
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Highlights	front cover
Changes and Trends	1
Acknowledgements/Frequent References	2
Contents	3
History	4
Types of Mining	6
Production	
U.S. Production	7
Kentucky Production	8
County Production	9
Employment	
Employment	10
Employment/Productivity	11
Safety/Training	12
Employment/Wages by County	14
Economy	
Severance Tax by County	15
Tax Revenue	16
Economic Impact	17
Coal Prices	18
Coal Markets	
Coal - Low Cost Energy	19
Uses of Coal	20
Kentucky's Four Market Sheds	21
Kentucky Coal Shipments to Electric Utility Plants	22
Distribution - Utility Coal	24
Exports	26
Transportation	28
Environment	
Reclamation	30
Post Mining Land Uses	31
Air Quality	32
Clean Coal Technology	33
Coal Combustion By-products	34
AML Reclamation	35
Coal Resources	
Coal Origin and Properties	36
Coal Properties - Improvements	37
U.S. Comparisons	38
Resources	40
Energy Equivalents and Conversions	43
Coal's Future	44
Information Assistance	rear cover



Sources: Energy Information Administration, Coal Data. A Reference, 1989.
Ky. Dept. of Mines and Minerals, Annual Report.
Willard Rouse Jillson, Coal Industry in Kentucky, 1922.



Kentucky has two distinct coal fields, each containing numerous deposits of bituminous coal of various characteristics and mines of every type and size. By the use of large draglines and shovels, the excavation of two or more coal seam deposits (multi-seam mining) is possible in the large *area surface mines* of the gently rolling **Western Kentucky** coal field and in the large *mountain top removal mines* in the steeper terrain of the **Eastern Kentucky** coal field. Both the Eastern and Western Kentucky coal fields have large, modern, and efficient underground mines (of various entry types) utilizing improved mining methods with increased mechanization - continuous miners, longwall mining panels, or both.

Of Kentucky's 174.3 million tons of 1992 coal production, 109.2 million tons were produced by underground mining methods and 65.1 million tons were produced by surface mining methods.

A breakdown of the different types of surface and underground mining methods used in Kentucky is as follows:

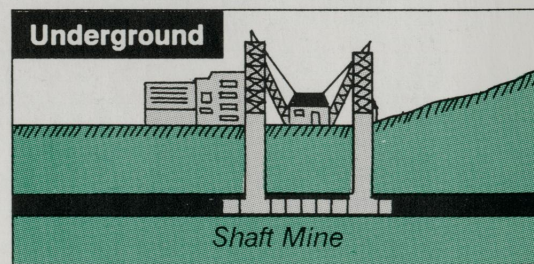
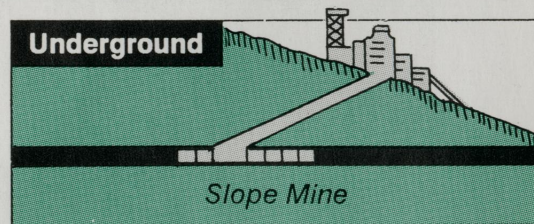
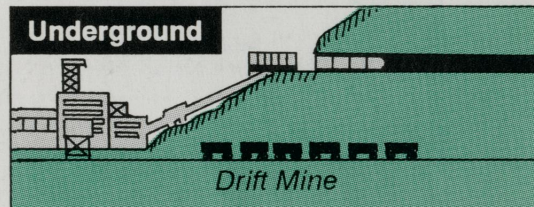
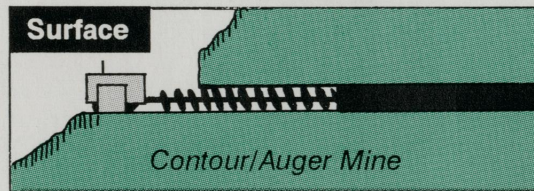
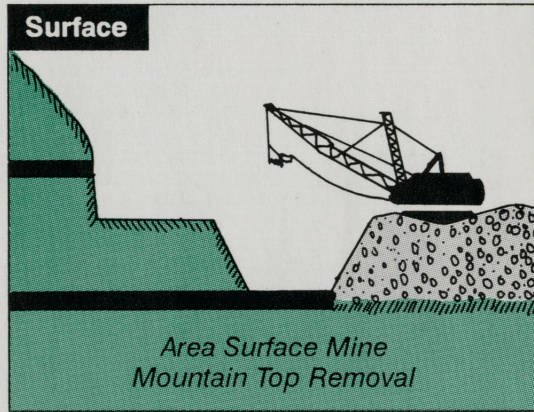
1992 Mining Types

Mine Type	No. of Licenses	Prod. Million Tons
Surface		
Surface Mining	188	19.4
Surface & Auger	492	44.8
Auger Mining	49	0.9
Underground		
Room and Pillar *	642	109.2
Longwall Mining **	(6)	(8.6)
State Totals *	1,371	174.3

* Underground *Room and Pillar* values include the *Longwall mining* estimates.

** Longwall mining figures are not reported separately and values are estimates from phone surveys by the Kentucky Coal Marketing and Export Council. The longwall production was estimated at 8.6 million tons and usually included 2 conventional mining sections used to support the development of the longwall panels. Only 4 of the 6 longwall mines were active during 1992 in Kentucky.

Sources: Ky. Dept. of Mines and Minerals, Annual Report, 1992
Kentucky Coal Marketing and Export Council.



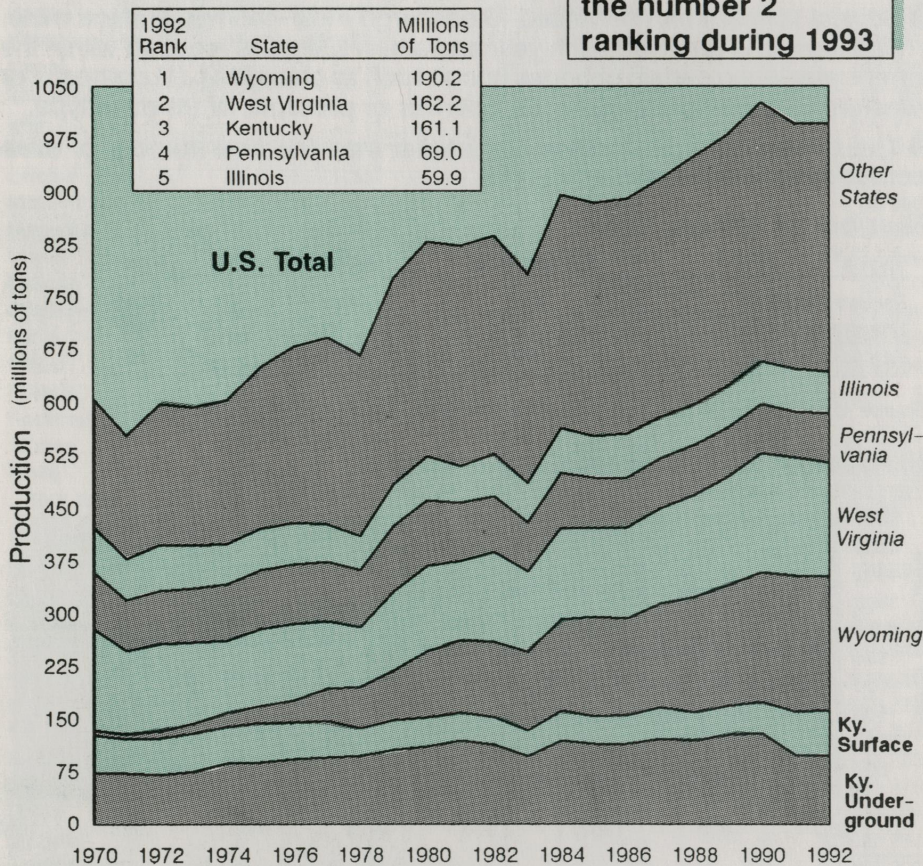
Source: Energy Information Administration, *Coal Data: A Reference*, 1989.

Kentucky and U.S. Coal Production,* 1970-1992 (millions of tons)

Year	Kentucky			United States	Kentucky as % of U.S.
	Eastern	Western	Total		
1970	72.5	52.8	125.3	602.9	20.8
1971	71.6	47.8	119.4	552.2	21.6
1972	68.9	52.3	121.2	595.4	20.4
1973	74.0	53.7	127.6	591.7	21.6
1974	85.4	51.8	137.2	603.4	22.7
1975	87.3	56.4	143.6	648.4	22.1
1976	91.1	52.8	144.0	678.7	21.2
1977	94.0	52.3	146.3	691.3	21.2
1978	96.2	39.5	135.7	665.1	20.4
1979	104.1	42.5	146.5	777.9	18.8
1980	109.2	41.0	150.1	829.7	18.1
1981	117.9	39.7	157.6	823.8	19.1
1982	111.2	39.0	150.2	838.1	17.9
1983	95.6	35.6	131.2	782.1	16.8
1984	117.3	42.3	159.5	895.9	17.8
1985	113.3	39.0	152.3	883.6	17.2
1986	112.7	41.2	153.9	890.3	17.3
1987	119.9	45.3	165.2	918.8	18.0
1988	117.5	40.3	157.9	950.3	16.6
1989	125.7	41.6	167.4	980.7	17.1
1990	128.4	44.9	173.3	1,029.1	16.8
1991	117.2	41.8	159.0	996.0	16.0
1992	119.4	41.7	161.1	997.5	16.2

* This is the official U.S. DOE number for Kentucky. State and Federal numbers will differ, please see page 8 for details.

U. S. Leading Coal Producers**

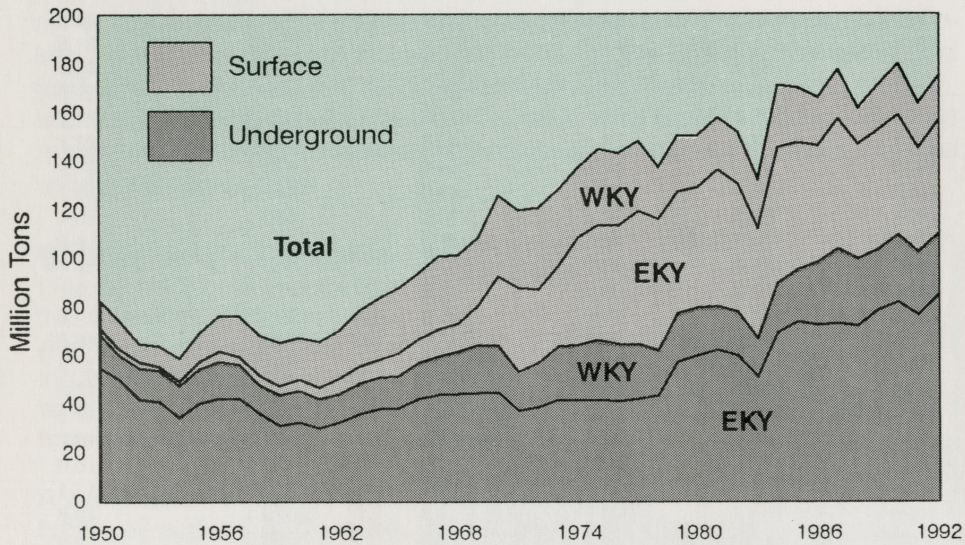


** Wyoming was not one of the top five coal producers until 1978, when it surpassed Virginia and Ohio, but is included before 1978 to show its rise to the leading coal-production state.

Sources: U.S. DOE - Energy Information Administration, Coal Production, 1977 - 1992.
U.S. Bureau of Mines, Minerals Yearbook, 1970 - 1976.

Kentucky produced 174.3* million tons of bituminous coal in 1992, down from the record of 179.4 million tons set in 1990.

Kentucky Production



Source: Ky. Dept. of Mines and Minerals, Annual Reports, 1950 - 1992.

Number of Mines in Kentucky

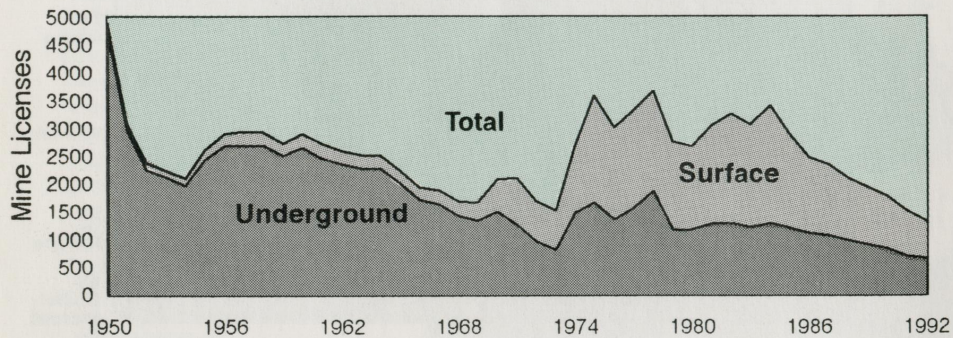
- There were 752 mines in Kentucky in 1992.
- Several licenses can be issued to one large multi-seamed surface mine. A mine license is renewed each year and a new license is required within the current year when certain changes occur, such as change of: (1) company or ownership, (2) company name, (3) operator or principal, or (4) mine type.
- The number of actual mines are smaller than the final number of mine licenses issued each year.

Number of Mines, 1992

Region	Underground	Surface	Total
Eastern Kentucky	459	225	684
Western Kentucky	23	45	68
Kentucky Total	482	270	752

Source: U.S. DOE - Energy Information Administration, Coal Production, 1992

Number of Mine Licenses in Kentucky**



Source: Ky. Dept. of Mines and Minerals, Annual Reports, 1950 - 1992.

* State production numbers differ slightly each year from Federal U.S. DOE - Energy Information Administration (EIA) production numbers, due to minor differences in their methodology (i.e. clean coal versus raw coal). Please note whether Federal or State numbers are referenced when using a value in this publication.

** Several licenses can be issued to one large multi-seamed surface mine.

County Production



There were 752 mines in Kentucky during 1992. These 752 mines were issued 1,371 Kentucky mine licenses and produced 174.3 million tons.

482 underground mines (642 licenses) accounted for 63% of Kentucky's production.

270 surface mines (729 licenses) accounted for 37% of Kentucky's production.

Eastern Kentucky's underground production was 64% of their total production and Western Kentucky's underground was 58% of their total.

1992 Production By County and Type of Mine License*

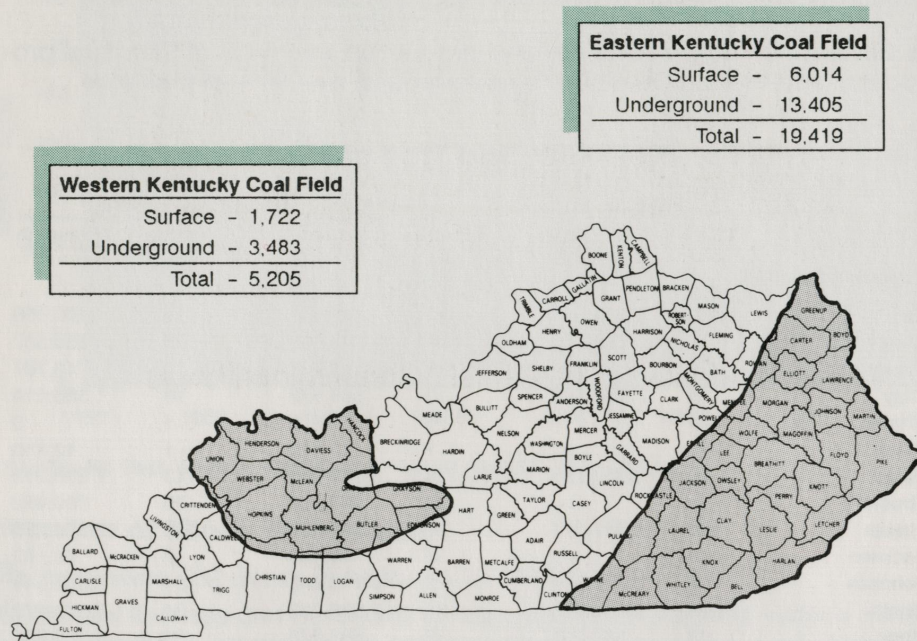
County	Underground		Surface		Total	
	Licenses	Tonnage	Licenses	Tonnage	Licenses	Tonnage
Eastern Kentucky						
Bell	22	2,931,938	17	1,168,412	39	4,100,350
Breathitt	2	24,472	54	4,309,865	56	4,334,337
Carter	—	—	1	13,767	1	13,767
Clay	6	767,592	10	588,522	16	1,356,114
Clinnton	—	—	1	0	1	0
Elliott	—	—	1	12,110	1	12,110
Floyd	75	3,957,255	38	3,279,060	113	7,236,315
Greenup	—	—	10	960,452	10	960,452
Harlan	100	10,432,377	36	2,072,609	136	12,504,986
Jackson	—	—	5	84,103	5	84,103
Johnson	8	1,527,505	13	1,733,643	21	3,261,148
Knott	39	5,818,738	55	2,686,732	94	8,505,470
Knox	43	591,291	16	562,270	59	1,153,561
Laurel	—	—	2	21,036	2	21,036
Lawrence	—	—	1	27,295	1	27,295
Lee	—	—	6	208,931	6	208,931
Leslie	14	6,849,944	18	1,722,006	32	8,571,950
Letcher	39	15,921,387	66	3,810,333	105	19,731,720
McCreary	—	—	4	62,896	4	62,896
Magoffin	1	84,392	10	798,162	11	882,554
Martin	34	7,082,737	21	4,364,882	55	11,447,619
Morgan	—	—	1	20,000	1	20,000
Owsley	—	—	4	338,568	4	338,568
Perry	16	4,684,327	98	8,601,033	114	13,285,360
Pike	202	22,728,490	135	8,178,174	337	30,906,664
Pulaski	—	—	1	0	1	0
Rockcastle	—	—	1	1,500	1	1,500
Whitley	15	934,881	29	689,168	44	1,624,049
Wolfe	—	—	8	562,106	8	562,106
EKY Total	616	84,337,326	662	46,877,635	1,278	131,214,961
Western Kentucky						
Butler	—	—	5	50,194	5	50,194
Caldwell	—	—	1	0	1	0
Christian	2	140,615	2	1,263,418	4	1,404,033
Davless	—	—	15	1,640,944	15	1,640,944
Henderson	1	1,124,918	3	2,548,662	4	3,673,580
Hopkins	9	2,978,859	15	6,093,915	24	9,072,774
McLean	—	—	2	198,099	2	198,099
Muhlenberg	1	1,673,776	10	2,108,479	11	3,782,255
Ohio	2	436,116	9	2,547,160	11	2,983,276
Union	6	7,232,067	2	477,333	8	7,709,400
Webster	5	11,235,808	3	1,356,946	8	12,592,754
WKY Total	26	24,822,159	67	18,285,150	93	43,107,309
KY Totals	642	109,159,485	729	65,162,785	1,371	174,322,270

* Several licenses can be issued to one large multi-seamed surface mine.

Source: Ky. Dept. of Mines and Minerals, Annual Report, 1992.

The Kentucky coal mining industry has a current work force of approximately 24,624* people directly employed in coal mining jobs. The Western Kentucky coal field employs approximately 5,205 persons, while the Eastern Kentucky coal field provides 19,419 direct mining jobs.

Kentucky's Coal Mining Work Force, 1992



■ Eastern Kentucky averaged 79% of Kentucky's coal mining work force and accounted for about 74% of Kentucky's total coal production in 1992.

■ Western Kentucky averaged 21% of Kentucky's coal mining work force and accounted for about 26% of Kentucky's total coal production in 1992.

■ Due to continued productivity gains, Kentucky maintained 161.1 million tons of production during 1992 while direct mining employment continued on a steady decline.

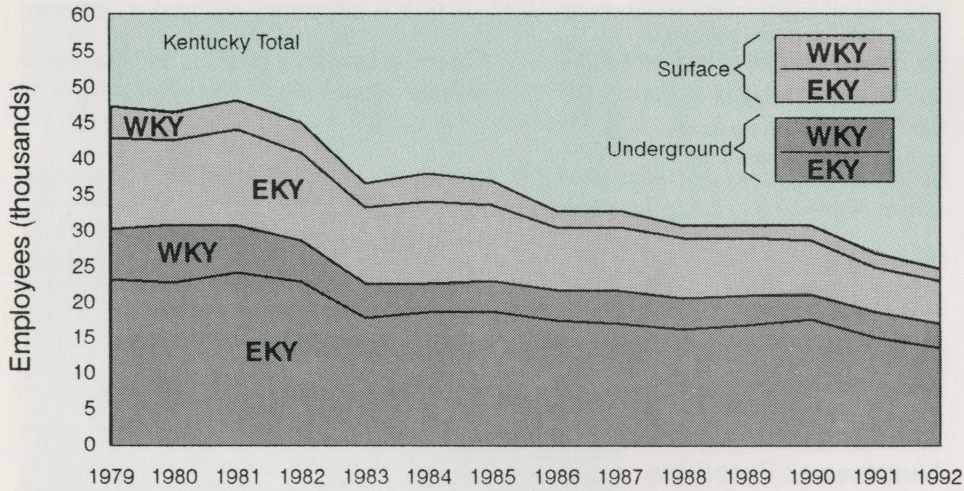
Kentucky Coal Mining Employment, 1979 - 1992

Year	Western Kentucky			Eastern Kentucky			Kentucky Totals
	Surface	Underground	Total	Surface	Underground	Total	
1979	4,343	6,945	11,288	12,838	23,064	35,902	47,190
1980	3,995	7,879	11,874	11,819	22,702	34,521	46,395
1981	4,056	6,489	10,545	13,473	24,032	37,505	48,050
1982	4,120	5,639	9,759	12,319	22,782	35,101	44,860
1983	3,415	4,918	8,333	10,485	17,615	28,100	36,433
1984	4,022	4,053	8,075	11,327	18,474	29,801	37,876
1985	3,421	4,294	7,715	10,516	18,583	29,099	36,814
1986	2,327	4,297	6,624	8,718	17,312	26,030	32,654
1987	2,345	4,605	6,950	8,740	16,900	25,640	32,590
1988	1,825	4,388	6,213	8,261	16,085	24,346	30,559
1989	1,870	4,166	6,036	8,034	16,586	24,620	30,656
1990	2,095	3,491	5,586	7,505	17,407	24,912	30,498
1991	1,910	3,603	5,513	6,251	14,878	21,129	26,642
1992	1,722	3,483	5,205	6,014	13,405	19,419	24,624

Source: U.S. DOE - Energy Information Administration; Coal Production, 1979 - 1992

* State employment numbers (page 14) differ slightly from federal EIA numbers.

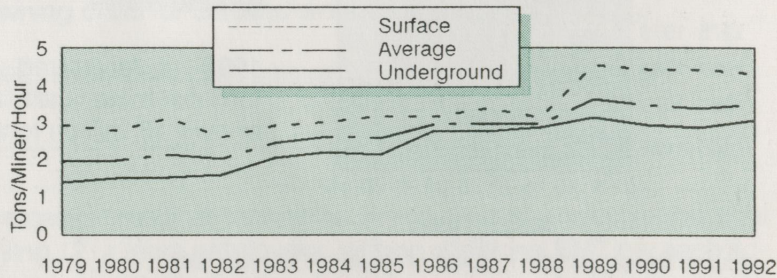
Kentucky Coal Mine Employment, 1979 - 1992



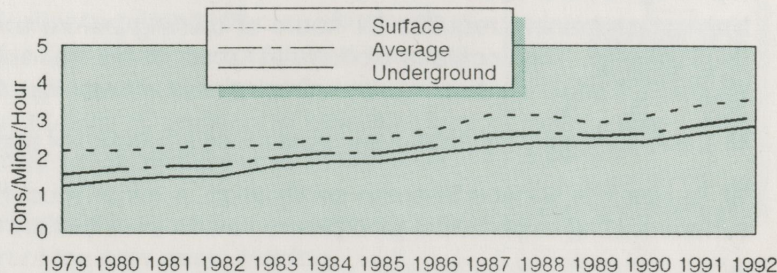
Coal Mine Productivity, 1977 - 1992 (tons/miner/hour)

Year	Eastern Kentucky	Western Kentucky	Kentucky Average	Appalachian Coal Field	Interior Coal Field	Western U.S. Coal Field	U.S. Average
1977	1.71	2.22	1.86	1.36	2.42	5.85	1.82
1978	1.62	1.97	1.71	—	—	—	1.79
1979	1.54	1.94	1.64	1.33	2.21	5.47	1.81
1980	1.67	1.96	1.74	1.39	2.30	5.64	1.93
1981	1.76	2.12	1.84	1.51	2.35	6.15	2.10
1982	1.79	2.01	1.84	1.51	2.38	6.26	2.11
1983	1.98	2.43	2.08	1.75	2.69	7.60	2.50
1984	2.13	2.61	2.24	1.86	2.80	8.30	2.64
1985	2.13	2.57	2.23	1.90	2.81	8.55	2.74
1986	2.31	2.94	2.45	2.09	3.14	9.27	3.01
1987	2.59	2.98	2.69	2.30	3.33	10.42	3.30
1988	2.68	2.95	2.74	2.44	3.45	11.01	3.55
1989	2.58	3.62	2.78	2.49	3.84	11.63	3.70
1990	2.66	3.46	2.83	2.60	3.88	11.82	3.83
1991	2.90	3.37	3.01	2.74	3.98	12.42	4.09
1992	3.10	3.49	3.20	2.95	4.18	12.73	4.36

Western Kentucky Coal Mine Productivity, 1979 - 1992



Eastern Kentucky Coal Mine Productivity, 1979 - 1992



Source: U.S. DOE - Energy Information Administration: Coal Production, 1977 - 1992.

Coal mining ranked 19th on the 1991 list of occupational injury and illness incidence rates by industry according to the U.S. Department of Labor's Bureau of Labor Statistics, May 1993, Bulletin 2424.

☛ Safety and health standards are highly regulated by the national Mine Safety and Health Administration (MSHA) and the Kentucky Department of Mines and Minerals.

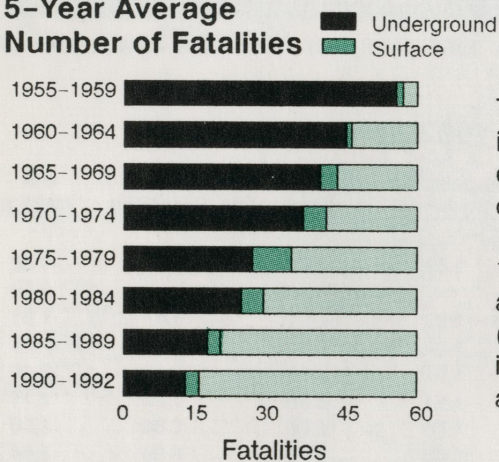
☛ All surface and underground mines are inspected regularly for violations; larger mines may have inspectors present daily.

☛ Miners are highly skilled technicians who receive extensive training, both general safety training and job-specific training.

Kentucky Gains in Productivity and Safety

5-Year Average

Number of Fatalities

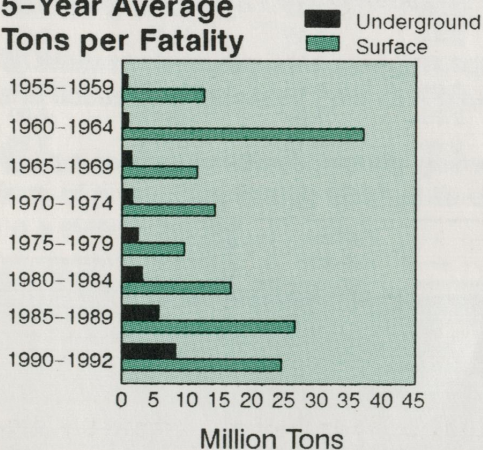


The bar chart shows the overall trend in mine safety improvements by averaging out somewhat erratic yearly data.

1992 ended with 9 mine fatalities, and the three year average (1990-1992) was less than 16 which is below the preceding 5 year average.

5-Year Average

Tons per Fatality



The productivity bar chart indicates safety improvements both in underground and surface mines, with steady improvement in underground mines.

1992 underground production in tons per mine fatality reached a high of over 18 million tons.

Source: Developed from Ky. Dept. of Mines and Minerals data.

Training for Surface Miners

New miner training requires 24 hours of training before employment at a surface mine. This includes workers at prep plants, rail sidings, and river terminals, and all contract workers on a mine site must take the training.

☛ Each surface mine employee must receive 8 hours of annual retraining.

☛ To obtain a surface foreman certification, a miner must have 2 years of surface mining experience, plus pass a written examination.

☛ To obtain a surface blaster's license, a miner must have 2 years of work experience under an experienced blaster, plus pass a written examination.

Underground Miner Classifications

Years* Experience Required	October 1993 Underground Mining Position	Current No. of Miners Certified
10 Yrs.	Electrical Inspector*	15
	Mine Inspector / Mine Safety Analyst*	600
5 Yrs.	Mine Foreman**	9,319
	Electrical Instructor*	75
3 Yrs.	Asst. Mine Foreman**	3,013
	Fire Boss	34
	Instructor	115
	Belt Examiner	2,664
1 Yr.	Electrical Worker*	7,210
	Shot Firer / Solid Blasting*	4,050
	Drill Oper / Solid Blasting*	3,690
	Holsting Engineer*	1,107
90 days	Mine Rescue	184
	Conventional Shot Firer*	12,699
	Gas Detection Certified Miners	15,459 20,897
<u>Special Training</u>		
	EMT - Emergency Medical Technician First Aid	1,520 2,923

* Tests are required in addition to years of experience.
** Includes fire boss and first aid.

Source: Ky. Dept. of Mines and Minerals.

Each miner receives new work assignment training of 20 hours minimum to become certified for each new job classification.

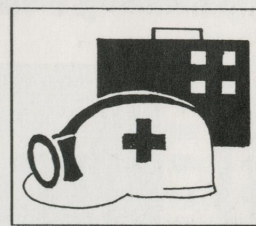
▀ To maintain certification and qualifications, satisfactory completion of an electrical retraining class for certified workers is required annually.

▀ Only certified shot-firers can detonate explosives within a mine.

EMT - An emergency medical technician is required at underground coal mines employing 12 or more employees, with an additional EMT per each additional 50 miners or majority fraction thereof.

▀ EMT certification requires 110 hours of instruction and 10 hours of emergency room intern observations and training (4 written tests) plus 24 hours of retraining every 2 years, in addition to maintaining a cardiopulmonary resuscitation (CPR) certification.

▀ A minimum of 10 hours of First Aid training is required as part of the new miner training.



Training for Underground Miners

New miner training requires a minimum of 48 hours of training to start work as a certified inexperienced miner.

▀ A certified inexperienced miner must work a minimum of 90 days in an underground mine and pass a written examination before becoming a certified experienced miner.

▀ A minimum of 16 hours of annual retraining is required to maintain the miner certification and continue to work at an underground mine.

▀ A newly hired miner (experienced or inexperienced) receives 8 hours of minesite-specific new miner training.

Employment/Wages by County

Coal County Wages and Employment, 1992⁴

County ¹	Direct Mining Employment	% of Labor Force	Miners as % of Total Employed	Mining Wages	% of Total County Wages	Avg. Weekly Mining Earnings ³
Eastern Kentucky						
Bell	880	9.1%	10.2%	28,019,638	16.6%	\$612.32
Breathitt	660	14.6%	16.8%	24,540,448	34.1%	715.05
Carter	38	.4%	.4%	571,184	8%	289.06
Clay	120	2.2%	2.4%	3,268,996	4.7%	523.88
Floyd	1,364	8.7%	9.6%	40,774,963	17.5%	574.88
Harlan	2,554	23.2%	26.7%	90,714,347	44.3%	683.05
Johnson	339	3.9%	4.3%	10,886,749	10.1%	617.58
Knott	927	18.4%	20.7%	26,993,315	44.0%	559.98
Knox	165	1.7%	1.8%	3,608,893	3.4%	420.62
Laurel	252	1.4%	1.5%	7,647,806	2.6%	583.62
Lawrence	43	.9%	1.0%	890,560	2.1%	398.28
Lee	25	.9%	1.0%	420,549	1.9%	323.50
Leslie	1,247	22.9%	24.8%	44,595,041	59.3%	687.73
Letcher	1,210	13.4%	15.6%	37,630,802	32.4%	598.07
Magoffin	16	.5%	.5%	469,779	1.4%	564.64
Martin	1,509	51.0%	57.4%	68,451,261	70.9%	872.35
Perry	2,094	18.9%	21.0%	71,998,580	31.5%	661.22
Pike	4,806	19.1%	21.4%	164,017,060	34.9%	656.30
Pulaski	26	.1%	.1%	1,148,152	4%	849.22
Whitley	594	5.3%	5.9%	20,065,674	11.2%	649.63
<i>Subtotal</i>	<i>18,869</i>	-	-	<i>646,713,797</i>	-	<i>659.11</i>
EKY Total²	19,744	-	-	679,341,290	-	661.68

Fayette 1,075.93
Jefferson 1,368.83

Note: The direct mining employment classification does not include most of the administrative or professional employees of the coal companies located in Kentucky's two major metropolitan areas and does not include any private services or indirect employment

Western Kentucky						
Butler	14	.2%	.2%	316,396	6%	434.61
Daviess	342	.8%	.8%	11,992,292	1.7%	674.33
Henderson	489	2.3%	2.4%	23,440,233	6.1%	921.83
Hopkins	1,154	6.2%	6.9%	51,276,576	14.6%	854.50
Muhlenberg	444	4.6%	5.3%	21,853,815	15.1%	946.54
Ohio	358	5.3%	6.1%	14,186,176	16.3%	762.04
Union	1,781	30.1%	32.5%	81,023,232	48.1%	874.87
Webster	1,137	18.8%	20.7%	60,769,235	51.8%	1,027.83
<i>Subtotal</i>	<i>5,719</i>	-	-	<i>264,857,955</i>	-	<i>890.61</i>
WKY Total²	5,870	-	-	270,173,633	-	885.12

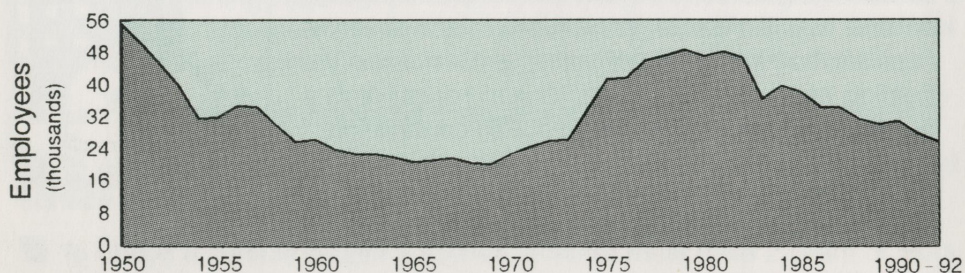
State Total² 25,722 - - **954,701,369** - **713.77**

¹ Counties with less than three employers or one employer with 80% of the total county miner work force were withheld to avoid disclosure of individual company data. The counties are as follows: Boone, Boyd, Casey, Christian, Elliott, Estill, Jackson, McCreary, McLean, Marshall, Menifee, Morgan, Nelson, Owsley, Warren, Wolfe. It is suspected that multicounty mining employment attributes to some counties being "under reported" and others being over reported.

² Columns do not add to the totals due to withheld data. ³ Variation in average weekly mining income affected greatly by hours worked per week as well as hourly wage rate.

⁴ The values and methodologies used in this table may not be consistent with LGEDF regulations (see page 17). Do not use these values for LGEDF estimates.

Coal Mining Employment in Kentucky, 1950 - 1992



Source: Kentucky Cabinet for Human Resources.

Severance Tax by County

Coal Severance Tax Revenue by County, Fiscal Year 1992-1993

County	Gross Value of Severed Coal	Tax on Severed Coal	Gross Value of Processing	Total Tax Receipts
Bell	\$ 101,179,291	\$ 4,161,816	\$ 17,484,279	\$ 4,916,169
Boyd			28,119,387	1,264,595
Breathitt	82,475,773	3,684,178	4,586,818	3,887,151
Butler	661,422	23,218	372,061	39,961
Caldwell	W	W	W	W
Carter	95,803	4,311	62,847	7,139
Christlan	22,031,732	984,296	2,196,597	1,082,513
Clay	26,068,165	1,169,631	1,622,488	1,242,250
Davless	31,019,276	1,395,914	5,413,831	1,639,537
Elliott	W	W	W	W
Estill	W	W	W	W
Floyd	158,518,971	7,085,528	6,072,569	7,357,028
Greenup	W	W	W	W
Harlan	326,797,384	14,260,498	28,259,979	15,498,368
Henderson	65,601,895	2,952,087	3,555,952	3,112,105
Hopkins	169,172,165	7,599,692	21,915,632	8,583,699
Jackson	1,767,558	78,914	200,925	87,956
Johnson	27,197,747	1,225,665	2,505,915	1,339,083
Knott	208,021,661	9,285,374	26,587,467	10,474,625
Knox	31,562,478	1,416,980	2,266,343	1,518,917
Laurel	1,310,128	58,870	921,717	99,947
Lawrence	18,853	848	355,358	16,337
Lee	2,383,118	72,465	80,861	76,104
Leslie	209,076,001	9,411,239	24,703,700	10,522,907
Letcher	119,450,011	5,328,422	20,245,256	6,239,670
McCreary	4,231,098	190,400	127,541	196,140
McLean	W	W	W	W
Magoffin	16,957,865	743,196	2,718,257	862,938
Martin	323,787,565	14,302,452	38,356,609	15,988,359
Morgan	4,591,870	206,634	961,852	249,918
Muhlenberg	56,081,727	2,524,499	3,835,341	2,697,090
Ohio	48,360,428	2,172,011	4,355,220	2,367,978
Owsley	3,860,404	163,736	237,389	174,419
Perry	299,639,910	13,208,836	38,239,439	14,926,106
Pike	760,550,829	34,028,132	108,721,575	38,901,110
Rockcastle	60,523	2,802	243,004	13,737
Union	161,550,019	7,269,751	19,088,592	8,128,738
Webster	247,765,450	11,149,447	24,780,252	12,264,558
Whitley	45,367,901	1,913,575	14,160,182	2,527,182
Wolfe	W	W	W	W
State Totals*	\$3,581,083,347	\$159,152,556	\$458,621,274	\$179,618,484

^W Withheld to avoid disclosure of individual company data.

* Columns do not add to State Totals because of counties in which information was withheld to avoid disclosure of individual company data.

Source: Kentucky Revenue Cabinet.

The gross value of the coal mined and processed in Kentucky during Fiscal Year 1992-1993 was \$4.04 billion.

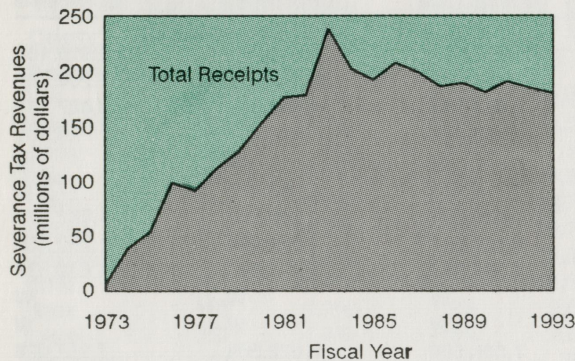
Eastern and Western Kentucky Severance Tax Contribution, Fiscal Year 1992-1993

Eastern Kentucky	\$147,722,024
Western Kentucky	\$ 31,896,460

Pike County was the leading Eastern Kentucky county, accounting for over \$38 million in coal severance taxes during Fiscal Year 1992-1993.

Webster County was the leading Western Kentucky county, accounting for over \$12 million in coal severance taxes during Fiscal Year 1992-1993.

The Kentucky coal industry paid \$179.6 million in coal severance taxes in Fiscal Year 1992 - 1993.



Source: Ky. Revenue Cabinet, Annual Reports, 1973-93

Coal production and the gross value of coal per ton decreased, causing a small decline in coal severance tax receipts.

■ In addition to the \$21.6 million of the severance tax returned directly to the counties (LGEAF), 3% (approximately \$5.3 million) is going to the new Local Government Economic Development Fund (LGEDF see page 17).

LGEAF

Coal Severance Tax - Local Government Economic Assistance Fund returned directly to Coal Producing and Impacted Counties.

County* and Municipal Totals for Fiscal Year 1992-1993

Coal Producing Counties

Bell	\$ 473,483
Breathitt	441,296
Butler	90,829
Carter	120,106
Christian	239,257
Clay	296,954
Davless	383,623
Elliott	88,885
Floyd	964,249
Greenup	195,245
Harlan	1,358,872
Henderson	406,816
Hopkins	858,860
Jackson	102,117
Johnson	371,794
Knott	892,965
Knox	252,760
Laurel	175,934
<i>Subtotal</i>	

Lawrence	\$ 388,009
Lee	96,190
Leslie	945,281
Letcher	684,186
McCreary	136,932
McLean	80,023
Magoffin	264,636
Martin	1,303,530
Morgan	105,837
Muhlenberg	370,070
Ohio	314,009
Owsley	106,232
Perry	1,376,470
Pike	3,264,437
Union	705,999
Webster	1,088,032
Whitley	324,786
Wolfe	134,798
<i>Subtotal</i>	\$ 19,403,502

Coal Impacted Counties

Adair	\$ 48,908
Boone	40,089
Bourbon	53,773
Boyd	307,880
Bullitt	36,110
Caldwell	56,814
Calloway	41,917
Campbell	39,688
Clark	107,305
Crittenden	42,014
Estill	46,073
Fayette	62,812
Franklin	34,975
Grant	47,097
Harrison	52,211
Jefferson	62,989
Kenton	28,284
Livingston	38,807
<i>Subtotal</i>	

Logan	\$ 57,162
Lyon	47,811
Madison	53,246
Marshall	37,972
Mason	37,209
Nelson	46,479
Nicholas	34,108
Pendleton	51,661
Powell	115,318
Pulaski	138,503
Rockcastle	49,798
Rowan	41,925
Russell	38,413
Scott	46,033
Shelby	50,717
Simpson	35,365
Taylor	36,557
Warren	56,442
Woodford	33,478
<i>Subtotal</i>	\$ 2,155,943

State Total

\$ 21,559,445

Source: Governor's Office, Department of Local Government.

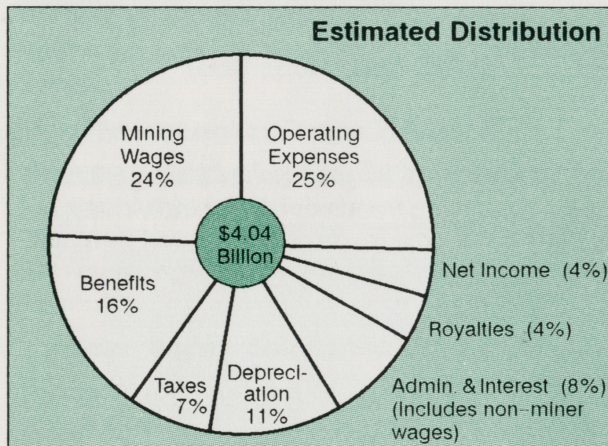
* Cities within each county are included in county totals.

The production and sale of Kentucky coal:

- ◆ brought \$3.3 billion into Kentucky from out-of-state
- ◆ provided over 100,000 jobs directly or indirectly
- ◆ generated about \$530 million in revenues in state taxes

The gross value of the coal mined and processed in Kentucky during Fiscal Year 1992 - 1993 was \$4.04 billion.

An estimated \$3.3 billion (or 81% of the total) was brought into Kentucky from 29 other states and from foreign countries. The six largest include: Tennessee (\$510 million), Florida (\$450 million), Georgia (\$360 million), North Carolina (\$340 million), South Carolina (\$270 million), and Ohio (\$250 million).



The Kentucky coal industry paid over 0.95 billion dollars in total covered wages in 1992.

Miners' wages accounted for about 24% of the total, and economic ripple effects from the mining industry induced employment of an additional 75,000 persons.

The Kentucky coal industry resulted in over 8.4 billion dollars of total estimated economic output in 1992.

Unmined mineral taxes contributed \$10.2 million to state (23%) and local (77%) revenues during 1990 and will continue to be paid yearly.

Sources: Kentucky Coal Marketing and Export Council.
 U.S. Department of Commerce, Bureau of Economic Analysis.
 Seth Schwartz, *Coal and the Kentucky Economy*, 1985.
 Dr. Charles F. Haywood, *Estimating the Economic Impact of Reduced Production of Western Kentucky Coal*, 1991.
 Kentucky Revenue Cabinet, Mineral Valuation Section.

Local Government Economic Development Fund (LGEDF)

Legislation established this new fund to be administered in the Economic Development Cabinet by the Kentucky Economic Development Finance Authority (KEDFA) and the Secretary of the Cabinet.

In the 92-93 fiscal year, 3 percent of the coal severance tax revenues (approximately \$5.3 million) have been allocated to the fund (LGEDF). The statute calls for the following percentages of the yearly severance tax to be allocated to the fund (LGEDF):

FY 92-93	3%	Appropriated
FY 93-94	6%	Appropriated
FY 94-95	12%	*
FY 95-96	38%	*

*Needs appropriation by future legislatures.

The Local Government Economic Development Fund (LGEDF) will be used by coal producing counties to attract new jobs directly to the affected counties by selecting the best industrial development projects.

The coal producing counties will, in accordance with their approved Economic Development Plan, receive grants from their LGEDF account.

There is no such thing as an average coal price as "average" coal price is an ambiguous term. There are as many coal price averages as there are coal qualities (i.e., sulfur, Btu), market types (i.e., steam coal, metallurgical or coking, industrial, export), sales conditions (i.e., spot market, extended spot market; short-term contract, long-term contract), sales location and included costs (i.e., FOB* mine, FAS**, CIF***, total delivered). Within each of these ways to sell coal, there are wide ranges of price. A further review of the major points at which coal is sold and the different cost included during the mine-to-market process of coal in Kentucky are as follows:

Coal sold in place (reserves)	Gross value of the severed coal plus transportation
Coal sold in the pit	
Gross value severed coal	*FOB (Free on Board) the mine, rail-car, river terminal, export terminal
Gross value of the severed coal plus transportation and processing	**FAS (Free Along Side)
Total delivered price	***CIF (Cargo Cost/Insurance/Freight)

However, the U.S. Department of Energy does provide an average annual coal cost price which is useful for identifying trends only! For individuals not pricing, selling, buying or involved in the day-to-day marketing of Kentucky coal but just needing to follow the market price and trends, these values are helpful.

Average Value of Kentucky Coal FOB Mine (dollars per ton)

Year	Eastern Kentucky			Western Kentucky			Kentucky
	Underground	Surface	Average	Underground	Surface	Average	Average
1976	\$26.37	\$20.36	\$23.03	\$15.12	\$13.41	\$14.18	\$19.79
1977	\$25.98	\$18.71	\$21.67	\$19.88	\$14.80	\$17.07	\$20.02
1978	\$28.86	\$22.58	\$25.30	\$22.78	\$18.35	\$20.36	\$23.86
1979	\$30.18	\$24.85	\$27.62	\$26.26	\$18.79	\$22.17	\$26.04
1980	\$30.98	\$26.23	\$28.73	\$27.40	\$22.28	\$24.72	\$27.62
1981	\$32.47	\$28.86	\$30.72	\$30.92	\$25.03	\$27.66	\$29.95
1982	\$32.71	\$28.85	\$30.87	\$32.50	\$26.53	\$29.25	\$30.44
1983	\$30.71	\$28.43	\$29.63	\$30.72	\$25.97	\$28.09	\$29.20
1984	\$29.29	\$27.84	\$28.61	\$28.68	\$25.50	\$26.81	\$28.13
1985	\$29.83	\$27.41	\$28.77	\$26.79	\$26.68	\$26.73	\$28.24
1986	\$26.89	\$25.67	\$26.38	\$24.25	\$26.56	\$25.31	\$26.09
1987	\$27.48	\$25.74	\$26.71	\$25.06	\$24.16	\$24.68	\$26.15
1988	\$27.72	\$25.92	\$26.97	\$24.89	\$22.32	\$23.96	\$26.20
1989	\$25.69	\$25.96	\$25.80	\$23.03	\$21.79	\$22.48	\$24.97
1990	\$25.49	\$26.44	\$25.84	\$24.42	\$22.01	\$23.32	\$25.19
1991	\$26.29	\$26.51	\$26.37	\$24.83	\$20.26	\$22.88	\$25.45
1992	\$25.32	\$24.49	\$25.00	\$24.75	\$20.94	\$23.10	\$24.50

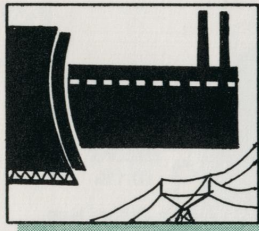
Sources: U.S. Bureau of Mines, Minerals Yearbook, 1976; U.S. DOE, Bituminous Coal and Lignite Production and Mine Operations, 1977-1978, and Coal Production, 1979-1992. DOE - EIA, Coal Data: A Reference, May, 1989.

For an indication of month-to-month trends, the spot sales data (steam coal and metallurgical coal) published in monthly trade publications are useful. These monthly spot coal prices are usually presented in 3 or 4 different incremental ranges of percent sulfur (i.e., 0-0.75, 0.76-1.5, 1.6-3.0, 3.1-4.0) for at least 4 different average Btu/lb values (i.e., 11,000, 11,500, 12,000, 12,500). The monthly trade publications sometimes list nine to twelve average prices for each mine region such as the Appalachian and the Interior Basin. It must be kept in mind though that spot sales are only *one part* of total coal sales transactions.

A good source of average "total delivered price" of electric utility coal is the values reported by the utilities on U.S. DOE Energy Information Administration Form 423 data. This is a good source for market prices, since the electric utility industry is a major market source for Kentucky coal. However, when using these "total delivered prices" for trend comparisons, it should be remembered that "total delivered price" is affected greatly by *transportation costs* and only consistent origins and destinations must be utilized in yearly trend comparisons.

Coal-Low Cost Energy

Coal is the lowest cost fossil fuel and its price is the most stable.



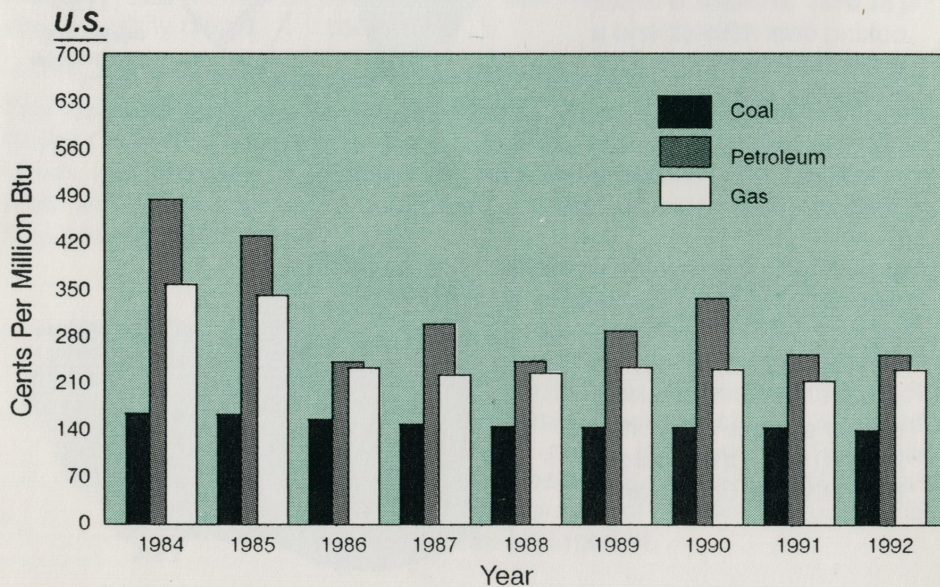
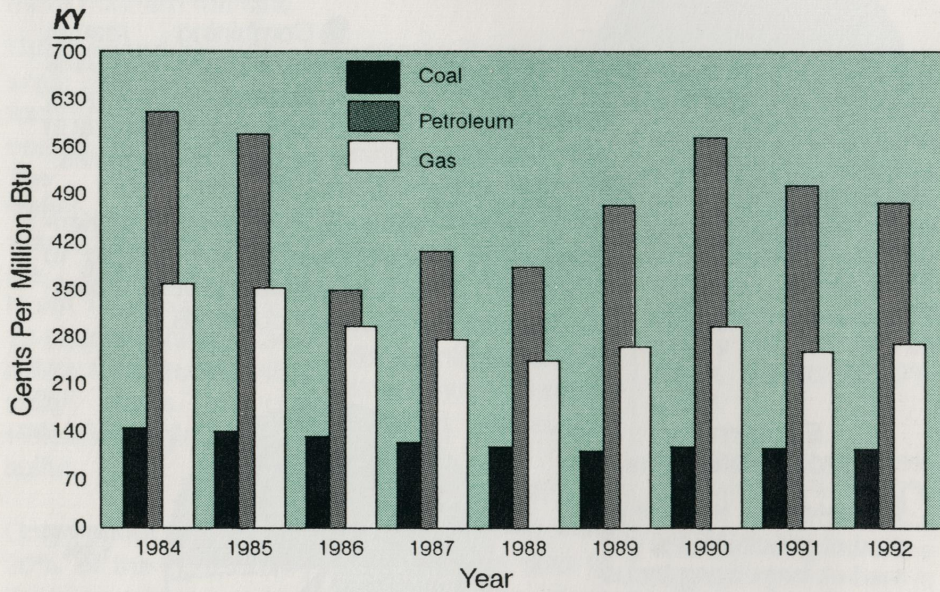
95% of Kentucky's electricity was generated from coal in 1991. (Hydro provided 4.8%; oil and gas together provided less than 0.2%.)

Utilities in Kentucky generated about 75.5 billion kilowatt-hours of electricity in 1991. Kentucky typically exports around 15% to 40% of the electricity produced in the state.

A comparison of fuel prices shows not only the fuel cost saving of coal but the more stable price dependability of coal. *Note that coal is the least cost energy source on the chart below.*

Notice the jump in gas cost during 1992 while coal cost continued to decrease.

Average Cost of Coal, Petroleum, and Gas



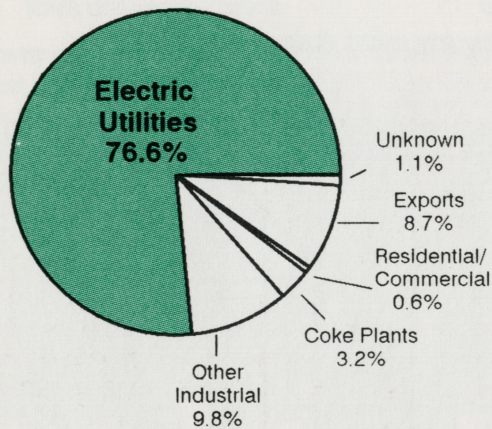
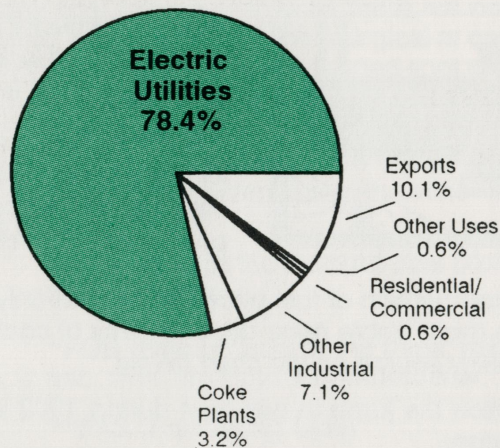
Source: Energy Information Administration, Cost and Quality of Fuels for Electric Utility Plants, 1992.

Distribution of Coal by Consuming Sector, 1992

U.S. Total 998.65 million tons

Electric utilities represent the largest market for U.S. and Kentucky coal.

The three major markets for coal are electric utilities, industry, and the export market.



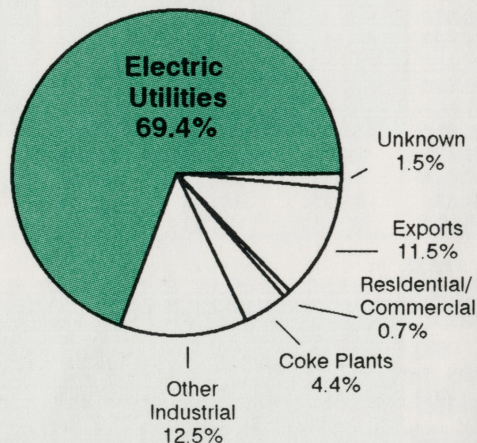
Kentucky 161.8 million tons

Combining market sectors shows that 91% of Kentucky's coal goes to the domestic market in approximately 30 states.

The other 9% of Kentucky's coal is sold to Canada and several overseas countries.

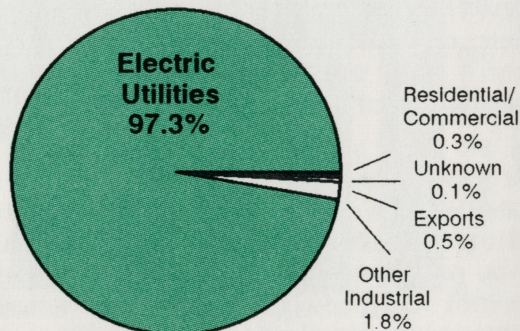
Eastern Ky. 120.2 million tons

Eastern Kentucky's market, much like the U.S. market, has strong industrial (12.5%) and export (11.5%) sectors, a small coking coal market, and a predominate electric utility market at 69.4%.



Western Ky. 41.7 million tons

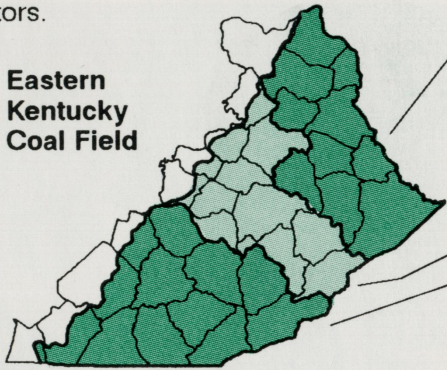
Western Kentucky is almost totally dependent on the electric utility market with 97% of its coal going to electric utility plants.



Kentucky's Four Market Sheds

The Eastern Kentucky coal field has been divided into three areas based on their different coal markets, transportation access, coal quality and other factors.

Eastern Kentucky Coal Field



Big Sandy River Counties: Boyd, Carter, Elliott, Floyd, Greenup, Johnson, Lawrence, Magoffin, Martin, and Pike.

Kentucky River Counties: Breathitt, Estill, Knott, Lee, Letcher, Morgan, Owsley, Perry, and Wolfe.

Cumberland Valley Counties: Bell, Clay, Clinton, Harlan, Jackson, Knox, Laurel, Leslie, McCreary, Pulaski, Rockcastle, Wayne, and Whitley.

As one considers these three "transportation/market sheds" in the following order - the Cumberland Valley, the Kentucky River, and the Big Sandy - there is: (1) an increase in market diversity as indicated by decreased reliance on the electric utility market, and (2) a shift from primarily southern markets to more northern markets.

Cumberland Valley area: sells over three-fourths (80-90%) of its coal to electric utilities. The major market states are Florida, South Carolina, Georgia, Tennessee, and North Carolina. These 13 counties shipped 24 million tons of coal to 45 utility plants in 11 states, averaging 1.2% sulfur.

Only about 10% to 20% of the coal from these counties goes to markets other than electric utility plants.

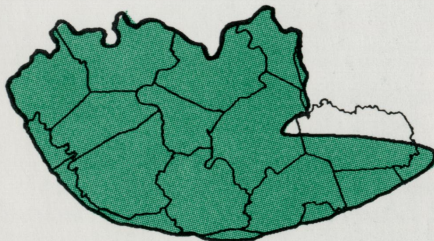
Kentucky River area: sells about half (46-52%) of its coal to electric utilities. The major market states are Georgia, Florida, Ohio, Kentucky, and South Carolina. These 9 counties shipped 22 million tons of coal to 76 utility plants in 16 states averaging 1.0% sulfur.

Approximately 48% to 54% of the coal from these counties goes to industrial users, coke plants and overseas markets.

Big Sandy area: sells over half (57-62%) of its coal to electric utilities. The major market states are North Carolina, Kentucky, Michigan, Ohio and Virginia. These 10 counties shipped 31 million tons of coal to 83 utility plants in 20 states, averaging 1.0% sulfur.

The non-utility markets consume 38% to 43% of the coal from these counties. In general the highest quality coal is sold to industrial users, coke plants and overseas markets.

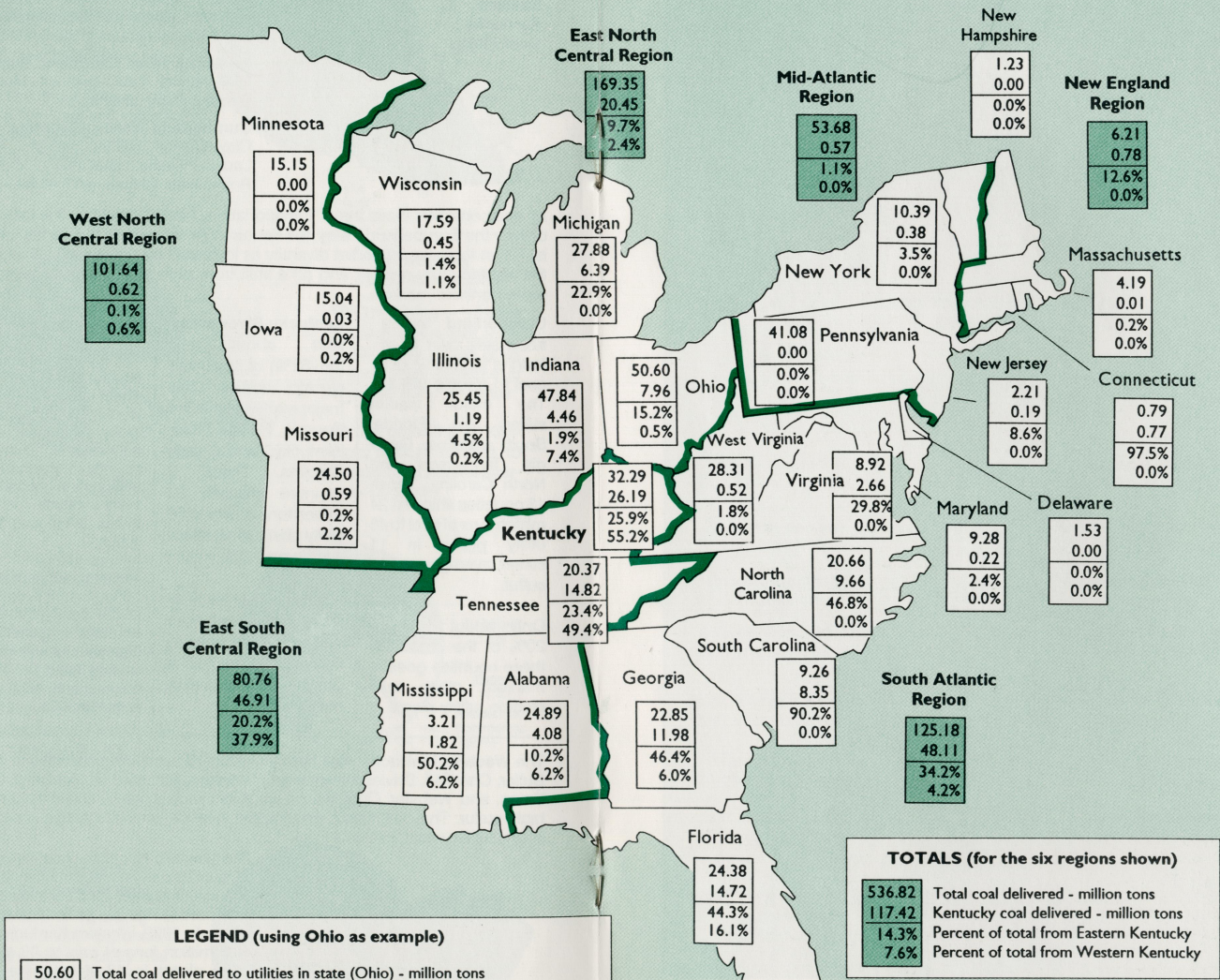
The **Western Kentucky coal field** included 10 producing counties in 1992: Butler, Christian, Daviess, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union, and Webster. Coal seams are thick, wide-spread, and medium- to high-sulfur. The coal field's geographic location provides ready access to ship coal by water, rail, and truck.



The Western Kentucky coal field sells 97% of its coal to electric utility plants. The major market states are Kentucky, Tennessee, Florida, Indiana, and Alabama. In 1992, Western Kentucky sold 40.6 million tons of coal to 39 electric utility plants in 13 states. Five utility companies purchased 33 million tons or over 80% of Western Kentucky's utility coal market.

Kentucky Coal Shipments to Electric Utility Plants by State in 1992

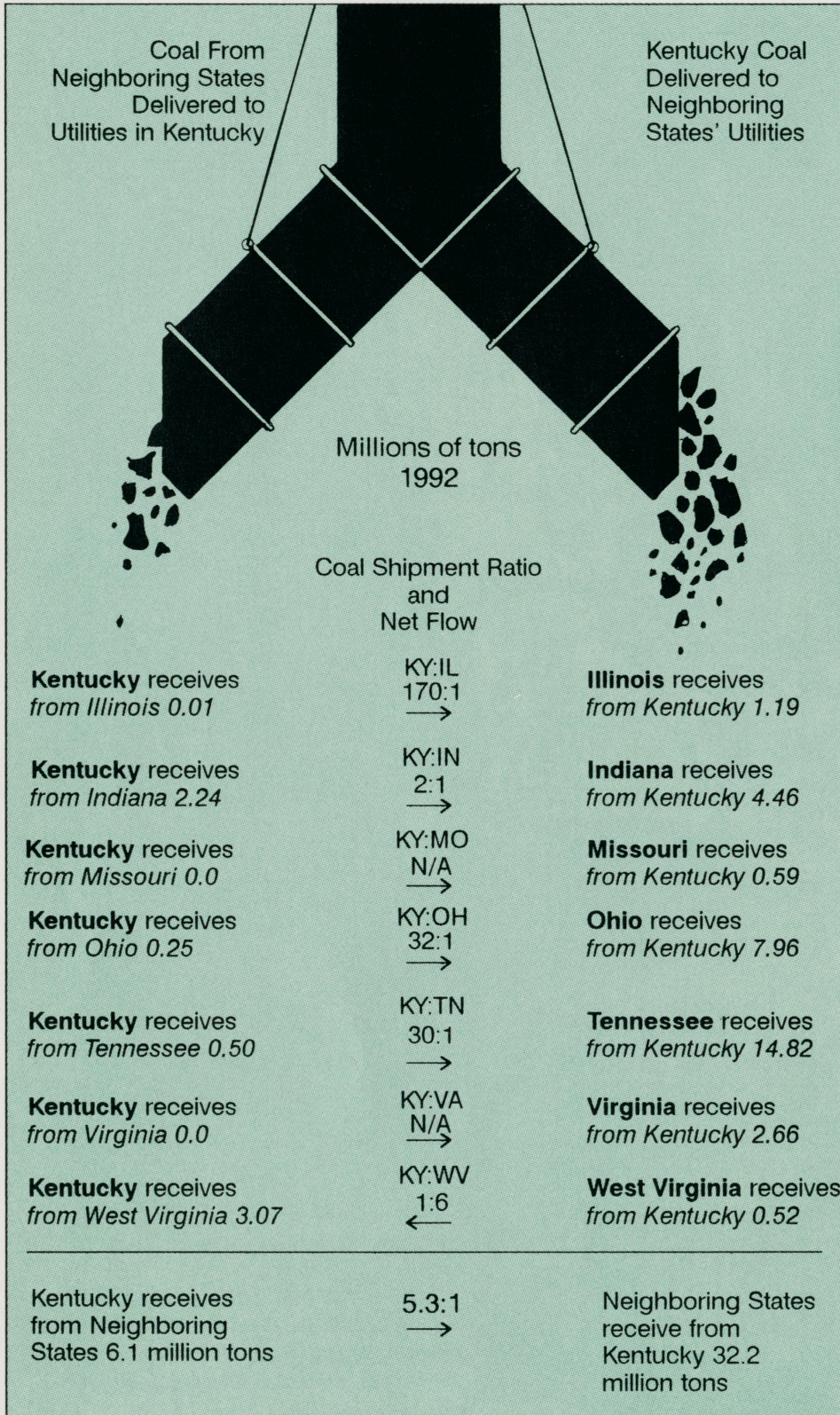
Kentucky coal was shipped to electric utilities in 22 states in 1992.



Source: Kentucky Coal Marketing and Export Council based on data from U.S. Department of Energy Energy Information Administration, *Cost and Quality of Fuels for Electric Utility Plants, 1992*

Distribution - Utility Coal

Kentucky exports over 5 tons of utility coal to neighboring states for every ton imported. The chart below shows the *Interstate Imports and Exports* of utility coal between Kentucky and its neighboring states.*



* Does not include metallurgical or industrial coal shipments.

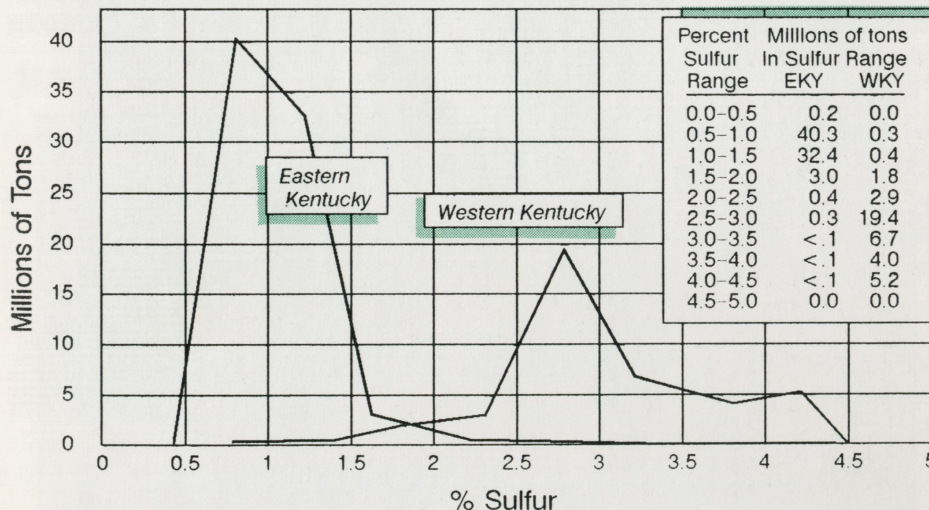
Source: U.S. DOE - Energy Information Administration, *Cost and Quality of Fuels*, 1992.

Kentucky coal was shipped to electric utility plants in 22 states in 1992.

Coal Field Destination State	Receipts Thousand Tons	Percentage of Receipts		Average Btu/lb	Average Percentage	
		Surface	Spot		Sulfur	Ash
Eastern Kentucky						
Alabama	1,535	33.8	44.8	12,336	1.1	9.4
Connecticut	772	0.0	10.4	13,162	0.5	6.3
Florida	10,791	32.7	16.7	12,760	1.0	8.0
Georgia	10,624	58.1	18.7	12,297	1.2	10.4
Illinois	1,148	12.1	24.8	13,239	0.6	6.4
Indiana	903	27.1	50.2	12,236	0.8	10.3
Kentucky	8,373	78.2	36.2	12,163	1.0	10.6
Maryland	215	100.0	14.9	12,922	0.7	7.4
Massachusetts	10	0.0	100.0	12,934	0.6	6.5
Michigan	6,392	39.0	15.7	12,770	0.9	8.3
Mississippi	1,613	14.9	2.8	12,672	0.9	8.4
Missouri	37	0.0	100.0	13,975	0.6	5.6
New Jersey	189	1.3	12.3	13,197	0.8	6.6
New York	377	0.0	30.0	13,035	0.6	7.0
North Carolina	9,659	42.9	28.0	12,529	0.9	8.9
Ohio	7,714	85.8	29.2	11,844	1.1	13.3
South Carolina	8,353	11.5	44.6	12,801	1.1	8.7
Tennessee	4,758	1.8	4.5	12,766	1.1	8.5
Virginia	2,663	37.5	34.2	12,730	1.1	8.6
West Virginia	524	100.0	4.5	12,508	0.9	9.0
Wisconsin	197	41.2	100.0	12,853	0.8	8.1
<i>Subtotal</i>	76,847	43.6	25.5	12,511	1.0	9.4
Western Kentucky						
Alabama	2,542	6.0	9.4	11,784	3.3	11.2
Florida	3,926	9.0	39.6	12,293	2.9	8.6
Georgia	1,357	100.0	0.0	11,737	3.0	10.1
Illinois	39	69.2	100.0	10,744	2.2	10.8
Indiana	3,551	75.3	10.8	11,446	3.1	10.3
Iowa	27	100.0	100.0	12,367	3.4	9.6
Kentucky	17,814	52.6	13.3	11,275	3.3	12.5
Mississippi	203	92.9	100.0	12,240	2.7	8.1
Missouri	548	66.7	0.0	11,651	3.6	8.1
Ohio	247	70.6	0.0	11,574	2.8	8.6
Tennessee	10,066	46.8	2.7	11,851	2.6	8.1
Wisconsin	249	100.0	100.0	12,384	1.5	8.6
<i>Subtotal</i>	40,570	48.4	13.2	11,598	3.1	10.5
Total	117,417	45.3	21.3	12,196	1.7	9.8

Eastern Kentucky coal shipped to electric utility plants during 1992 averaged 1.0% sulfur and Western Kentucky electric utility coal shipments averaged 3.1% sulfur.

Sulfur Distribution of Kentucky Coal Shipped to Utility Plants*

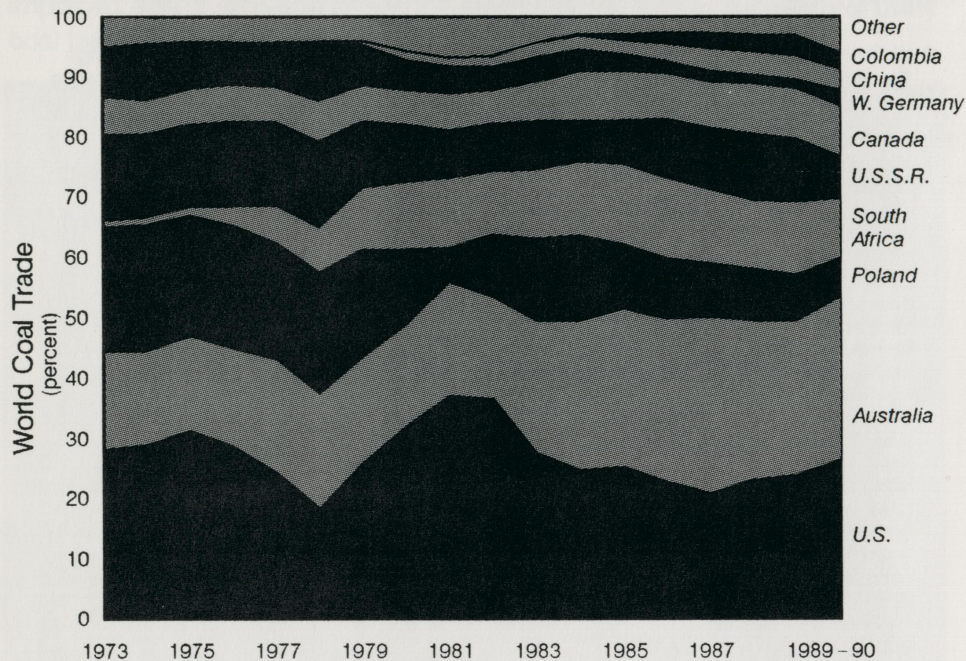


* 1992 values plotted at weighted average sulfur content within each sulfur range.

Source: U.S. DOE - Energy Information Administration, Form 423 data.

Exports

The U.S. Plays a Major Role in World Coal Trade



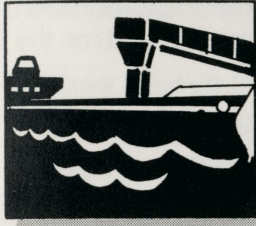
■ The United States continued to be of worldwide importance as a source of coal ranking second to Australia in the amount exported in 1990.

■ The United States exports coal to over 35 countries with five countries – Canada, Japan, Italy, Netherlands, Belgium-Luxembourg – accounting for more than half of the total.

Destination of U.S. Coal Exports (million tons)

Year	Canada	Brazil	Europe	Japan	Other	Total
1960	12.8	1.1	17.1	5.6	1.3	38.0
1961	12.1	1.0	15.7	6.6	1.0	36.4
1962	12.3	1.3	19.1	6.5	1.0	40.2
1963	14.6	1.2	27.7	6.1	.9	50.4
1964	14.8	1.1	26.0	6.5	1.1	49.5
1965	16.3	1.2	25.1	7.5	.9	51.0
1966	16.5	1.7	23.1	7.8	1.0	50.1
1967	15.8	1.7	19.4	12.2	1.0	50.1
1968	17.1	1.8	15.5	15.8	.9	51.2
1969	17.3	1.8	15.2	21.4	1.2	56.9
1970	19.1	2.0	21.8	27.6	1.2	71.7
1971	18.0	1.9	16.6	19.7	1.1	57.3
1972	18.7	1.9	16.9	18.0	1.2	56.7
1973	16.7	1.6	14.4	19.2	1.6	53.6
1974	14.2	1.3	16.1	27.3	1.8	60.7
1975	17.3	2.0	19.0	25.4	2.6	66.3
1976	16.9	2.2	19.9	18.8	2.1	60.0
1977	17.7	2.3	15.0	15.9	3.5	54.3
1978	15.7	1.5	11.0	10.1	2.5	40.7
1979	19.5	2.8	23.9	15.7	4.1	66.0
1980	17.5	3.3	41.9	23.1	6.0	91.7
1981	18.2	2.7	57.0	25.9	8.7	112.5
1982	18.6	3.1	51.3	25.8	7.5	106.3
1983	17.2	3.6	33.1	17.9	6.1	77.8
1984	20.4	4.7	32.8	16.3	7.2	81.5
1985	16.4	5.9	45.1	15.4	9.9	92.7
1986	14.5	5.7	42.6	11.4	11.4	85.5
1987	16.2	5.8	34.2	11.1	12.3	79.6
1988	19.2	5.3	45.1	14.1	11.3	95.0
1989	16.8	5.7	51.6	13.8	12.9	100.8
1990	15.5	5.8	58.4	13.3	12.8	105.8
1991	11.2	7.1	65.5	12.3	12.9	109.0
1992	15.1	6.4	57.3	12.3	11.4	102.5

Sources: Energy Information Administration, Coal Data: A Reference, 1989, Quarterly Coal Report, October - December, 1992, International Energy Annual, 1991.



The U.S. exported 102.5 million tons of coal in 1992, while importing only 3.8 million tons.

■ Kentucky's 1992 exports of 14 million tons were 13.8% of total U.S. exports in that year. The value of Kentucky's coal exports is estimated at over \$580 million based upon the average U.S. coal export F.A.S. value of \$41.34 per short ton.

Kentucky Coal Exports, 1992 (thousands of tons)

Region	Canada	Overseas*	Total
Eastern Kentucky	2,078	11,737	13,815
Western Kentucky	--	221	221
Kentucky Total	2,078	11,958	14,036

Source: EIA, Quarterly Coal Report, Oct.-Dec., 1992. *Includes Mexico

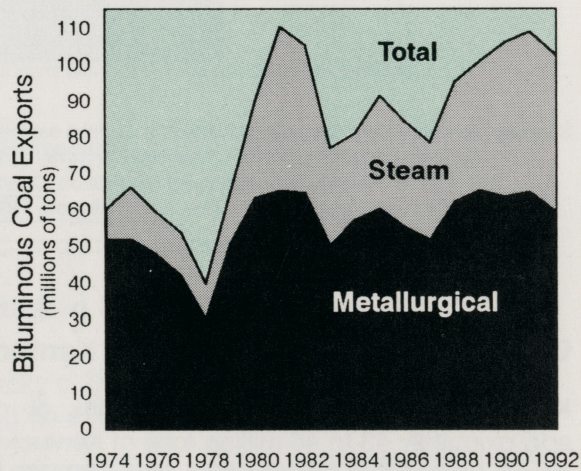
■ Kentucky ranks third in the U.S. for coal exports behind West Virginia (50.8 million tons) and Virginia (17.2 million tons). Canada, Taiwan, Italy, the Netherlands, and Brazil are considered to be major importers of Kentucky coal.

U.S. Bituminous Coal Exports, Steam and Metallurgical

Metallurgical coal has historically dominated U.S. bituminous exports, and is expected to continue to do so through the remainder of the century.

In 1992 the U.S. exported 102.5 million tons of coal (43.1 million of steam coal and 59.4 million of metallurgical coal).

Metallurgical coal remained the majority of U.S. exports, although its share of the total dropped to 58% in 1992.



Sources: Energy Information Administration, Coal Data: A Reference, 1989; Quarterly Coal Report, Oct.-Dec., 1992.

U.S. Imports*

U.S. Total		
Year	Quantity (millions)	Average Price / Ton
1981	1.043	\$28.47
1982	0.742	30.40
1983	1.271	33.59
1984	1.286	35.37
1985	1.952	36.04
1986	2.212	36.02
1987	1.747	32.04
1988	2.134	29.96
1989	2.851	34.14
1990	2.699	34.45
1991	3.390	33.12
1992	3.803	34.46

* Includes Puerto Rico and Virgin Islands.

Source: Energy Information Administration, Quarterly Coal Report, Oct.-Dec., 1992.

Colombia and Canada were the largest suppliers of imported coal in 1992. Their share was 1.7 million and 1.0 million short tons, respectively. Venezuela was next with its share being 0.5 million tons.

One electric utility plant (Jacksonville Electric Authority, St. Johns River Plant) received almost half of the total U.S. imports (1.5 million short tons mostly from Colombia during 1992).

Transportation

Most Kentucky coal is transported by more than one mode of transportation because of cost considerations, the location of the minesite, and/or the customer.

- ▀ Kentucky coal is transported by rail, truck, and/or barge.
- ▀ Transportation is often more than one third of the cost of delivered coal.

Kentucky Coal Transportation System Distribution Estimate

Minesite



**1992 Kentucky
Coal Production
174.3 Million Tons**

Distribution Modes

☞	75% Minesite to state-maintained highway (130 Million Tons)
	5% Kentucky power plants & other Ky. consumers
	11% Coal river terminals
	7% State Line
	6% Truck Sites
	46% Rail loading facilities
☞	14% Other Known Direct Minesite Distribution Modes (25 Million Tons)
	> 1% Minesite to barge facility via conveyor
	13% Loaded directly to rail at the minesite
☞	11% Unknown, Unreported, or Unclassified (19 Million tons - i.e. refuse, raw coal losses, other differences in reporting methods, etc.)

Sources: Kentucky Coal Marketing and Export Council estimates based on data from:
Ky. Transportation Cabinet's Coal Haul Highway System, 1993 Report.
U.S. DOE - Energy Information Administration, Quarterly Coal Report Oct.-Dec. 1992.
Ky. Dept. of Mines and Minerals, Annual Report, 1992.

Coal Transportation by Barge in Kentucky

Kentucky has more than 1,000 miles of navigable rivers over which approximately 43 to 46 million tons of Kentucky coal are shipped each year. Approximately 5 to 8 million tons, about 30 - 50 percent of total annual exports of Kentucky coal, are transported to port facilities by river.



▀ Statewide, 61 coal river terminals on the Ohio River and its tributaries serve Kentucky coal shippers. Approximately 44 are within Kentucky's borders and 17 on opposite banks.

▀ In total, 23 coal river terminals are located near Eastern Kentucky, 8 in Central Kentucky, and 30 near Western Kentucky.

▀ Of these, 25 of the coal river terminals have rail access, 52 have truck access, 22 have barge off-loading access, and 5 have conveyor access.

▀ Automated blending is found in 45 of the coal river terminals with 34 having automatic sampling, 29 having some coal crushing equipment, and 11 having stoker preparation equipment.

Source: Kentucky Coal Marketing and Export Council, 1993 Kentucky Coal Marketing Updates - Coal River Terminals.

Coal Transportation by Rail in Kentucky

Kentucky has over 2,700 miles of railroad lines, over which 102.6 million tons of Kentucky coal were transported in 1992.

There are 2 Class I railroads, 1 Class II railroad, originating coal and 2 short line railroads that operate totally in Kentucky or originate coal in Kentucky.

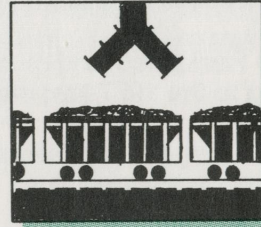
These railroads have in excess of 100,000 hopper cars dedicated to the transport of coal.

Kentucky has approximately 205 coal rail loading facilities, with 89% of the more efficient and modern facilities being active during 1992. Many of the older, less efficient facilities are temporarily inactive as excess capacity.

There are 121 coal loading rail facilities with unit train service (74 provide 4 hour service, and 47 provide 24 hour service). Over 94 million tons (92% of rail shipments) of Kentucky coal moved by unit train service during 1992.

Coal is the main commodity of Kentucky's rail industry which employs over 6,700 Kentuckians and has a combined annual payroll of over 256 million dollars.

Sources: Kentucky Coal Marketing and Export Council estimates based on data from:
 CSX Transportation, Inc.
 Paducah and Louisville Railway
 TransKentucky Transportation Railroad, Inc.
 Norfolk Southern Corporation
 Tradewater Railway Corporation



Coal Transportation by Truck in Kentucky

Approximately 20% of Kentucky's 27,000 miles of state-maintained highways are used for transporting coal.

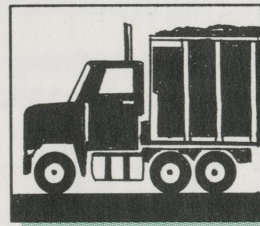
In 1992 over 130 million tons of coal were shipped direct from the minesite by coal truck accounting for 75% of 1992 Kentucky production.

Truck shipments are a very important mode of coal transportation in Kentucky. Approximately 80% of Kentucky's coal uses trucks in at least one leg of the many different types of multimodal coal transportation market routes.

Over 2.8 billion ton miles of coal transportation by truck were reported during 1992.

Over 3,500 coal trucks were registered during 1992 in Kentucky; indicating that over 3,500 coal truck drivers were employed in Kentucky.

The sale of extended weight coal decals generated \$917,000 in 1992.



Source: Ky. Transportation Cabinet, Official Coal Haul Highway System. 1993:
 Department of Vehicle Regulation - IRP Section.

Mined land must be returned to its approximate original contours, with the exception of mountaintop removal operations, in accordance with the Federal Surface Mining Control and Reclamation Act of 1977.

- ▀ The 1977 law allows mountaintops to be reclaimed as flat land, which leaves the land more valuable for development.
- ▀ Reclaimed land must be as useful as the land was before mining, according to the 1977 law; often it is more useful.
- ▀ Stringent regulations govern the design, operations, and environmental impact of every mine.
- ▀ Mining and reclamation sites are inspected on a regular basis by state inspectors with random oversight inspections by federal inspectors.
- ▀ Kentucky coal operators have paid over \$544 million to date into a federal program to reclaim land that was mined prior to August 3, 1977.
- ▀ Before surface mining begins Kentucky coal operators must post bonds to ensure proper reclamation.
- ▀ Under Kentucky's 1984 Permanent Program or "Primacy Program," bonds are not fully released until a coal operator has demonstrated five years of consecutive successful reclamation. (See chart)

The Kentucky coal mining industry currently has over \$781 million of reclamation bonds outstanding to assure timely and successful reclamation.

Bond Release Phase	Reclamation Release Type	% of Bond Released	Time / Phase Requirement
Phase I	Backfilling, Grading and Drainage	60%	Complete Landscaping
Phase II	Vegetation	25%	Approximately 2 Yrs. of Successful Reclamation
Phase III	Final	15%	5 Years of Consecutive Successful Reclamation

Successful Mining Reclamation - Primacy Bond Releases (1984 through 1992)

Year	Phase I			Phase II			Phase III		
	# of Releases	Acres*	Bond	# of Releases	Acres*	Bond	# of Releases	Acres*	Bond
1984	4	123	\$277,886	-	-	-	-	-	-
1985	40	767	\$1,946,323	2	84	\$79,841	1	8	\$11,600
1986	248	6,361	\$16,781,470	-	-	-	1	14	\$16,800
1987	332	8,379	\$21,390,109	11	253	\$289,767	4	155	\$284,300
1988	561	15,583	\$38,194,394	57	1,303	\$1,261,810	-	-	-
1989	446	16,777	\$32,058,350	60	1,632	\$1,967,811	3	21	\$38,500
1990	533	15,383	\$28,108,146	260	7,298	\$6,221,870	51	1,697	\$1,569,147
1991	626	14,642	\$28,373,662	428	12,667	\$11,200,897	130	2,958	\$6,890,877
1992	670	18,278	\$33,822,612	477	13,338	\$11,489,035	255	8,101	\$6,811,872
Total	3,460	96,293	\$200,952,952	1,295	36,575	\$32,511,031	445	12,954	\$15,623,096

* Includes surface acreage over underground mines.

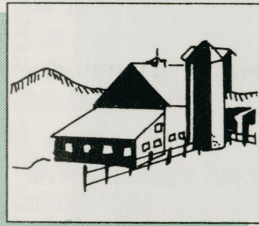
Kentucky is deriving many benefits from post mining land use in the form of wildlife refuges, airports, mountaintop farms, duck sanctuaries, parks, playgrounds, and level land for schools, hospitals, homes, businesses and churches.

Post mining land use changes go hand-in-hand with economic development in Kentucky, especially in many parts of Eastern Kentucky where much needed level land for development is still a premium.

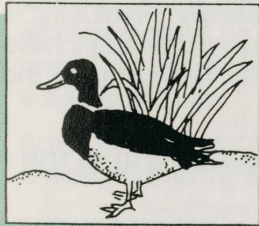
Post Mining Land Uses



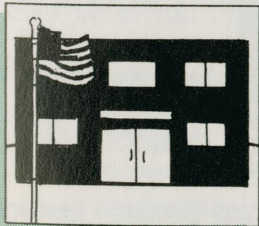
Industrial / Commercial



Cropland / Pasture Land



Developed Water Resources
Fish & Wildlife Habitat



Residential / Industrial /
Commercial

Samples of Post Mining Land Use

County

Regional Airports

Big Sandy Regional Airport	Martin
Pike County / Hatcher Field Airport	Pike
East Kentucky Regional Airport / Carroll Field	Perry
Ohio County Airport	Ohio
Manchester Airport	Clay

Correctional Facilities

Federal Correctional Institute	Clay
East Kentucky Correctional Complex	Morgan
Medium Security Prison	Muhlenberg
Private Prison	Floyd

Government Facilities

Earle C. Clements Job Corps Center	Muhlenberg
Kentucky Army National Guard Training Center	Muhlenberg
U.S. Postal Service	Laurel
Ohio County Park	Ohio
Madisonville South By-pass	Hopkins
Municipal Solid Waste Landfills	Webster, Davless*, Greenup, Hopkins, and Muhlenberg

Mountaintop Farms

Starfire Project	Perry
MAPCO / Morehead Agriculture Center	Martin
Martin County Coal Farm	Martin
D & R Brangus Farm	Perry
Avlan Farms	Wayne

Industrial/Commercial

Industrial Waste Disposal (scrubber sludge)	Ohio, Davless
Explosive Manufacturing	Muhlenberg
Recycling Center (proposed)	Ohio*
Wood Fabrication Plant	Breathitt*

Fish & Wildlife

Duck Refuge Areas	Ohio, Perry, Breathitt, Knott, Martin, and Muhlenberg
Goose Down Production	Greenup
Catfish Farming	Greenup, McLean
Trout Farm	Bell
Wildlife Management Area	Muhlenberg
Wetland Development	Muhlenberg

R & R / Sport

State Park (proposed)	Knott*
Recreation Areas	Greenup
Golf Courses	Clay, Letcher*, Martin*, McLean
Harness Track (proposed)	Boyd*

Sites for Homes, Schools, Churches, and Businesses

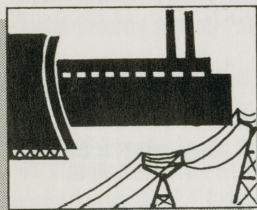
High Schools	Bell, Harlan, Pike
Bell County Middle School	Bell
Athletic Complexes	Bell, Letcher, Perry
Hazard Appalachian Regional Hospital	Perry
Housing Developments	Pike, Letcher
Faith Assembly of God Church, School, Daycare	Laurel
Humfleet Mobile Home Sales	Laurel
Shopping Centers	Breathitt, Clay, Knox, Laurel, Letcher, Pike, Perry
Numerous other Small Businesses In East Kentucky	

* Proposed Post Mining Land Uses

Sources: Natural Resources and Environmental Protection Cabinet - DSMRE;
Kentucky Coal Marketing and Export Council.

Coal is being burned more cleanly today than ever before.

Air pollution from coal is decreasing, while coal use is increasing.



The major source of air pollution from coal is electric utility plants, because they are the major users of coal.

Electric utilities are using less polluting coal and their use of pollution control equipment has increased dramatically.

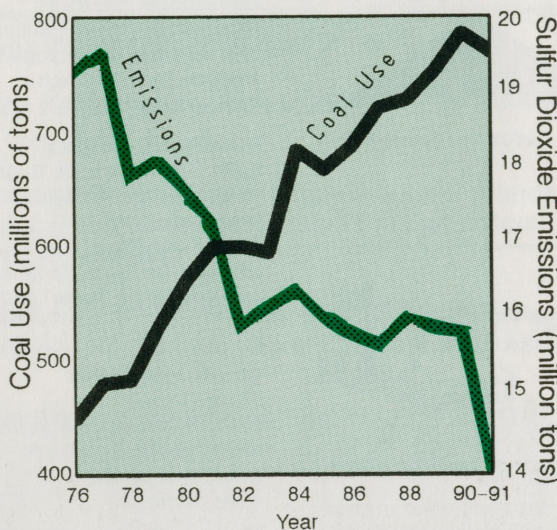
The pollution most often associated with coal has historically been smoke and soot - called particulates. Virtually all power plants have now installed pollution control equipment which captures over 99% of the smoke and soot. Sulfur dioxide is also of concern as one of the several causes of acid rain.

Coal Use and Sulfur Dioxide Emissions from Electric Utility Plants

Coal-fired power plants in the U.S. have reduced their sulfur dioxide emission rate (the amount of pollution produced for each ton of coal burned) by 55% since 1977.

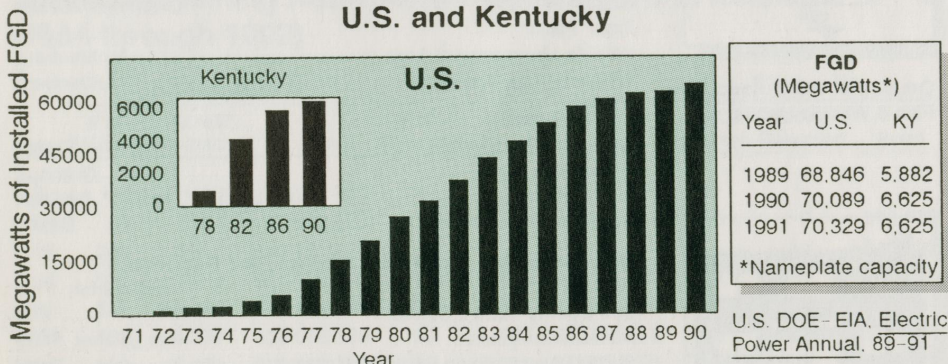
- U.S. sulfur dioxide emissions have decreased by 28% since 1977, even though power plants increased their coal use by 61%.

- In Kentucky, sulfur dioxide emissions have been reduced by 54% since 1976.



These achievements are the result of using lower sulfur coal and using pollution control equipment, like scrubbers. The use of flue gas desulfurization equipment (FGD or scrubbers) has increased dramatically. Kentucky is second in the nation in installed scrubber capacity. Utilities in Kentucky have scrubbers on 42% of their coal-fired generating capacity, compared to the national average of 22%.

Increased Use of Flue Gas Desulfurization (scrubbers) in the U.S. and Kentucky



Please take note of the source change from the historical sources listed below to current sources.


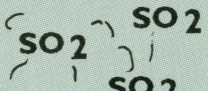



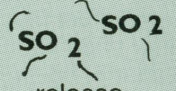






- Every new coal-fired power plant is required to install pollution control equipment which captures over 99% of the particulates (smoke and soot) and between 70% and 95% of the sulfur (depending on the sulfur in the coal).

Sources: National Acid Precipitation Assessment Program, Acid Deposition: State of Science and Technology, Summary Report, 1991 and Interim Assessment, 1987; Oak Ridge National Laboratory, Utility FGD Survey, 1991; Argonne National Laboratory, Current Emission Trends (ANL/EAIS/TM-25); Kentucky Division of Air Pollution Control; U.S. DOE - EIA, Electric Power Annual, 89-91

Coal use in the future will be even cleaner.

With coal being burned more cleanly today than ever before, can future coal use be even cleaner? YES! Through clean coal technology.

What is clean coal technology and how does energy efficiency and clean coal use relate? Lets look at electricity as an example:

Resource	Environment	Electricity	Light
In the past we:  used >5-lumps of coal	 released 100% of SO ₂ from 5-lumps	 made 1-lump's worth of electricity	 enjoyed 1-measure of light
Today we:  use 3-lumps of coal	 release 50% of SO ₂ from 3-lumps	 make 1-lump's worth of electricity	 are enjoying 2-measures of light
Tomorrow we:  will use <2-lumps of coal	 will release 2%-5% of SO ₂ from <2-lumps	 will make 1-lump's worth of electricity	 will enjoy >3-measures of light

It becomes apparent that the order of magnitude from past coal burning efficiencies compared to the future "efficient lighting" is great. The technology improvement potential results in overall environmental benefits and resources saved. Why is this multiplier effect not already more noticeable? Because there are more of us demanding more measures of light each day.

How can the goal of environmentally cleaner coal use and greater energy efficiency both be obtained?...through clean coal technology. Advancing one at the expense of the other (as has sometimes happened in the past) is a failure of both.

Advanced coal technologies address both goals of efficiency and reduced emissions into the environment in a combination of the following processes:

- Pre-combustion Cleaning.
- Combustion.
- Post Combustion.
- Conversion.
- Industrial Clean Coal Technologies.

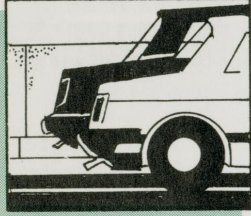
U.S. DOE - Clean Coal Technology Program

The U.S. has embarked on an unprecedented Clean Coal Technology Program. Under this program about \$2.4 billion of federal funds and \$4.5 billion in private sector funds have been committed to 46 demonstration projects (65% of this by industries and state governments). There are three sites in Kentucky (2-McCracken Co., 1-Marshall Co.) participating in the federal clean coal technology program.

Joint efforts by industry and governments are developing and demonstrating *Clean Coal Technologies* that will use coal with less emissions and greater efficiency. Some of these technologies are expected to reduce sulfur dioxide emissions by more than 99%, reduce nitrogen oxide emissions by 95%, and increase the amount of electricity that can be generated per ton of coal.

Coal Combustion By-Products

Coal utilization by-products have a long, useful history. Some of the major by-products produced by today's coal-fired power plants are **scrubber gypsum**, **fluidized bed material**, **bottom ash**, and **fly ash**. The following are just a few of the many current uses for coal-burning electric generation plant by-products in Kentucky.



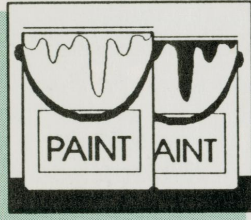
Scrubber Gypsum Use:

Highway by-pass in Webster County.

Fluidized Bed Combustion Bed Material Use:

Service roads in McCracken Co.

Bottom Ash Use: Farm lanes, driveways, and road shoulder maintenance on the Pennyrite and Green River Parkways. Sand blasting materials and asphalt shingle aggregate factory in Muhlenberg County.



New Product Development

There are also several new innovative uses of coal-burning electric utility plant waste currently in various stages of development. Some of the more widely publicized ones are: **Autoclaved Cellular Concrete** used as a lightweight, strong, fire resistant concrete that can be hammered and sawed similar to wood.

Metal filler used with aluminum for a strong, light material with greater wear resistance for use in car parts. **Ceramic filler** for protective coating systems such as ceramic cookware. **Paint filler** for protective paint coating systems. Fly ash cenospheres are strong, hard, inert thin walled spheres. Their ultralight weight makes them ideal for use in golf balls, bowling balls, tennis rackets, screw driver handles, fiberglass in cars, charcoal, etc.

Coal Combustion Materials:

"...not a waste product but a product being wasted"

William H. Kennoy, Director Tennessee Valley Authority

Coal Marketing

Coal combustion material beneficial reuse and proper disposal of unused combustion materials are becoming integral parts of marketing Kentucky coal. Kentucky coal was shipped to electric utilities in 22 states during 1992 (15% of the U. S. total).

The 6 to 7 million tons of estimated coal combustion materials generated within Kentucky does not include the coal combustion materials generated from Kentucky coal used outside Kentucky in the other 22 states.

1991 U. S. Coal Combustion By-product Production and Consumption (million tons)

	Production	Consumption	%used
Fly Ash	51.3	13.2	25.8%
Bottom Ash	13.3	5.0	37.4%
Bollet Slag	6.1	3.6	59.2%
Subtotal	70.7	21.8	30.8%
FGD Material	18.1	0.4	1.9%
Total	88.8	22.2	25.0%

Source: American Coal Ash Association, Inc.

Existing Consumption:

Cement and concrete products
Structural fills
Road base / Subbase
Mineral filler in asphalt
Snow and Ice control
Blasting grit / Roofing granules
Grouting
Coal mining applications
Wallboard
Waste stabilization / Other

Disposal of excess coal combustion materials

Coal combustion materials that are not recycled (beneficial reuse) are being disposed of in Kentucky as high volume - low hazard special waste. Electric utility plants use existing ash ponds (lagoons) and stabilized landfills for on-site disposal, and for off-site disposal, special waste landfills such as, mono-fills or co-disposal (minesite haulback) are used.

Sources: American Coal Ash Association, Inc.; UK-Center for Applied Energy Research; Electric Power Research Institute; American Electric Power; Tennessee Valley Authority.

Abandoned Mine Land (AML) Reclamation

The Federal Surface Mining Control and Reclamation Act of 1977 establishes authority for the AML Fund. Contributions to this fund are made by each mining company at the rate of \$0.35 per ton for surface mined coal and \$0.15 per ton for deep-mined coal. These funds are used to reclaim pre-law (1977) and hazardous interim program (1977-1982) sites left abandoned, unreclaimed, or insufficiently reclaimed.

■ **The Kentucky coal industry has contributed \$544.4 million to the Abandoned Mine Land (AML) Reclamation Fund since 1977.**

■ **50% of the total KY AML fees go directly to the state share account.** However, \$58 million is unallocated due to the federal appropriation process (see the Kentucky State Share Balance column of the table below).

Abandoned Mine Land (AML) Reclamation Fund

Fiscal Year	Kentucky Collection	Kentucky State Share*	KY State Share Allocation	KY State Share Balance
1978	\$29,966,438	\$14,981,014	\$ 0 **	\$14,981,014
1979	33,702,502	16,848,579	0 **	31,829,594
1980	35,028,033	17,510,931	0 **	49,340,525
1981	35,819,239	17,906,720	0 **	67,247,245
1982	36,588,637	18,290,813	15,893,953	69,644,105
1983	31,136,314	15,564,205	28,547,738	56,660,573
1984	37,757,638	18,872,676	30,717,141	44,816,108
1985	34,614,559	17,299,511	30,730,933	31,384,685
1986	34,514,743	17,249,466	16,993,952	31,640,199
1987	35,228,098	17,609,447	12,539,885	36,709,761
1988	26,339,994	13,168,400	12,412,279	37,465,882
1989	35,387,170	17,422,508	16,393,455	38,494,936
1990	38,439,852	19,414,611	14,634,933	43,274,614
1991	37,041,434	18,447,844	13,923,680	47,798,777
1992	35,595,377	17,822,309	10,675,702	54,945,384
1993***	27,228,454	13,218,399	10,195,176	57,968,607
Totals	\$544,388,482	\$271,627,434	\$213,658,827	\$57,968,607

* Includes reclamation fees, interest and audit adjustments, and will not equal exactly 50%.

** Does not include Federal Cooperative Agreement Grants managed by Kentucky for OSM.

*** Collection data through June 30, 1993.

AML Reclamation Accomplishments in Kentucky to Date

Kentucky AML Projects

420 Multi-site State AML Projects.
\$255 million in expenditures.
13,500 acres reclaimed.
84 projects in the design phase
(+ various projects in the bid process).

Federal AML Projects

679 Multi-site AML Projects
\$87.9 million in expenditures.
5,080 acres reclaimed.
Federal AML Projects include the Rural Abandoned Mine Program (RAMP), Emergency, and Non-Emergency.

■ 1,100 multi-site AML projects have been undertaken in Kentucky by both the state of Kentucky and federal programs from 1978 - 1992 reclaiming over 18,580 acres and expending \$343 million in AML reclamation funds.

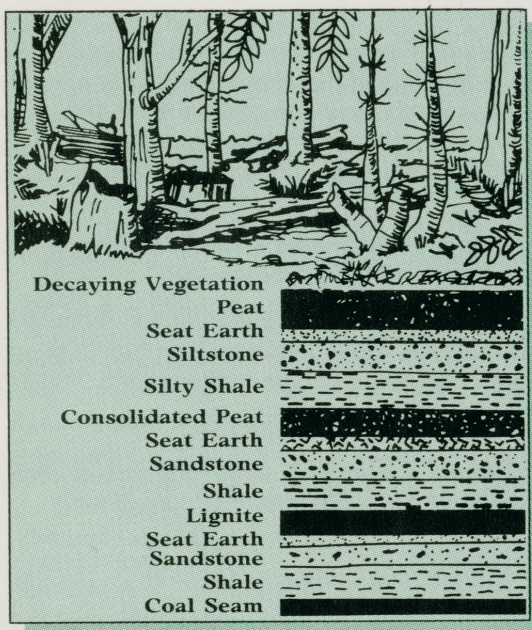
Some accomplishments to date of the state's AML Projects in Kentucky are:

29 water line projects - \$34 million	1,725 mine portal closures.
Over 17,064 feet of highwall eliminated.	107 vertical shafts sealed.
Over 100 hazardous structures removed.	47 miles of stream restoration.
Over 1,400 multi-site landslide projects stabilized.	23 mine fires controlled.

■ Today's coal industry in Kentucky is reclaiming the land to uses as good or better than before mining, and through contributions to the AML fund, is also helping to restore lands mined prior to today's reclamation standards.

Sources: Natural Resources and Environmental Protection Cabinet, Division of Abandoned Lands
U.S. Office of Surface Mining (OSM); U.S. Department of Agriculture, RAMP.

Coal Origin and Properties



It is generally accepted that coal originated from plant debris including ferns, trees, bark, leaves, and seeds that accumulated and settled in swamps.

This unconsolidated accumulation of plant remains is called peat. Peat is being formed today in marshes and bogs.

Layers of peat, covered by sediment receiving heat and pressure from the subsidence of the swamps, went through a metamorphic process called coalification to form coal.

The metamorphic process is thought to have occurred in several stages over millions of years. The conditions of the metamorphic process and the swamps and bogs greatly affect the formation of the coal.

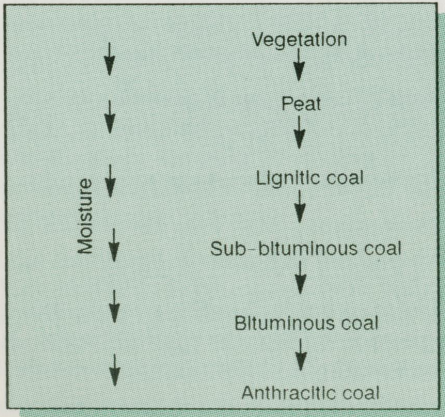
Several factors which greatly affected the content, makeup, quality, and rank of the coal were:

- Temperature
- Pressure
- Time
- Layering process
- Fresh water / sea water
- Swamp acidity
- Types of plant debris
- Types of sediment cover

Coal first formed from peat has a high moisture content and a relatively low heating value.

Coal Rank

Coal usually is divided into two main classes – anthracite (hard coal) and bituminous (soft coal). When anthracite was formed, it was squeezed under greater pressure than was bituminous. As a result anthracite contains the highest percentage of carbon and the lowest percentage of moisture. Anthracite makes up only a small part of the world's supply of coal. About half of the world's coal reserve is bituminous coal. (See U.S. Coal Reserves map). Remaining coal reserves are even softer (lignite and sub-bituminous).

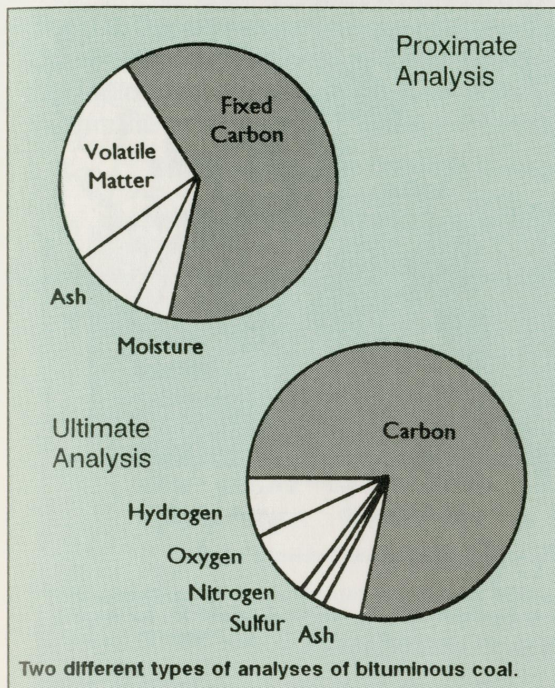


Moisture decreases, rank increases.

Rank increases, fixed carbon increases.

Rank increases, volatile matter decreases.

Rank increases, heating value increases. (optimum Btu at low-volatile bituminous)



Proximate analysis determines (on an as-received basis)

-Moisture content

-Volatile matter (gases released when coal is heated).

-Fixed carbon (solid fuel left after the volatile matter is driven off).

-Ash (impurities consisting of silica, iron, alumina, and other incombustible matter).

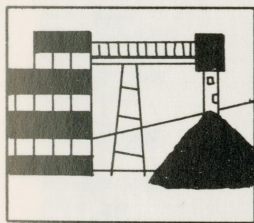
Ultimate analysis determines the amount of carbon, hydrogen, oxygen, nitrogen, and sulfur.

Heating value is determined in terms of BTU both on an as-received basis (including moisture) and on a dry basis.

Source: U.S. DOE - Energy Information Administration, *Coal Data: A Reference*, 1989.

Improving the Properties of Mined Coal

Kentucky coal is improved by the partial removal of the impurities sulfur and ash. The cleaning process to remove impurities from the coal is often called *beneficiation, coal preparation, or coal washing*.



In general, coal cleaning is accomplished by separating and removing inorganic impurities from organic coal particles. The inorganic ash impurities are predominantly more dense than the coal particles. This property is generally the basis for separating the coal particles from the ash impurities.

Kentucky has 70,000 tons per hour of coal preparation design capacity at approximately 130 coal preparation plants (101 in Eastern Kentucky and 29 in Western Kentucky).

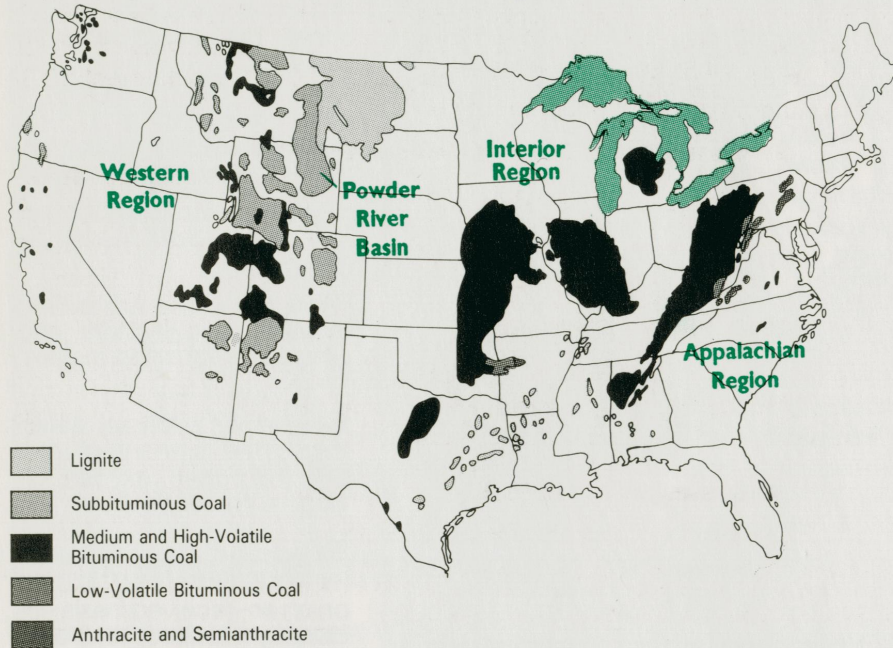
Each coal seam has a different washability characteristic. The range of improvement to a particular seam by mechanical washing varies from plant to plant and location to location.

In Western Kentucky, the sulfur (inorganic sulfur) and ash are the two main impurities removed. Considering the 7 principal mined seams in W. Ky., 0.5% to 2.5% can be subtracted from the average sulfur content and 9% to 13% can be subtracted from the ash content after the coal washing process.

In Eastern Kentucky, coals with very high ash contents are washed. High ash content results from seam impurities, splits or partings in the seam, or ash accumulating mining methods. In these seams the ash is the main impurity removed, 10% to 15% can be subtracted from the ash content after the coal washing process and with only a slight reduction in the sulfur content.

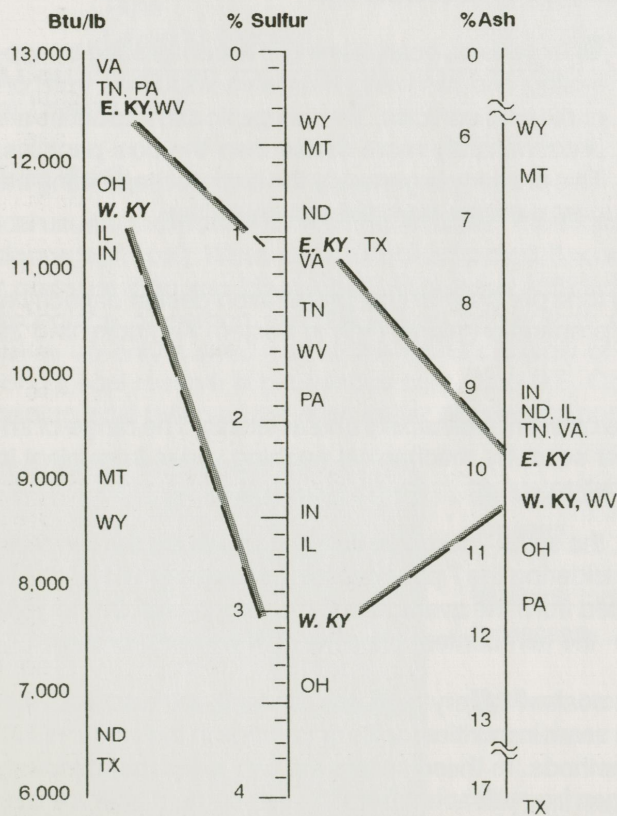
Source: Kentucky Coal Marketing and Export Council's Kentucky Coal Marketing Information System.

U.S. Coal Fields and Coal Producing Areas



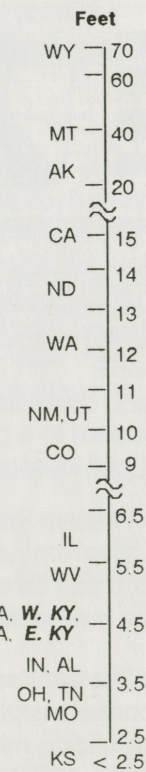
Source: Developed from the U.S. Geological Survey

Average Quality of Coal Produced for Power Plants by Selected Producing States, 1992



Source: Energy Information Administration. Cost and Quality of Fuels for Electric Utility Plants, 1992.

Average* Coalbed Thickness Mined In 1987

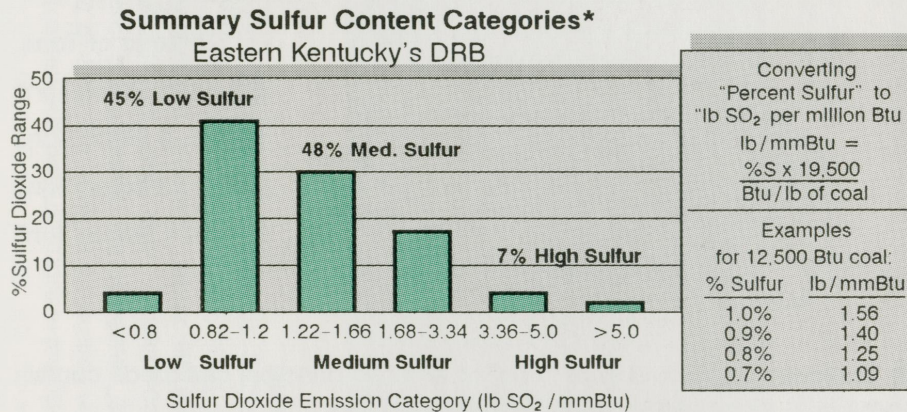


* Weighted average.

Source: Energy Information Administration. Coal Data: A Reference, 1989.

Eastern Kentucky Low-sulfur Coal

The U.S. Department of Energy estimates that over 45% of Eastern Kentucky's Demonstrated Reserve Base (DRB) would meet a 1.2 pounds of sulfur dioxide per million Btu emissions limit (Low Sulfur), and that 48% would meet a 3.34 lb/mmBtu emissions limit (Medium Sulfur).



* EIA uses six sulfur content ranges. For general discussion and summary data, however, those six ranges are combined into three qualitative ratings of low, medium, and high-sulfur content.

Sources: U.S. DOE - EIA, U.S. Coal Reserves: An Update by Heat and Sulfur Content, Feb 1993.

1992 U.S. Demonstrated Coal Reserve Base* (millions of tons)

The U.S. Demonstrated Coal Reserve Base is an estimate of the tonnage that can be economically *mined with today's technology*.*

Coal Producing Region and State	Anthracite	Bituminous	Sub-bituminous	Lignite	Total**
Appalachian Total	6.9%	92.1%		1.0%	106,799.6
Alabama		77.0%		23.0%	4,717.6
Georgia		100.0%			3.6
Kentucky, Eastern		100.0%			8,600.8*
Maryland		100.0%			744.1
North Carolina		100.0%			10.7
Ohio		100.0%			23,845.4
Pennsylvania	24.9%	75.1%			29,071.2
Tennessee		100.0%			841.5
Virginia	5.1%	94.9%			2,466.5
West Virginia		100.0%			36,498.2
Interior Total	0.1%	89.6%		10.3%	133,250.9
Arkansas	25.0%	68.9%		6.1%	417.1
Illinois		100.0%			78,006.9
Indiana		100.0%			10,070.7
Iowa		100.0%			2,189.7
Kansas		100.0%			976.4
Kentucky, Western		100.0%			20,203.5
Louisiana				100.0%	479.6
Michigan		100.0%			127.7
Missouri		100.0%			5,997.5
Oklahoma		100.0%			1,584.4
Texas				100.0%	13,197.6
Western Total	<0.1%	10.2%	77.0%	12.8%	234,004.5
Alaska		11.4%	88.4%	0.2%	6,133.9
Arizona		100.0%			220.4
Colorado	0.1%	52.2%	22.9%	24.8%	16,924.6
Idaho		100.0%			4.4
Montana		1.2%	85.7%	13.1%	119,870.3
New Mexico	<0.1%	43.6%	56.4%		4,399.1
North Dakota				100.0%	9,550.3
Oregon			100.0%		17.5
South Dakota				100.0%	366.1
Utah		>99.9%	<0.1%		6,047.1
Washington		21.5%	77.9%	0.6%	1,412.4
Wyoming		6.3%	93.7%		69,058.5
U.S. Total	1.6%	51.0%	38.0%	9.4%	474,054.9

* Kentucky coal resource values are considered by some to be too high of a value; while the Eastern Kentucky "Demonstrated Coal Reserve Base" value is openly rejected by many others as being too low.

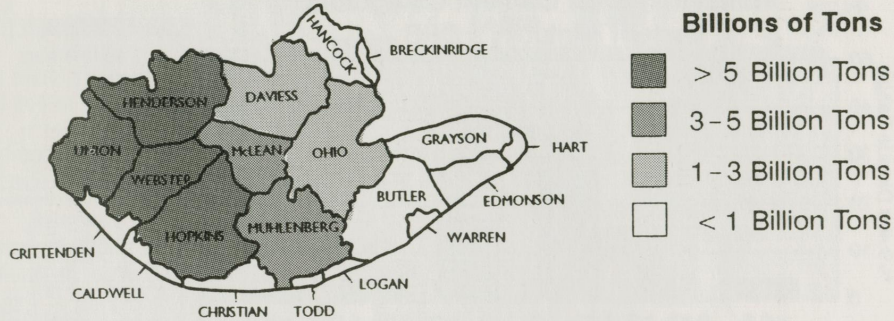
** Millions of tons.

Source: U.S. DOE - Energy Information Administration, Coal Production, 1992.

Western Kentucky Coal Field

The Western Kentucky coal field covers 6,400 square miles and contains over 36 billion tons of remaining resources. (Part of this cannot be mined economically using today's technology.)

Remaining Resources



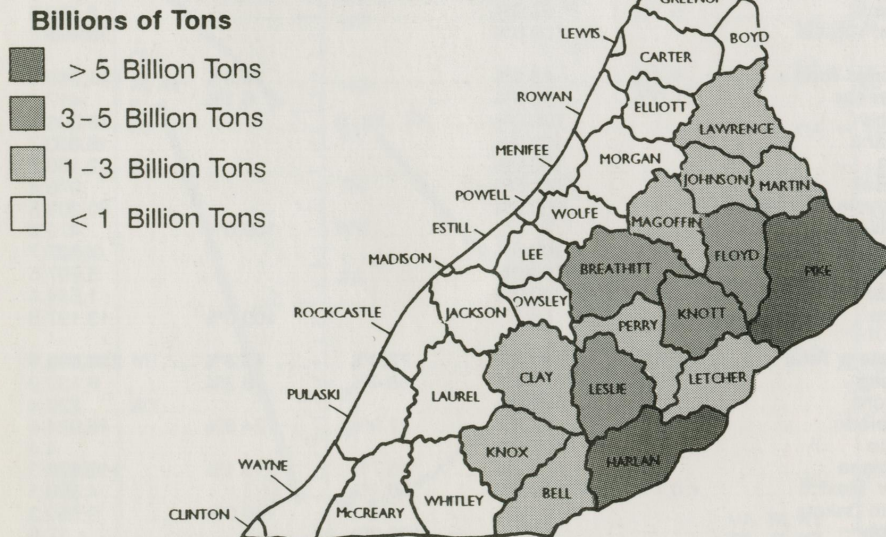
- There are 35 named coal beds, of which 7 principal coal beds contain about 94% of the resources in Western Kentucky.
- Over 4.5 billion tons of coal have been mined or lost due to mining, amounting to only about 11% of total Western Kentucky coal resources.

Unmined mineral taxes contributed \$10.2 million to state (23%) and local (77%) revenues during 1990 and will continue to be paid yearly.

Eastern Kentucky Coal Field

The Eastern Kentucky coal field covers 10,500 square miles and contains approximately 54.6 billion tons of remaining resources. (Part of this cannot be mined economically using today's technology.)

Remaining Resources



- There are more than 80 named coal beds in the Eastern Kentucky coal field which covers parts of 37 counties.
- Approximately 9.5 billion tons of coal have been mined or lost due to mining, amounting to only about 15% of total Eastern Kentucky coal resources.

Source: Updated from Brant and Other, *Coal Resource Series*, 1980-1983.
Kentucky Revenue Cabinet, Mineral Valuation Section.

Original resource estimates for Western and Eastern Kentucky were 41 and 64 billion tons respectively. The resources currently remaining after 200 years of mining are estimated to be 36.5 billion tons in Western Kentucky and 54.6 billion tons in Eastern Kentucky. As shown in the tables below, assumptions on the percentage available for development reduce this value even further. These values and percentages available for development are now carefully being determined. However, they will be a much debated subject for several more years to come. The table also calculates some values for years of remaining production at current levels of production, at given percentage availabilities, and at current levels of recovery technology.

Part of these resources cannot be mined using today's technology, and should be used mainly as original resource/mined and lost estimates. Some quadrangle areas have been estimated to have only 40% of the "remaining estimated original resource" available for development due to land-use restrictions, geological conditions, and the limitations of today's technologies. Other quadrangle areas, however, average 60% or more availability for development. Thus, the "Assumed Percentage" portion of the table is useful for estimating resources remaining and available for development in a given county.

County	Estimated Original Resource (mm tons)	Mined 1790-1992 (mm tons)	Estimated Resources Lost Due to Mining 1790-1992 (mm tons)	Estimated Remaining Resource (mm tons)	Western Kentucky Coal Resources					Current Year Production 1992 (mm tons)
					Assumed Percentage of Remaining Original Resource Available for Development					
					80% mm Tons / Yrs. *	70% mm Tons / Yrs. *	60% mm Tons / Yrs. *	50% mm Tons / Yrs. *	40% mm Tons / Yrs. *	
Butler	413.69	29.55	29.55	354.59	284 / >200	248 / >200	213 / >200	177 / >200	142 / >200	.05
Daviess	1,330.32	53.41	53.41	1,223.50	979 / >200	856 / >200	734 / >200	612 / >200	489 / >200	1.64
Henderson	6,852.78	44.96	44.96	6,762.86	5,410 / >200	4,734 / >200	4,057 / >200	3,381 / >200	2,705 / >200	3.67
Hopkins	8,814.80	682.29	682.29	7,450.22	5,960 / >200	5,215 / >200	4,470 / >200	3,725 / >200	2,980 / >200	9.07
McLean	3,576.41	14.80	14.80	3,546.81	2,837 / >200	2,483 / >200	2,128 / >200	1,773 / >200	1,419 / >200	.20
Muhlenberg	4,723.84	706.48	706.48	3,310.88	2,648 / >200	2,318 / >200	1,987 / >200	1,655 / >200	1,324 / >200	3.78
Ohio	1,824.55	249.37	249.37	1,325.81	1,061 / >200	928 / >200	795 / >200	663 / 174	530 / 139	2.98
Union	6,506.98	265.21	265.21	5,976.56	4,781 / >200	4,184 / >200	3,586 / >200	2,988 / 199	2,391 / 159	7.71
Webster	6,322.95	199.27	199.27	5,924.41	4,740 / 197	4,147 / 173	3,555 / 148	2,962 / 123	2,370 / 99	12.59
Other**	623.08	21.50	21.50	580.08	464 / >200	406 / >200	348 / >200	290 / 168	232 / 134	1.40
WKY Totals	40,989.30	2,266.84	2,266.84	36,455.62	29,165 / >200	25,519 / >200	21,873 / >200	18,228 / >200	14,582 / >200	43.10

* The years remaining are calculated based on 1992 production (county's 1992 underground production (x) times a mined and lost factor of 2 plus a county's 1992 surface production (x) times a mined and lost factor of 1.15 equals (=) the counties 1992 mined and lost value, divided into the assumed percentage (%) recovery columns value in tons equals (=) estimated years of production remaining at current levels of production.

** "Other" includes Breckenridge, Caldwell, Christian, Crittenden, Edmonson, Grayson, Hancock, and Warren Counties.

Source: Smith and Brant (1980). "Mined and Lost" and "Remaining Resources" updated by the Kentucky Coal Marketing and Export Council from the Kentucky Dept. of Mines and Minerals Annual Reports.

Cont. from pg. 41.

County	Estimated Original Resource (mm tons)	Mined 1790-1992 (mm tons)	Estimated Resources Lost Due to Mining 1790-1992 (mm tons)	Estimated Remaining Resource (mm tons)	Eastern Kentucky Coal Resources					Current Year Production 1992 (mm tons)
					Assumed Percentage of Remaining Original Resource Available for Development					
					80% mm Tons / Yrs *	70% mm Tons / Yrs *	60% mm Tons / Yrs *	50% mm Tons / Yrs *	40% mm Tons / Yrs *	
Bell	3,194.70	250.38	250.38	2,693.94	2,155/ >200	1,886/ >200	1,616/ >200	1,347/ 187	1,078/ 150	4 10
Boyd	630.68	19.93	19.93	590.82	473/ >200	414/ >200	354/ >200	295/ >200	236/ >200	0 00
Breathitt	4,112.20	164.13	164.13	3,783.94	3,027/ >200	2,649/ >200	2,270/ >200	1,892/ >200	1,514/ >200	4 33
Carter	501.96	18.60	18.60	464.76	372/ >200	325/ >200	279/ >200	232/ >200	186/ >200	0 01
Clay	1,536.11	58.50	58.50	1,419.11	1,135/ >200	993/ >200	851/ >200	710/ >200	568/ >200	1 36
Elliott	316.32	9.83	9.83	296.66	237/ >200	208/ >200	178/ >200	148/ >200	119/ >200	0 01
Floyd	4,168.08	396.97	396.97	3,374.14	2,699/ >200	2,362/ >200	2,024/ 173	1,687/ 144	1,350/ 115	7 24
Greenup	204.87	10.19	10.19	184.49	148/ 135	129/ 117	111/ 101	92/ 84	74/ 67	0 96
Harlan	7,881.12	784.40	784.40	6,312.32	5,050/ >200	4,419/ 190	3,787/ 163	3,156/ 136	2,525/ 109	12 51
Jackson	375.87	10.98	10.98	353.91	283/ >200	248/ >200	212/ >200	177/ >200	142/ >200	0 08
Johnson	1,419.44	81.41	81.41	1,256.62	1,005/ 199	880/ 174	754/ 149	628/ 124	503/ 100	3 26
Knott	4,385.10	194.03	194.03	3,997.04	3,198/ >200	2,798/ 190	2,398/ 163	1,999/ 136	1,599/ 109	8 51
Knox	1,381.93	67.74	67.74	1,246.45	997/ >200	873/ >200	748/ >200	623/ >200	499/ >200	1 15
Laurel	408.04	35.33	35.33	337.38	270/ >200	236/ >200	202/ >200	169/ >200	135/ >200	0 02
Lawrence	2,024.68	19.37	19.37	1,985.94	1,589/ >200	1,390/ >200	1,192/ >200	993/ >200	794/ >200	0 03
Lee	363.98	8.33	8.33	347.32	278/ >200	243/ >200	208/ >200	174/ >200	139/ >200	0 21
Leslie	3,554.65	169.21	169.21	3,216.23	2,573/ 164	2,251/ 144	1,930/ 123	1,605/ 103	1,286/ 82	8 57
Letcher	3,692.80	447.33	447.33	2,798.14	2,239/ 62	1,959/ 54	1,679/ 46	1,399/ 39	1,119/ 31	19 73
McCreary	444.97	55.21	55.21	334.55	268/ >200	234/ >200	201/ >200	167/ >200	134/ >200	0 06
Magoffin	1,969.10	50.15	50.15	1,868.80	1,495/ >200	1,308/ >200	1,121/ >200	934/ >200	748/ >200	0 88
Martin	3,319.97	259.08	259.08	2,801.81	2,241/ 117	1,961/ 102	1,681/ 88	1,401/ 73	1,121/ 58	11 45
Morgan	849.40	15.06	15.06	819.28	655/ >200	573/ >200	492/ >200	410/ >200	328/ >200	0 02
Owsley	574.14	8.85	8.85	556.44	445/ >200	390/ >200	334/ >200	278/ >200	223/ >200	0 34
Perry	3,596.70	448.34	448.34	2,700.02	2,160/ 112	1,890/ 98	1,620/ 84	1,350/ 70	1,080/ 56	13 29
Pike	11,391.70	1,016.69	1,016.69	9,358.32	7,487/ 136	6,551/ 119	5,615/ 102	4,679/ 85	3,743/ 68	30 91
Whitley	987.44	84.03	84.03	819.38	656/ >200	574/ >200	492/ 186	410/ 155	328/ 124	1 62
Wolfe	443.92	6.03	6.03	431.86	345/ >200	302/ >200	259/ >200	216/ >200	173/ >200	0 56
Other**	334.89	33.09	33.09	268.71	215/ >200	188/ >200	161/ >200	134/ >200	108/ >200	< 0 01
EKY Totals	64,064.76	4,723.19	4,723.19	54,618.38	43,695/ 196	38,233/ 172	32,771/ 147	27,309/ 123	21,848/ 98	131.21

* The years remaining are calculated based on 1992 production (county's 1992 underground production (x) times a mined and lost factor of 2 plus a county's 1992 surface production (x) times a mined and lost factor of 1.15 equals (=) the county's 1992 mined and lost value, divided into the assumed percentage (%) recovery column's value in tons equals (=) estimated years of production remaining at current levels of production.

** "Other" includes Clinton, Pulaski, Rockcastle, and Wayne Counties.

Source: Smith and Brant (1980). "Mined and Lost" and "Remaining Resources" updated by the Kentucky Coal Marketing and Export Council from the Kentucky Dept. of Mines and Minerals Annual Reports.

Energy Equivalents / Conversions

One **Btu equals approximately:**

- 1 blue-tip kitchen match

One **million Btu equals approximately:**

- 90 pounds of U.S. coal
- 120 pounds of oven-dried hardwood
- 8 gallons of motor gasoline or the amount it took in 1987 to move the average passenger car in the United States about 154 miles
- 10 therms of dry natural gas
- 11 gallons of propane

One **million Btu of fossil fuels burned** at electric utilities can generate about 100 kilowatt-hours of electricity, while about 300 kilowatt-hours of electricity generated at electric utilities can produce about 1 million Btu of heat.

One **short ton of coal** equals approximately:

- 106 days of coal consumption per person (U.S. - 1988)
- 3.8 barrels of crude oil
- 21 thousand cubic feet of dry natural gas
- 6,500 kilowatt-hours of electricity consumed

One **thousand kilowatt-hours (kwh) of electricity** equals approximately:

- 35 days of electricity use per person (U.S. - 1988)
- 0.59 barrels of crude oil (although it takes about 1.8 barrels of oil to produce 1,000 kwh)
- 0.15 short tons (or 310 pounds) of coal (although it takes about 0.47 short tons to produce 1,000 kwh)
- 3,300 cubic feet of dry natural gas (although it takes about 10,000 cubic feet to produce 1,000 kwh)

Converting "Percent Sulfur" to "lb SO₂ per million Btu":

$$\frac{\%S \times 19,500}{\text{Btu/lb of coal}} = \text{lb/mmBtu}$$

Examples for 12,500 Btu coal:

% Sulfur	lb/mmBtu
1.0%	1.56
0.9%	1.40
0.8%	1.25
0.7%	1.09

Source: U.S. DOE - Energy Information Administration, Energy Facts, 1988.

Tons Per Acre -Inch

$$\text{Total Tons} = \frac{\text{Acres} \times \text{Inches} \times 135 \text{ tons per acre-inch}}{(\text{acres of coal}) \times (\text{height of coal}) \times (\text{density of coal})}$$

Handy Calorific Value Conversion* for Coal

kcal / kg	Btu/lb	kcal / kg	mj / kg	Btu / lb	Btu / lb	kcal / kg
7500	13500	7403	31	13227	13500	7500
	13050	7264	30	12897	13000	7222
7000	12600	6925	29	12467	12500	6944
	12150	6686	28	12037	12000	6667
6500	11700	6448	27	11607	11500	6389
	11250	6209	26	11177	11000	6111
6000	10800	5970	25	10748	10500	5833
	10350	5731	24	10318	10000	5556
5500	9900	5492	23	9888	9500	5278
	9450	5254	22	9458	9000	5000
5000	9000	5015	21	9028		

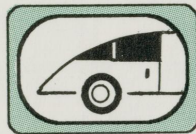
* Conversion chart alignment is approximate and values are rounded to the nearest whole number.

Btu / lb British thermal units per pound.
 mj / kg Megajoules (a unit of work) per kilogram.
 kcal / kg Kilocalorie per kilogram.

For more precise conversion between units:
 kcal / kg = 238.8 x mj / kg
 Btu / lb = 1.800 x kcal / kg = 429.9 x mj / kg

Source: Developed from source ideas by: BP Coal Limited, Coal Handbooks.

Your Future with Coal



Will you be driving a coal powered electric car in the 21st century? Will you microwave your clothes dry? Will you purify your drinking water with electricity? **Did you know?**....that future coal combustion by-products are here now!

Cenospheres are a specific type of coal combustion fly ash - they are the floating materials skimmed from fly ash ponds, dried, and sorted by micron size. Cenospheres are strong, hard, inert, thin-walled hollow spheres. Their flowability, ultralight weight and strength provide specific advantages in aerospace and plastics industry applications.



A fly ash filler in the core provides a low-cost, lighter weight charcoal.



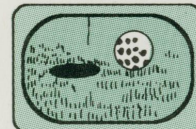
Fly ash can replace talc as a mineral in the production of paint.



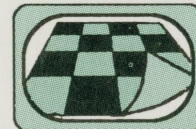
Fly ash is a lightweight, low-cost filler in the matrix of some tennis rackets.



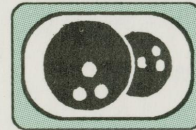
Fly ash is a low-cost mineral filler replacing expensive resins and calcium carbonate in plastics. Fly ash can reduce cost while increasing performance and reliability of brake linings.



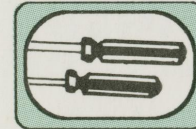
Used as a less-expensive filler in ball cores, fly ash plays an important role in golf.



The versatility of fly ash is demonstrated by its use as a filler in the backing of linoleum floor covering.



Fly ash binder reduces costly resins loading in a thermosetting plastic bowling ball.



Thermosetting plastics such as screw driver handles incorporate fly ash as a filler.

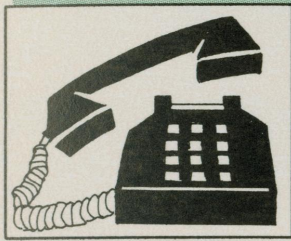


Fly ash combined with asphalt is used for coating on underground steel and aluminum surfaces.

Source: Reprints from American Electric Power's Coal Ash Helping To Mold The Future.

Coal Teaching Materials, American Coal Foundation
 1130 Seventeenth St. N.W. - Suite 220
 Washington, DC 20036, (202) 466-8630

Help the teachers at your school obtain coal education classroom materials.



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Kentucky coal data, information, and referral assistance to government, private organizations, and individuals are available from the following:

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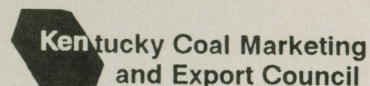
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