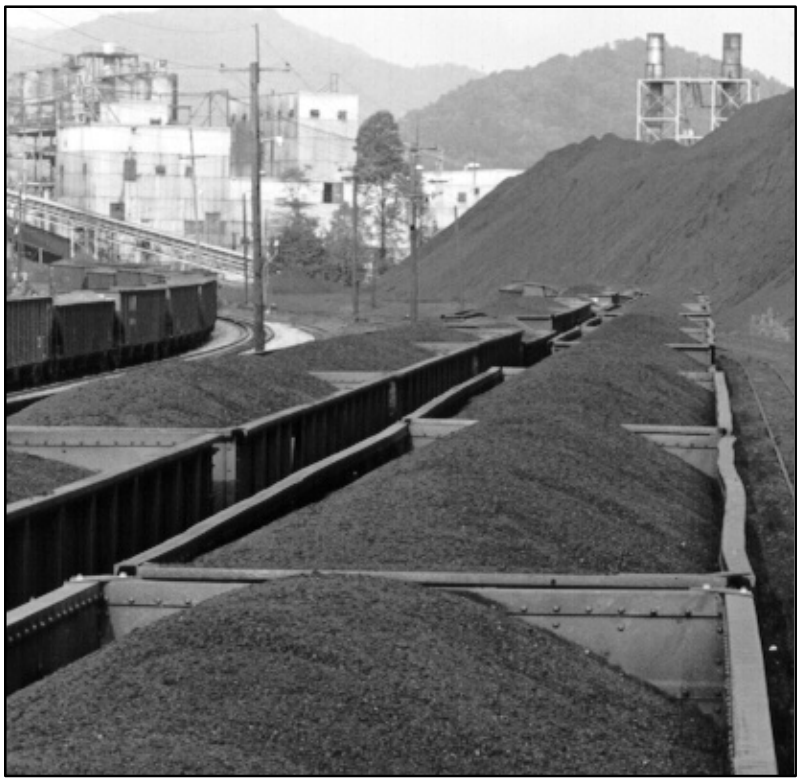
Coal Mining Outlook

International, National, and Virginia Trends



Virginia Tech

Virginia Center for Coal and Energy Research
Virginia Polytechnic Institute and State University
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November 2000

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- Clair James for editorial review and verification of references
- Margaret Radcliffe for editorial review, layout and production

Their assistance helped to insure the timely and accurate publication of this information.

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Introduction

Sustainable development studies clearly show that the world's fundamental challenges remain the same: population growth and the need to improve many people's quality of life and standard of living. World population scenarios predict a population increase, of between 50% and 100% over the next fifty years. Currently the world population resides at the 5.9 billion mark and is growing at a rate of 1.33% annually. At this rate, the population is expected to surpass 6 billion people in 1999 (United Nations Population Division, 1998). By the year 2050, it is expected to be almost 9 million persons, although recent projections indicate the total could reach as high as 11 billion (Figure 1). This growth can be fueled and sustained only by the increased use of basic products, such as food, energy, and materials, all of which are based on mineral resources production. Reduced consumption, re-use or recycling, and energy savings may offset some of the growth. However, these reductions will not be sufficient. According to a recent article ("Outlook 1998," 1998), "*quantum leaps of technology, productivity and eco-efficiency are required*."

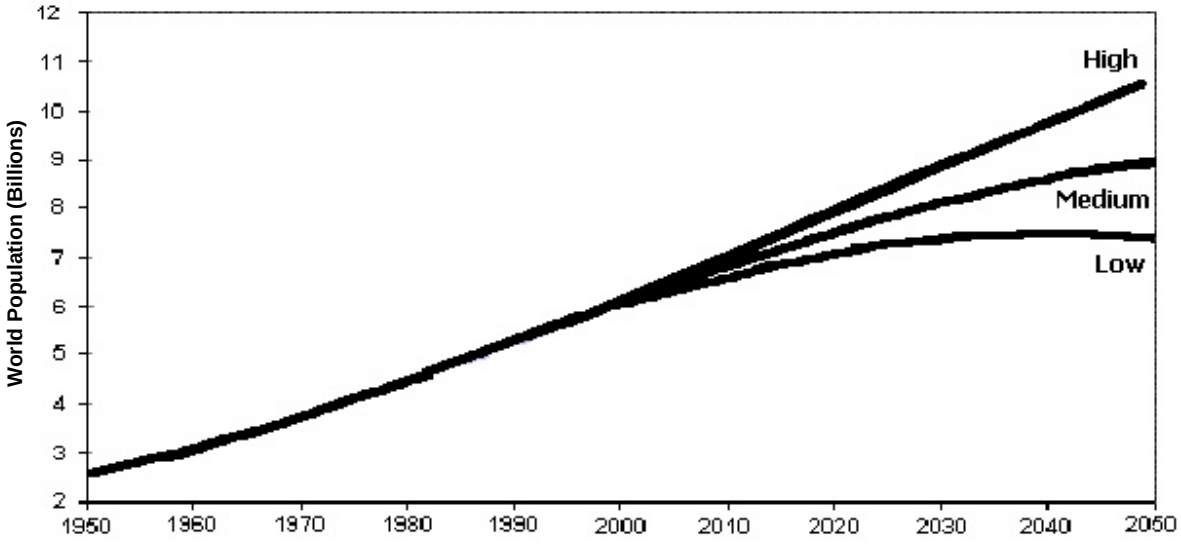

Figure 1: World Population Trends in Billions of People (United Nations Population Division, 1998)

Total energy production will have to increase significantly to meet the global population needs. The forecast for total energy production calls for over a 60% increase from 1996 to 2020. In 1996, coal supplied 24% of the total energy generated throughout the world. This share is expected to remain relatively constant over the next 20 years, increasing slightly to 28% in 2010 and 29% in 2020.

Electricity will be a key component of the increased energy needs of a larger population, and coal is vital to this electricity production because of its availability and modest start-up fees. In 1998, coal provided 37% of the world's electricity. These facts point to a significant increase in the demand for coal (EIA, 1999A).

In addition to energy demand caused by population increases, per capita energy consumption is rising steadily, particularly in the developing regions. This is clearly shown in Table 1. The rise in industrial output and the substantially improved standards of living in many parts of the world have contributed to this increase in energy use. Furthermore, the rising energy demands of the developing world and the growth rates achieved within certain income groups (Table 2) are clear indicators of the future needs and requirements on a global scale.

Table 1: Energy Consumption by Region/Country (Jones and Hollier, 1997)

Region/Country	1950	1960	1970	1980	1990	1993
World	657	869	1202	1,316	1,432	1,396
Europe	1,186	1,680	2,576	3,037	3,293	3,550
Former Soviet Union	1,024	1,910	2,842	3,821	4,642	---
N. America	3,858	4,093	5,382	5,152	5,271	5,264
S. America	233	368	515	716	748	780
Africa	105	144	196	284	313	307
Asia	53	190	266	413	591	680
Oceania	1,367	1,786	2,528	3,121	3,957	3,962
USA	5,140	5,535	7,436	7,163	7,526	7,570
UK	2,573	2,945	3,352	3,300	3,735	3,910

Table 2: Per Capita Energy Consumption by Economic Class (World Bank, 1996)

	Energy Consumption (kg oil equivalent per capita)			World Energy Consumption (%)		World Population (%)
Economic Class	1980	1994	% Change (1980-94)	1980	1994	1994
Low Income	271	384	42	9.7	15.2	56.8
Lower Middle Income	---	1,593	---	27.4	21.0	19.6
Upper Middle Income	1,297	1,715	32	7.1	10.1	8.4
High Income	4,822	5,168	7	55.8	54.7	15.2

Global Coal Production and Consumption Trends

In order to meet the current and projected demand for coal, coal production must increase. The most likely sources of expanding coal production are the two largest producing regions, North America and the Far East / Oceania. Coal exports reached 162 million tons in 1997; almost double the 87 million tons that were exported in 1984. Correspondingly, Australia's share of the world coal market increased from 17% in 1980 to 33% in 1997. Current projections call for this percentage to rise by an additional 3% by 2020. Over 70%

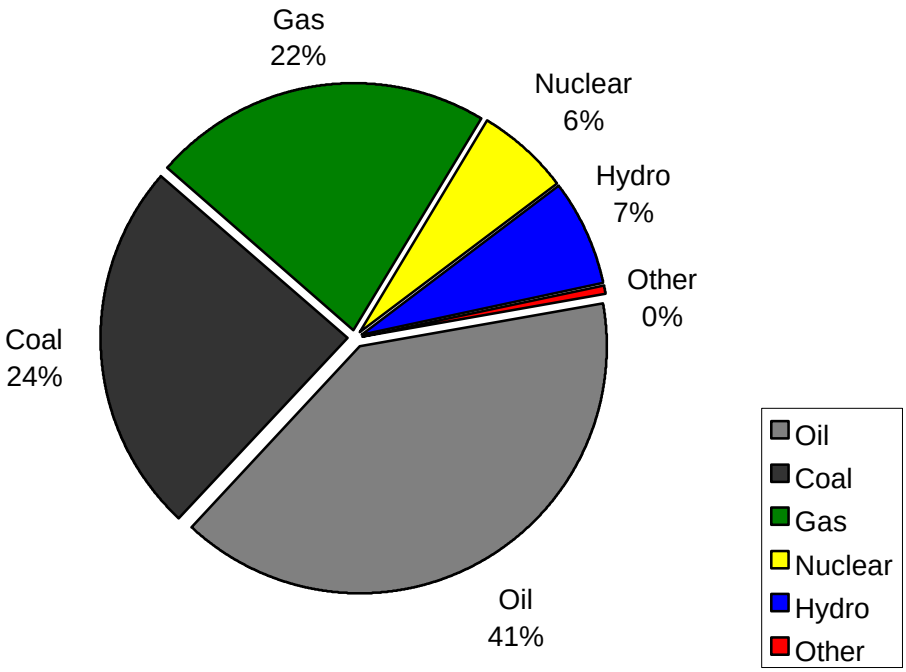

Figure 2: 1996 Total World Energy Production by Fuel (IEA, 1998A)

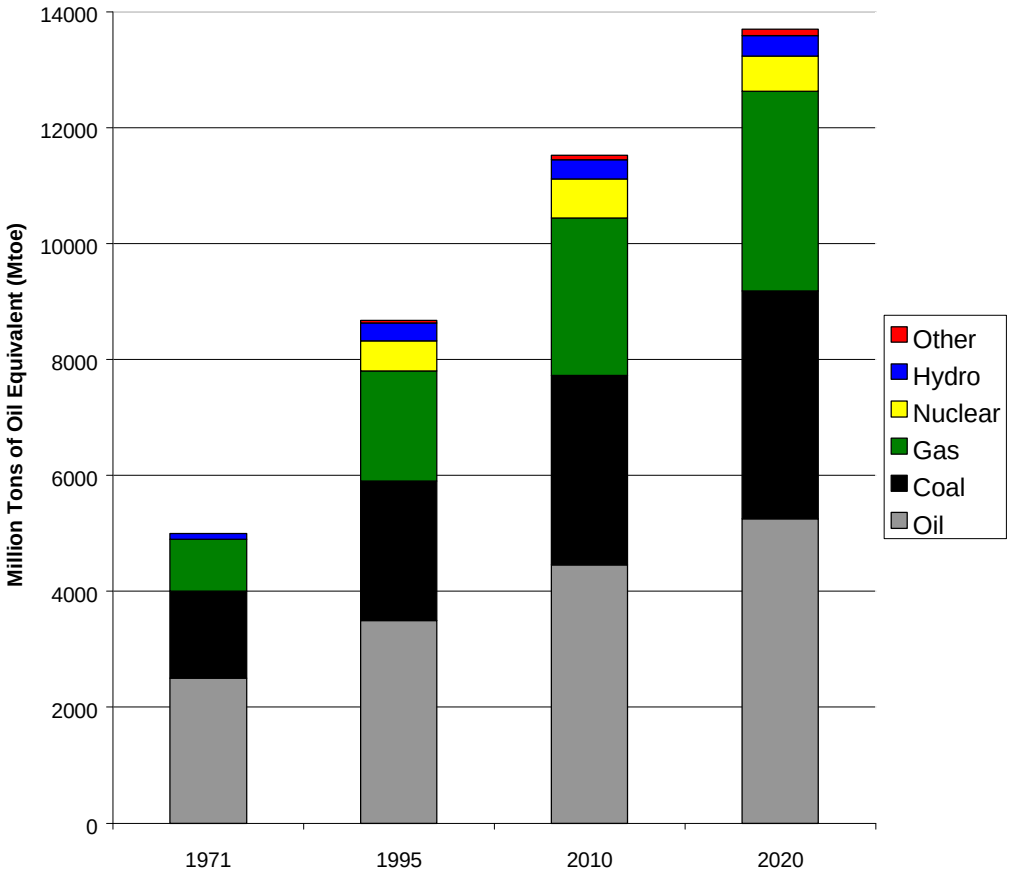

Figure 3: World Energy Demands by Fuel (IEA, 1998A)

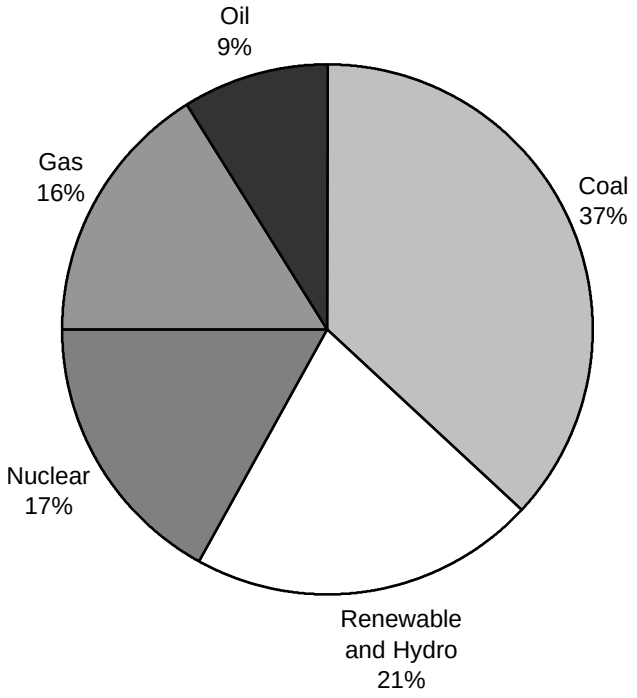

Figure 4: World Electricity Generation by Source (EIA, 1998A)

of exports in 1997 were to the Asian sector. Australian improvements in productivity and decreases in production cost, rail transport costs and tariffs have led to an overall price reduction. The result was lower selling prices and an increased share of the export market that replaced tonnages from other exporters such as the United States. Most other countries cannot match the lower production costs realized by Australia, which enjoys a young industry with infrastructure focused on export markets.

Coal is abundant and cheap in China, which leads the world in both production (Figure 5) and consumption (Figure 6). Presently, coal accounts for 75% of domestic energy consumption in China. The proximity of China to major coal importers makes for an ideal export situation. However, the nation's heavy reliance on coal, which is rapidly increasing because of economic growth, allows for only a small amount of exports. Additionally a poor transportation infrastructure hinders China's ability to increase their share of the world coal trade in the short term (EIA, 1997D & 1999C). Nevertheless, an increase in foreign investment, coupled with the world's third largest reserve base, stands to make China a potentially large player in the world export market in the future (IEA, 1999B).

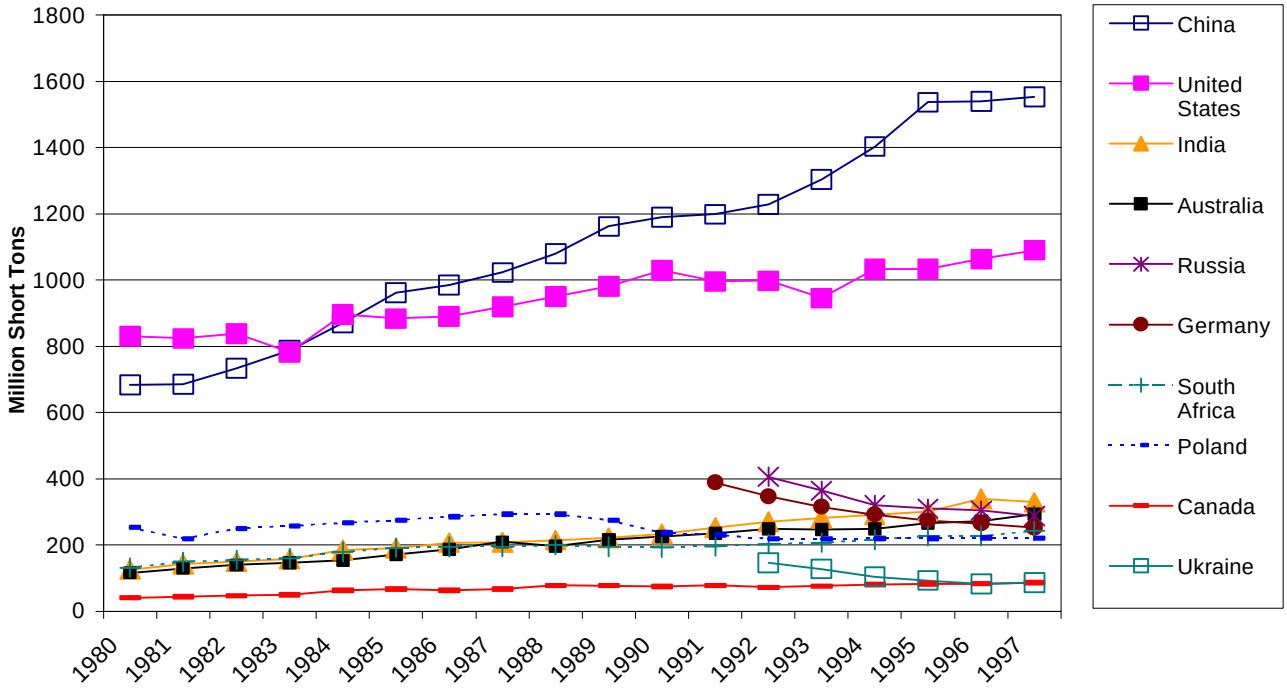

Figure 5: World Coal Production by Country (EIA, 1999B)

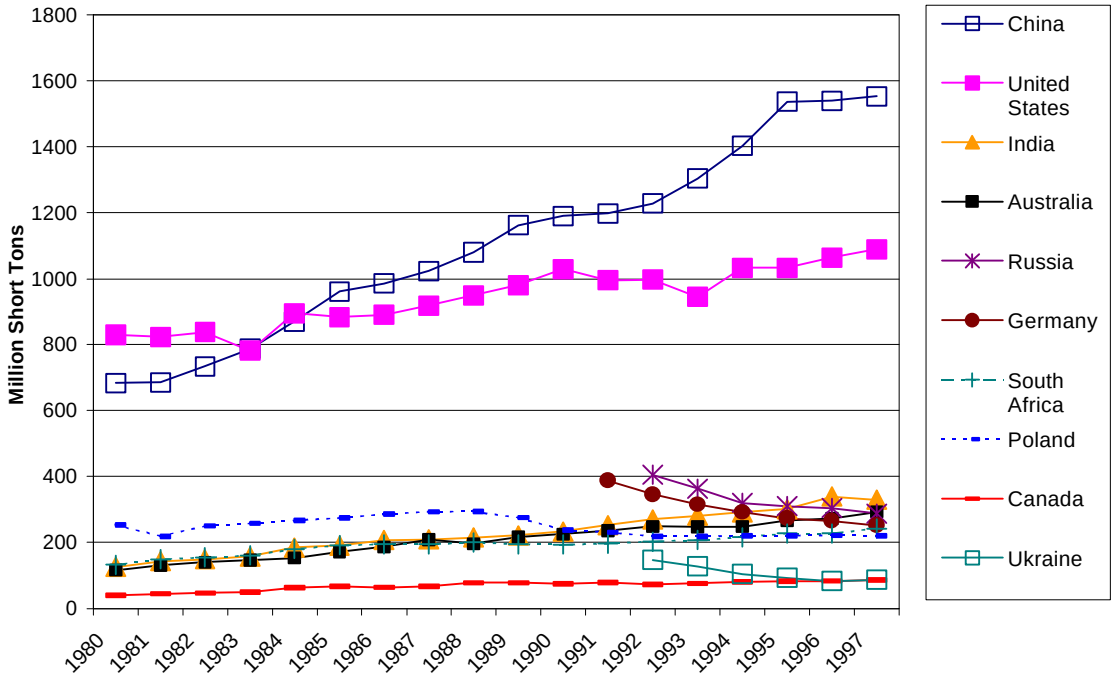

Figure 6: World Coal Consumption by Country (EIA, 1999A)

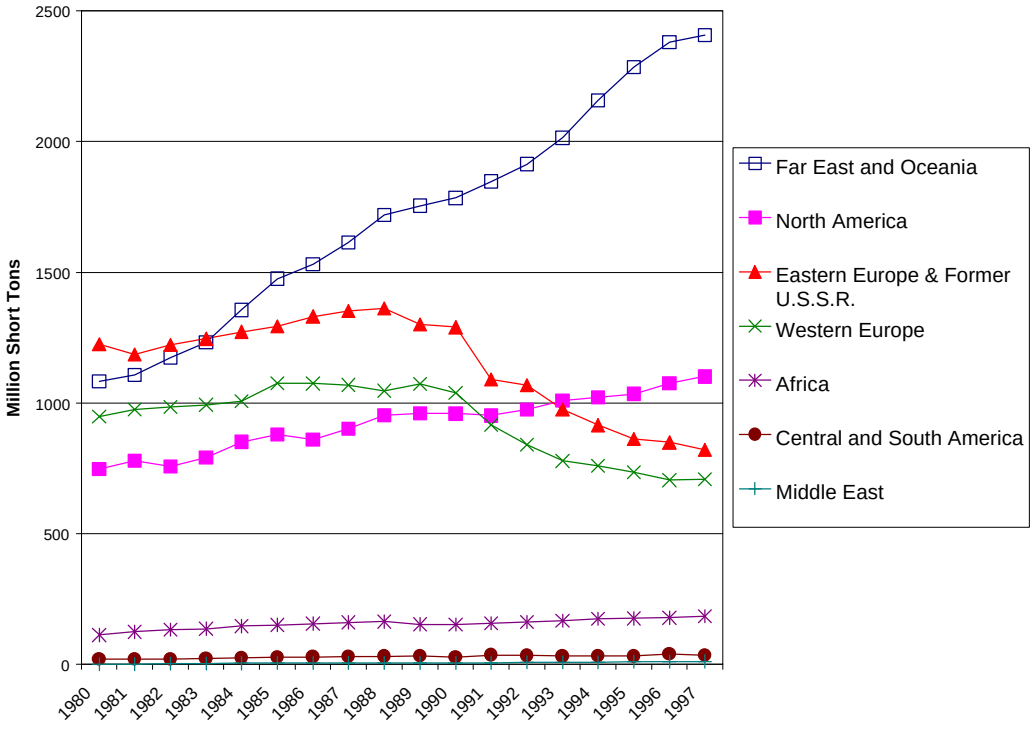

Figure 7: World Coal Consumption by Region (EIA, 1999A)[1]

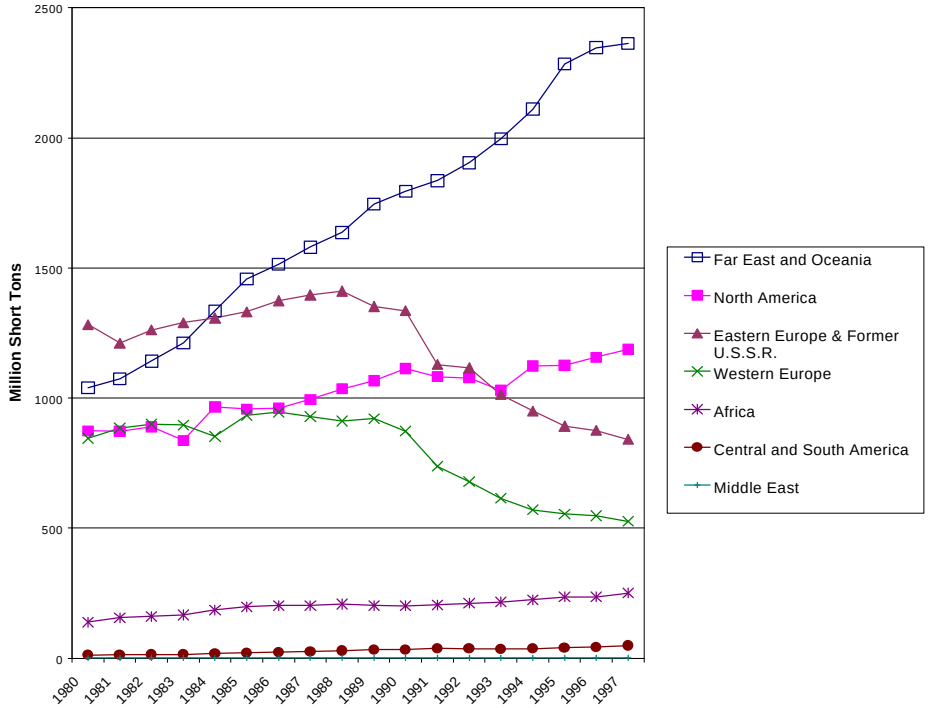

Figure 8: World Coal Production by Region (EIA, 1999B)

[1] Oceania includes: Australia, New Zealand, Papua New Guinea.

The third largest world producer of coal is India. The Indian coal industry, however, is suffering from low productivity, distribution problems, and government control. India is seeking to rectify this problem by modernizing and expanding their existing mines with a US$1.6 billion loan from the World Bank (EIA, 1997E & 1999D). Due to high levels of domestic consumption, demands in energy growth, and poor quality (high ash), India may not be able to meet even its own coal needs through domestic production. Thus, India will have an impact on the world market in the near future mainly as an importer and not as an exporter (IEA, 1998B).

The Far East is the leading consumer of coal (Figure 7), with imports expanding to meet a rapidly increasing demand for electric power. Japan is by far the largest coal trader, importing about143 million tons in 1997. This figure accounted for 28% of the total world coal imports for 1997. Much uncertainty exists concerning the future of Japanese imports because Japan has committed to reduce carbon dioxide emissions in accordance with the Kyoto agreement. Current projections, however, call for Japanese demand to increase by 0.7% annually through 2020, although Japanese utilities insist this figure is closer to 2.1% (EIA, 1999E & 1998D). South Korea and Taiwan also import significant amounts of coal into this region.

Production from North America is dominated by the United States. The United States is currently second in world exports of coal, exporting 77.2 million tons in 1998 (EIA, 1998E & 1999F). The overall status of the U.S. coal industry will be treated in detail in a later section of this report. Canada produced 86.7 million tons of coal in 1997. Despite this small domestic production, Canada in 1998 affected the world coal market by exporting 25 million tons, mainly to Asian markets (EIA, 1998F & 1999G).

Another region that is experiencing growth in the export market is Latin America, particularly Colombia and Venezuela. Colombia is currently the ninth largest exporter of coal, and holds the largest amount of reserves in the region. The 1997 production in Venezuela was only 6.12 million tons, primarily destined for exports. Current plans call for an expansion of production to 21 million tons by the year 2008. An influx of foreign investment is expected to greatly increase Latin America's contribution to the world coal trade (EIA, 1996). It has been speculated, however, that with the current trend of minimal price growth, additional export production may not be realized because investors will be reluctant to commit additional funds to infrastructure investment (IEA, 1998B).

South Africa is also a major force in the world coal market, currently third in world exports. High levels of existing technology, a large reserve base and recent foreign investment could drive South African coal exportation to even higher levels (EIA, 1997F & 1999H). On the other hand, lower prices could also prevent further investment in the expansion of the South African coal industry (IEA, 1998B).

Eastern and Western Europe have experienced significant production declines (Figure 8). This decline is especially prevalent in Eastern Europe and the former USSR, as indicated in the corresponding production statistics by country (Figure 5). The Russian industry is beset by the country's economic troubles, with miners often being unpaid and the inability of

the population to pay their electric bills. Production in 1997 was down to 269 million tons, from over 400 million tons achieved in 1992. Moreover, current restructuring efforts call for the closure of approximately 149 unprofitable coal mines by 2002 (EIA, 1997I & 1999L). The 1998 production from the Ukraine was only half of what it was in 1990. Only 3 of the almost 250 mines operating in the Ukraine are profitable, and no new mines have been opened in the past 25 years. The industry is greatly troubled with unsafe conditions, limited spare parts, lack of significant modernization over the past 20 years, and an average production cost of US$50 per short ton (EIA, 1997H & 1999K).

Poland is currently undertaking major restructuring efforts aiming to make the Polish coal industry profitable once again. The elimination of government subsidies through these efforts will cause as many as 30 of the 53 currently active coal mines to close by 2002 (EIA, 1997G & 1999I). Similar efforts to eliminate government subsidizing of the coal industry in Germany will leave only 11 or 12 mines in operation by the year 2005. Production has already dropped from 600 million short tons in 1984 to under 250 million short tons in 1997 (EIA, 1998G & 1999J).

These factors call for increased imports of coal to Europe, with the producing European countries consuming internally much of domestic production (IEA, 1999B). In fact, the level of coal imports into Germany rose 20% in 1997, and an additional 15% in 1998 (EIA, 1998G & 1999J).

Coal Reserves

Coal is unique among energy sources, specifically fossil fuels, in that mineable deposits are distributed throughout the world. In this sense, the world can never be held hostage by the sort of scenario that occurred with oil in the 1970s. The greatest concentration of coal reserves is found in the Far East / Oceania. Large amounts of mineable coal exist throughout the rest of the world (Figure 9), with an estimated 1.1 trillion short tons available worldwide. Complete parity does not exist on a national level, however. The United States holds an estimated 270 billion short tons of coal, and Russia, which has the second largest reserve base, holds approximately 165 billion short tons (Figure 10).

Comments

The future of the global coal market seems strong because of the strong demands dictated by population increases and by growth trends in the developing world. The nations that will benefit are those that are able to expand production economically or that currently have excess production capabilities.

Environmental commitments made under international agreements, such as the Kyoto Treaty, will almost certainly affect coal supply and demand. The true impact of Kyoto will depend on the accessibility of new technologies and on alternative means of generating energy by nations with sub-par economies. Not only will accessibility be a factor, but also availability in terms of meeting immediate energy needs in those and all countries. The nations of the world are not likely to sacrifice economic growth, nor degrade the quality of life of their citizens, strictly for instituting tougher environmental standards.

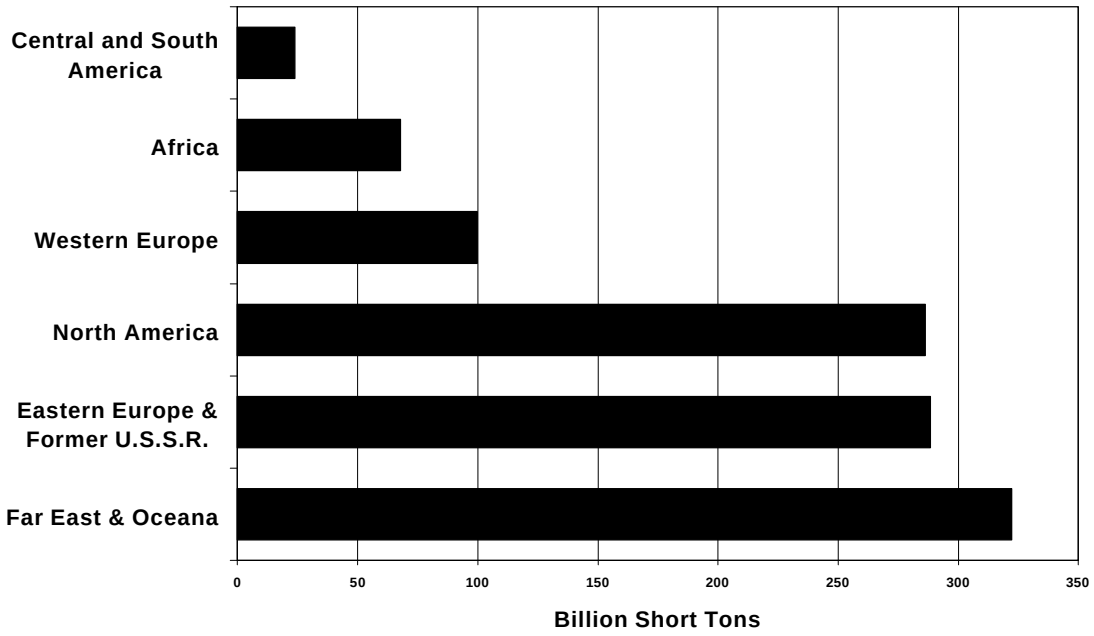

Figure 9: Recoverable Coal Reserves by Region (EIA, 1999M)

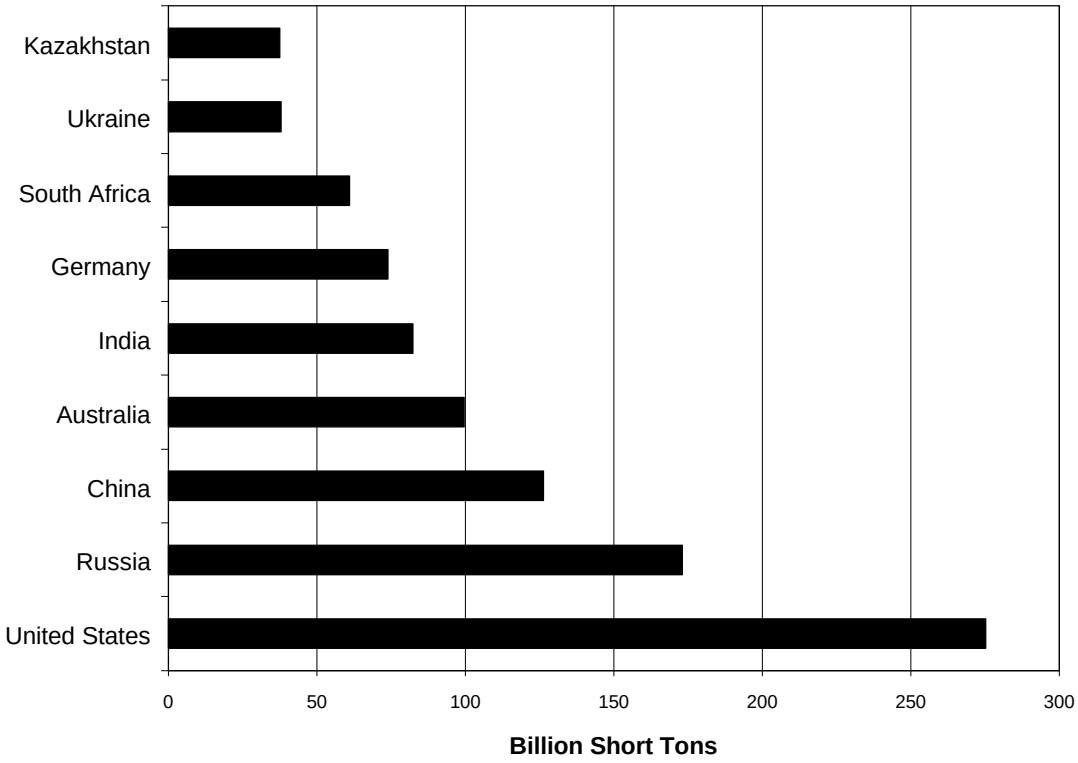

Figure 10: Recoverable Coal Reserves by Country (EIA, 1999M)

National Outlook

United States Coal Production, Productivity, and Reserves

In 1998, the United States produced a record 1,118.1 million tons of coal. The coal production for 1999 is expected to be close to 1,105 million tons, down 13 million tons from the 1998 level. During 1998, low-sulfur western coal production surpassed higher-cost, higher-sulfur, Appalachian coal for the first time (Figure 11). The Western coal region increased production from 1997, while coal production in the Appalachian and Interior regions fell slightly from 1997 levels. Phase 1 of the Clean Air Act, which requires lower sulfur emissions from coal combustion, has largely prompted this change. Moreover, Western reserves are amenable to large-scale, low-cost, surface mining methods. As Phase 2 of the Clean Air Act comes on-line in 2000 and more of the high-quality Appalachian and Interior reserves are depleted, it is expected that the increasing demand for coal in the United States will be met with lower-sulfur Western coals.

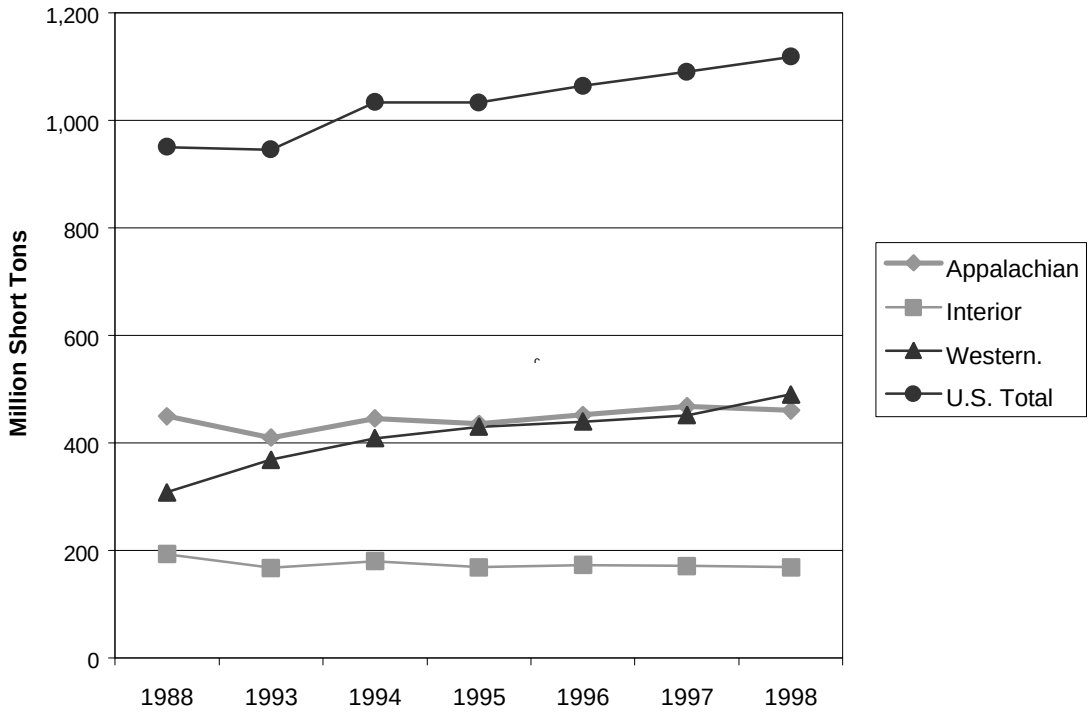

Figure 11: U.S. Coal Production by Region (EIA, 1998B & 1999N)

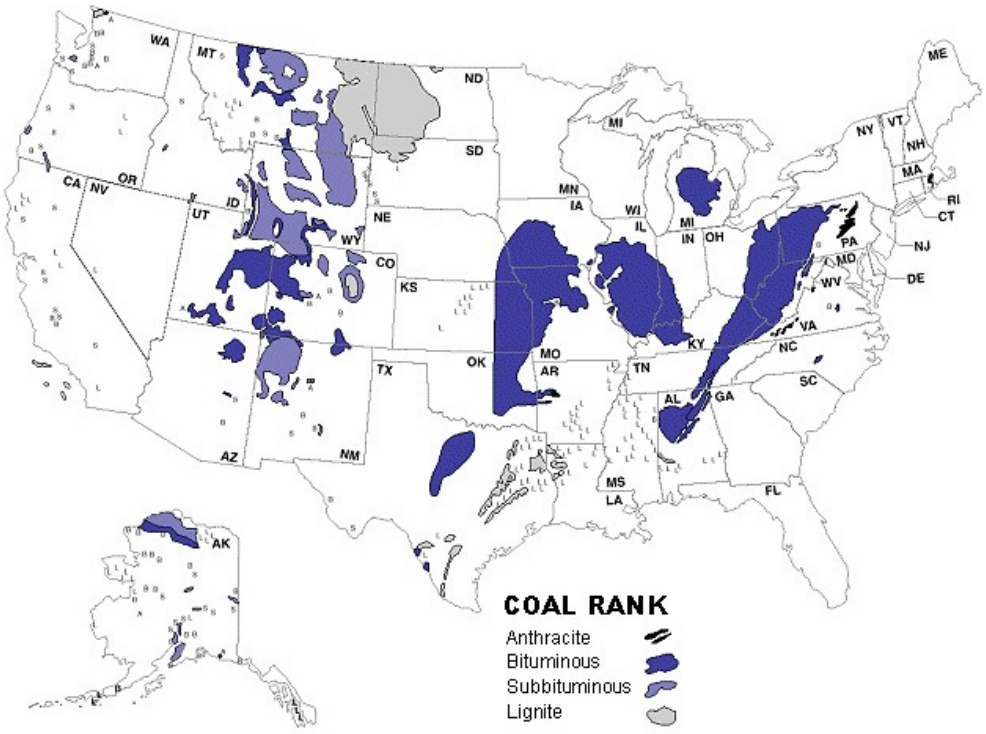

Figure 12: Coal-Bearing Areas of the United States (EIA, 1999O)

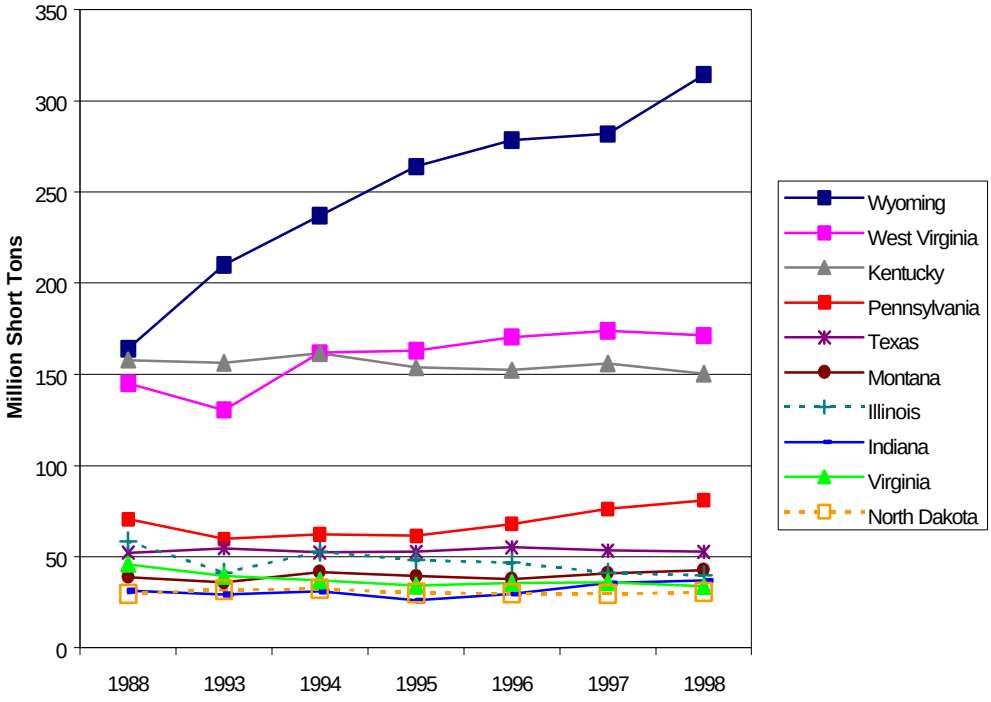

Figure 13: U.S. Coal Production by Top Ten Producing States in 1998 (EIA, 1999N & 1999P)

The U.S. Demonstrated Coal Reserve Base (DRB) is found mostly in three distinct regions: the Appalachian, the Interior, and the Western (Figure 12). The national estimate of the DRB as of January 1, 1997, is 508 billion short tons, which is 466 times the U.S coal production in 1997. Only about half (54%) of the DRB can be recovered. The remaining half is not economically mineable under the current technological and economic conditions.

Nearly half of the DRB is found in the Western region. Surface mining makes up one-third of the DRB, with 58% occurring in the West. The other two-thirds is mineable only by underground mining, with 58% occurring in the Interior and Appalachian regions. Low-sulfur coal is estimated at 33% of the DRB, medium-sulfur at 28%, and high-sulfur at 39%. Most of the low-sulfur coal (84%) and medium-sulfur coal (61%) is found in the West, and 71% of the high-sulfur coal is found in the Interior (EIA, 1999O).

Wyoming was the leading U.S. coal producing state in 1998, followed by West Virginia, Kentucky, and Pennsylvania (Figure 13). Wyoming accounted for 64% of the national production, producing a record 314.4 million tons, while West Virginia, Kentucky, and Pennsylvania produced 171.2, 150.2, and 81.0 million tons respectively. The top ten producing states accounted for 953.0 million tons, or approximately 85% of the total U.S. production. The significant production increase in Wyoming can be related directly to the low mining cost, low sulfur content, and plentiful reserves in that region.

From 1923 to 1998, US coal production has more than doubled, from 564.6 million tons in 1923 to 1,118.1 million tons in 1998 (Table 3). Over this same time span, the number of miners and the number of coal mines have decreased drastically. The number of active miners dropped by more than 80% to 81,000 in 1998. Higher productivity rates have increased production while decreasing the workforce. This higher productivity clearly demonstrate the technological progress made in the coal mining industry. Indeed, the coal mining industry has been transformed from labor intensive to technologically advanced.

From 1985 to 1997, the short tons/miner/hour have risen from 2.74 to 6.04 (Table 4). This dramatic productivity increase, in a short span of 12 years, is directly related to the advent of the longwall mining method in the mid-1980s and the large increase in size of surface mining equipment. These changes were advanced by mining and equipment manufacturing companies who realized the productivity benefits to be gained through capital investments.

Table 3: Trends in U.S. Coal Mining from 1923 to 1998 (NMA, 1999)

Year	Number of Mines	Number of Miners	Total U.S. Production (millions of short tons)	Productivity (tons/miner)
1923	9,331	704,793	564.6	801
1933	5,555	418,703	333.6	797
1943	6,620	416,007	590.2	1,419
1953	6,671	293,106	457.3	1,560
1963	7,940	141,646	458.9	3,240
1973	4,744	148,121	591.7	3,995
1983	3,337	175,642	782.1	4,453
1984	3,496	177,848	895.9	5,037
1985	3,355	169,281	883.6	5,220
1986	4,424	154,645	890.3	5,757
1987	4,094	142,667	918.8	6,440
1988	3,860	135,366	950.3	7,020
1989	3,620	131,497	980.7	7,458
1990	3,430	131,306	1,029.1	7,837
1991	3,022	120,602	996.0	8,259
1992	2,746	110,196	997.6	9,053
1993	2,475	101,322	945.4	9,331
1994	2,354	97,500	1,033.5	10,600
1995	2,104	90,252	1,032.9	11,445
1996	1,903	83,462	1,063.9	12,747
1997	1,828	81,516	1,089.9	13,370
1998	1,750	81,000	1,118.1	13,804

Table 4: U.S. Coal Mining Productivity in Short Tons per Miner per Hour (NMA, 1999)

Year	Underground	Surface	All Mines
1985	1.78	4.24	2.74
1986	2.00	4.60	3.01
1987	2.20	4.98	3.30
1988	2.38	5.32	3.55
1989	2.46	5.61	3.70
1990	2.54	5.94	3.83
1991	2.69	6.38	4.09
1992	2.93	6.59	4.36
1993	2.95	7.23	4.70
1994	3.19	7.67	4.98
1995	3.39	8.48	5.38
1996	3.57	9.05	5.69
1997	3.83	9.46	6.04

The Western coal region produced almost as much coal as the Appalachian region in 1997 with 82% fewer employees (Figure 14). In 1997, the West produced 451 million tons with 10,117 employees, while the East produced 467 million tons with 58,694 employees. Western coal is more efficiently produced because the Western coal seams are considerably larger, closer to the surface, and mining conditions (mainly surface mining) are easier than in the Eastern region. The Eastern region has also exhausted most of its easily accessible reserves. However, it should be noted that the East contains the highest quality thermal coals and virtually all the U.S. metallurgical grade coal reserves.

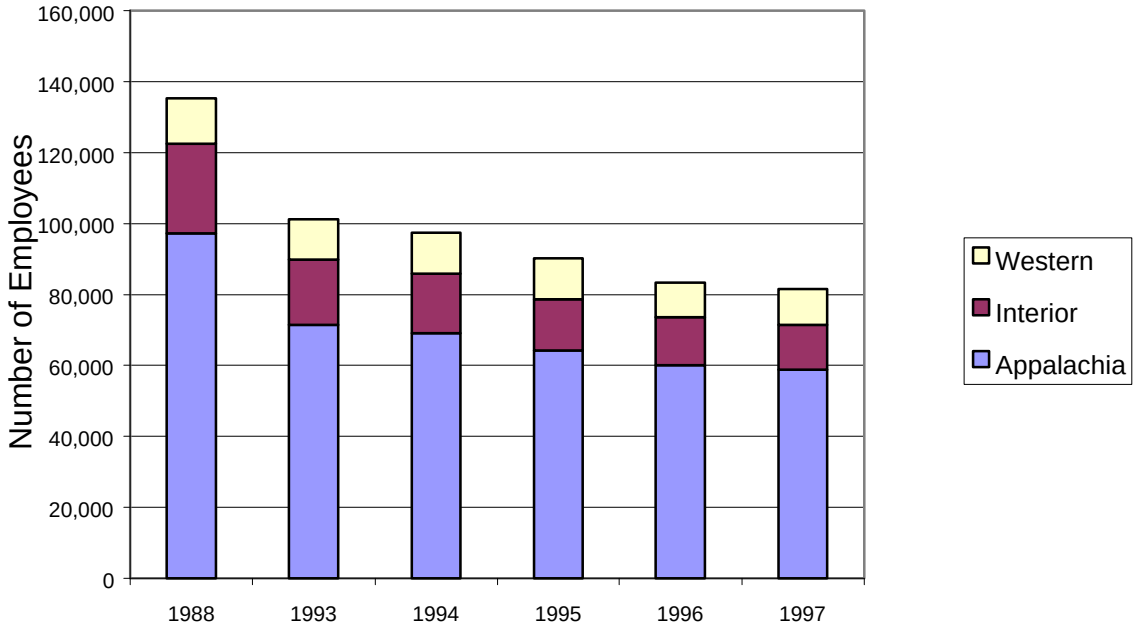

Figure 14: U.S. Coal Employees by Region (EIA, 1997A)[2]

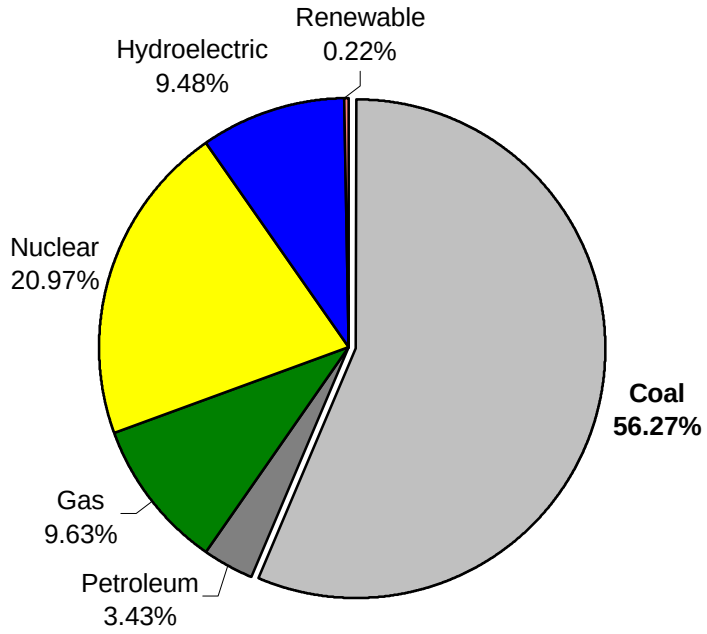

Figure 15: 1998 U.S. Utility Electricity Generation by Source (EIA, 1999R)

[2] Includes all employees engaged in production, management, and engineering at mining operations. Excludes office workers, mines producing less than 10,000 short tons, and preparation plants with less than 5,000 employee hours.

U.S. Electricity Generation

Coal-fired electricity generation produced more than 56% of the total electricity generated by utilities in the United States in 1998 (Figure 15). Nuclear generation is expected to decline, as older and higher-cost plants are retired. Because of the increasing demand for electricity and declining nuclear generation, coal and natural gas generation are expected to increase. In the United States, electricity cost in 1998 averaged 6.75 cents per kWh, a decrease from the 1997 average of 6.85 cents per kWh. The decline in price can be attributed to lower costs for fossil fuels and to rate reductions resulting from utility groups competing as they prepare for a deregulated environment (EIA, 1999Q).

U.S. Coal Consumption

The demand for coal in the United States was 1,037 million tons in 1998, and is expected to increase by 4.6 million tons in 1999. In 1998, the electric power industry accounted for the majority of the demand, nearly 90%, with other industries consuming 6.75%, the coke industry consuming 2.6%, and the residential and commercial sectors consuming only 0.87% of the U.S. coal production (Figure 16). The demand of other industries, coke plants, and the residential and commercial sectors has been constant in the 1990s. The increase in coal demand throughout the 1990s has been due to the electric power industry. The demand for electricity is increasing daily in order to sustain the technological and power-hungry society of the 21st century.

U.S. Coal Exports and Imports

U.S. coal exports dropped to 77.2 million tons in 1998 from 83.5 in 1997 (Figure 18) and are continuing to fall in 1999. Of the 1998 total exports, about one-half went to Europe, one-quarter to Asia, and the remainder mainly to Canada and Brazil (Figure 18). The decline in exports since 1995 is due to the Asian economic crisis, increased competition from other coal-producing countries (i.e., Australia, South Africa, Indonesia, Venezuela, and Colombia), and increased competition from natural gas (EIA, 1999Q). Metallurgical coal exports have been declining because of increased use of the Pulverized Coal Injection (PCI) technology that requires less high-grade coking coal. International competition has driven the U.S. steam coal exports down as well. U.S. coal exports (primarily from the West) are expected to increase gradually, because of an expected higher demand in Asia for steam coal imports.

Coal imports into the United States have risen to 8.7 million tons in 1998 from 7.5 in 1997 (Figure 18). Nearly 5 million tons are coming from South America, primarily from Colombia and Venezuela. The other import source countries are Canada and Indonesia.

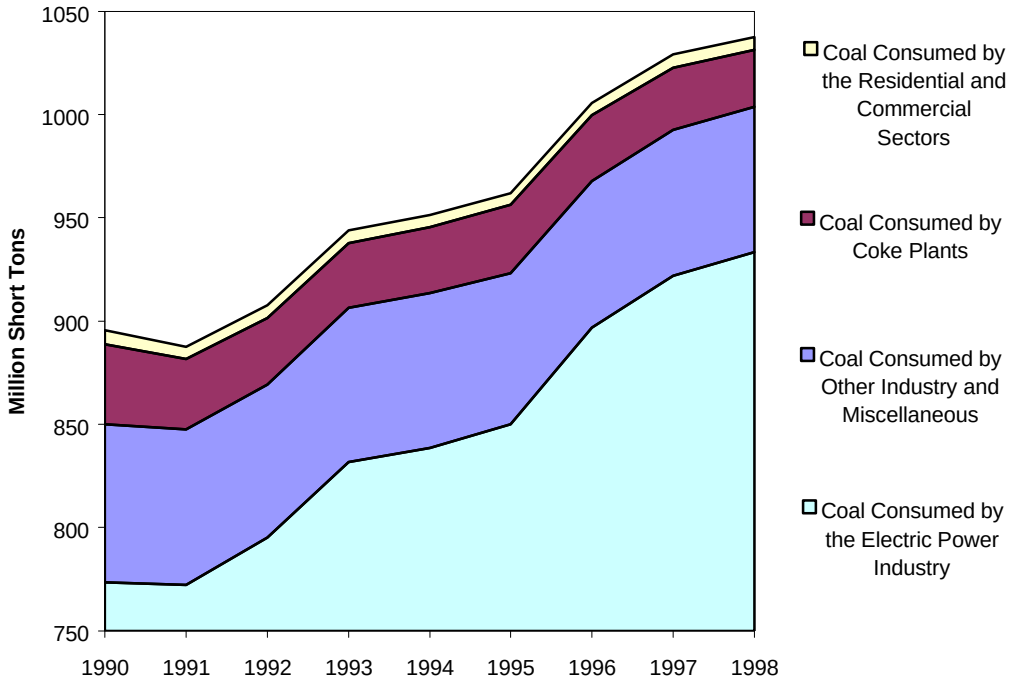

Figure 16: U.S. Coal Consumption by Source (EIA, 1999S)

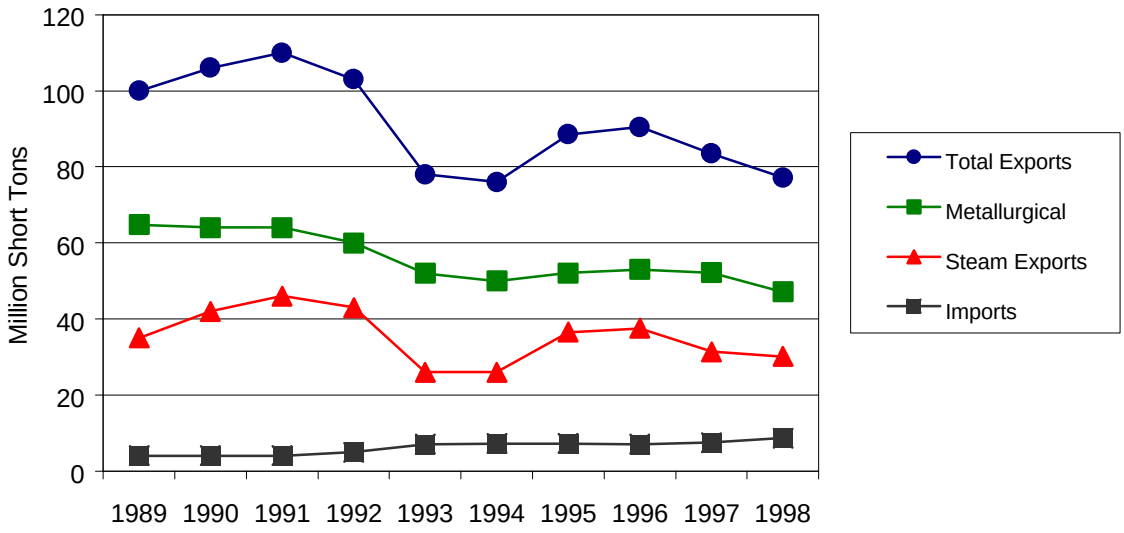

Figure 17: U.S. Coal Exports and Imports (EIA, 1997B & 1999V)

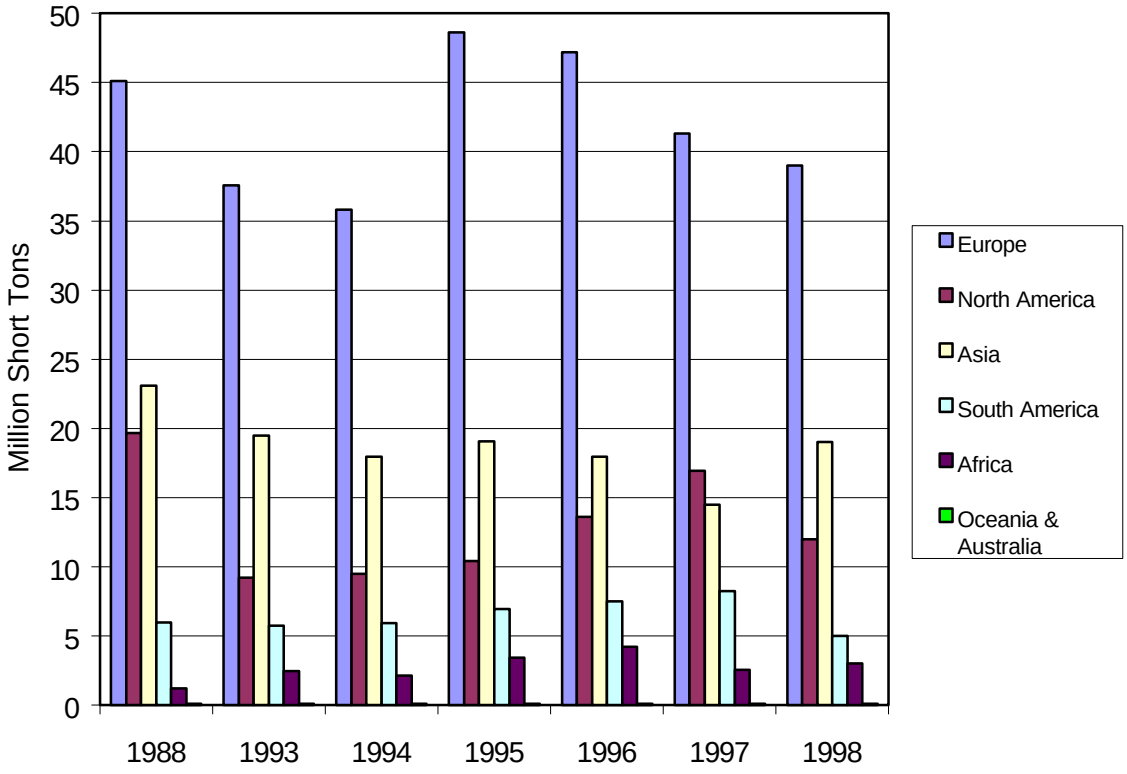

Figure 18: U.S. Coal Exports to Markets (EIA, 1997C & 1999V)

U.S. Coal Prices and Forecasts

The average delivered price of U.S. coal by end-use sector has remained relatively constant since 1993 (Figure 19). The coking coal price has remained consistently near $46/ton. The electric utility coal prices have been declining slightly to nearly $25/ton in 1999, while other industrial coal prices are at $32/ton. Coal mine-mouth prices are predicted to decline at an average annual rate of 1.5% (Figure 20) because of increased production from lower-cost Western mines, technology improvements, and competitive pressures on labor costs (EIA, 1999T). U.S. production is expected to increase at an average annual rate of 0.7% to the year 2020.

Electric power industry deregulation is expected to result in intensified price competition, growing price volatility, shorter-term wholesale electricity transactions, and industry consolidation and structural changes (EIA, 1998A). Because coal is the major fuel used in U.S. electricity generation and these power plants are the major consumers of coal, the changes in the restructuring of the electric power industry will directly affect the coal industry. Attempts to cut costs by the power industry will put pressure on coal prices. This will lead to shorter-term coal contracts and renegotiation of existing coal contracts. Deregulation of the power industry will also add to the increasing pressure for consolidation in the coal industry. Medium to small coal companies will be the subject of mergers and acquisitions, and the larger firms will grow in size. The strong incentives for the convergence of energy firms will expand to coal (EIA, 1998).

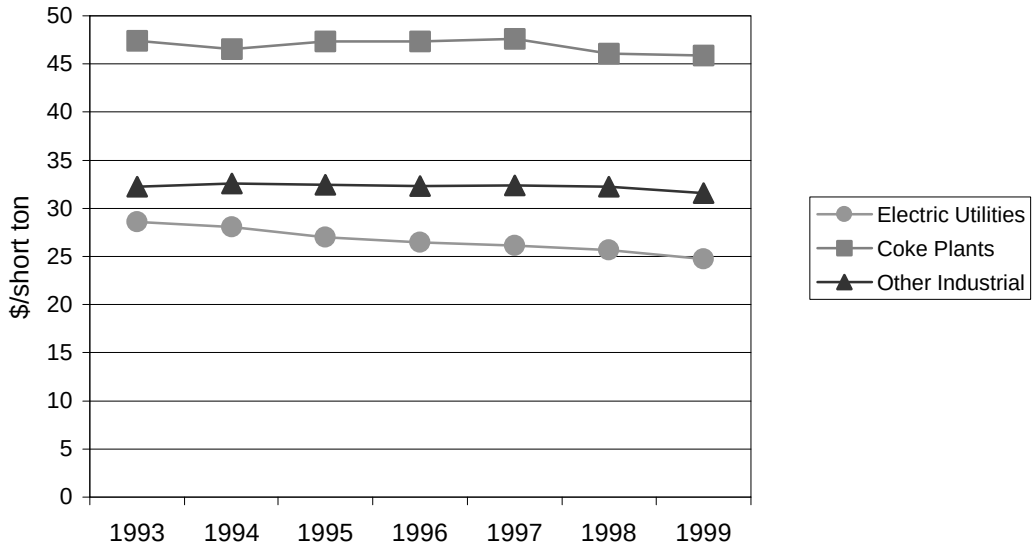

Figure 19: Average Price (FOB Plant) of U.S. Coal by End-Use Sector (EIA, 1999U)

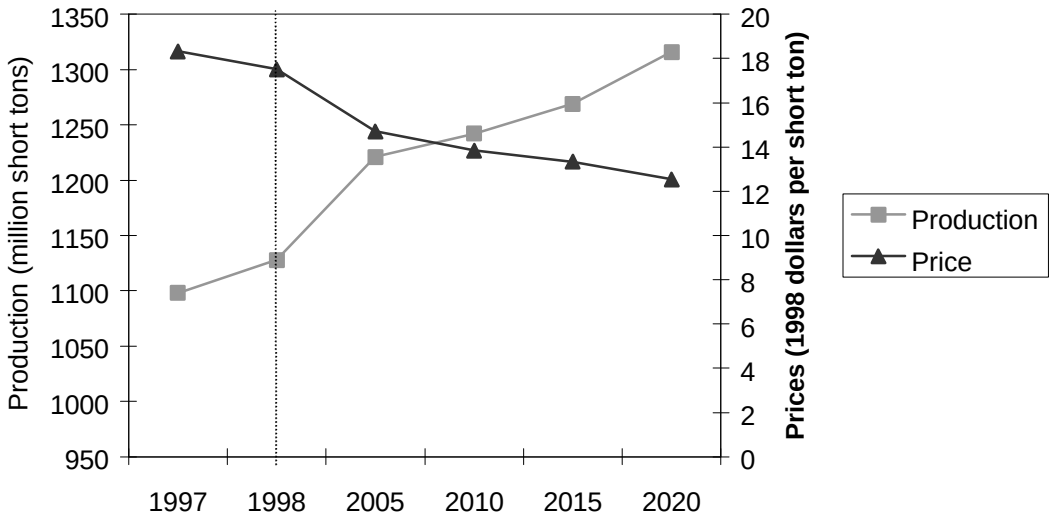

Figure 20: U.S. Production and Price Forecasts for Coal to the Year 2020 (EIA, 1999T)

Coal mining in the United States should show continued growth into the foreseeable future because of the increasing demand for electricity in the United States, and the strong position of coal in electricity generation. Low-sulfur and medium-sulfur coals, as well as natural gas, will capture most of the new demand, because of environmental laws and stipulations forcing lower-sulfur feedstocks. The higher-sulfur coals, which will continue to be treated by de-sulfurization techniques in power plants, will have a future in the Appalachian region. The driving force for Application coal is cheaper transportation costs to Eastern urban areas.

Virginia Outlook

Coal and Energy in Virginia

Production, Consumption, and Reserves

Almost 50% of the electric power consumed in the Commonwealth of Virginia is generated from coal-fired power plants, utilizing Virginia-mined coal as a portion of its energy source (Figure 21). This percentage has remained stable in the past ten years, and it is expected to continue in the future. Additionally, the share of nuclear power, now supplying approximately 43% of Virginia's electric generation, is expected to decrease as nuclear plants become older and are decommissioned. The loss in nuclear power is expected to be replaced by gas or coal-fired plants.

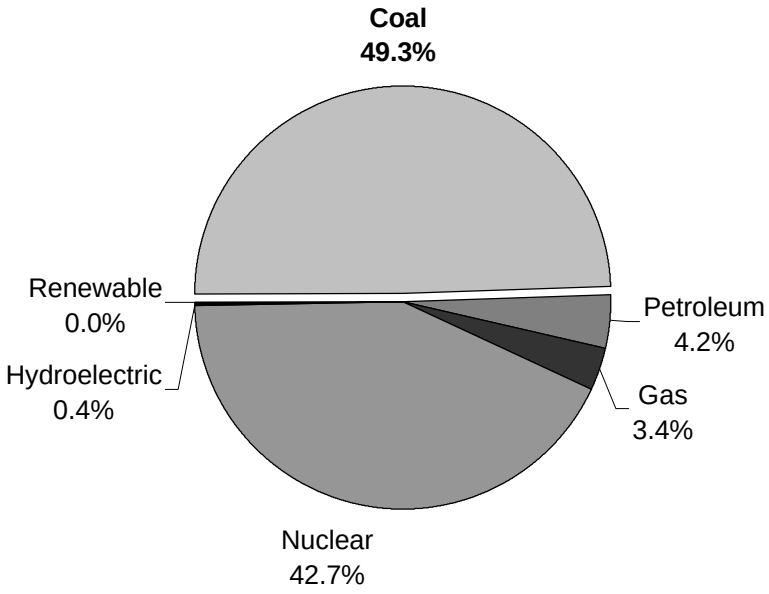

Figure 21: Electric Power Generation in Virginia in 1998 (EIA, 1998C)

Virginia's coal production has decreased in the past decade from 46 million tons in 1990 to 34 million tons in 1998 (Figure 22). The declining trend, however, has continued at a slower rate since 1995, because of the Coalfield Employment Enhancement Tax Credit discussed later.

County-specific coal production statistics (Figure 25) show a decrease in production in Buchanan County, where the VP #3 Mine, CONSOL, dropped from 2.2 million tons in 1997 to 0.25 million tons in 1998. Production increased at the #8 Mine of that company, but not enough to replace the lost production. Nevertheless, the overall state production was not significantly affected because production increased in Dickenson County. This increase is mainly attributed to the Coalfield Employment Enhancement Tax Credit.

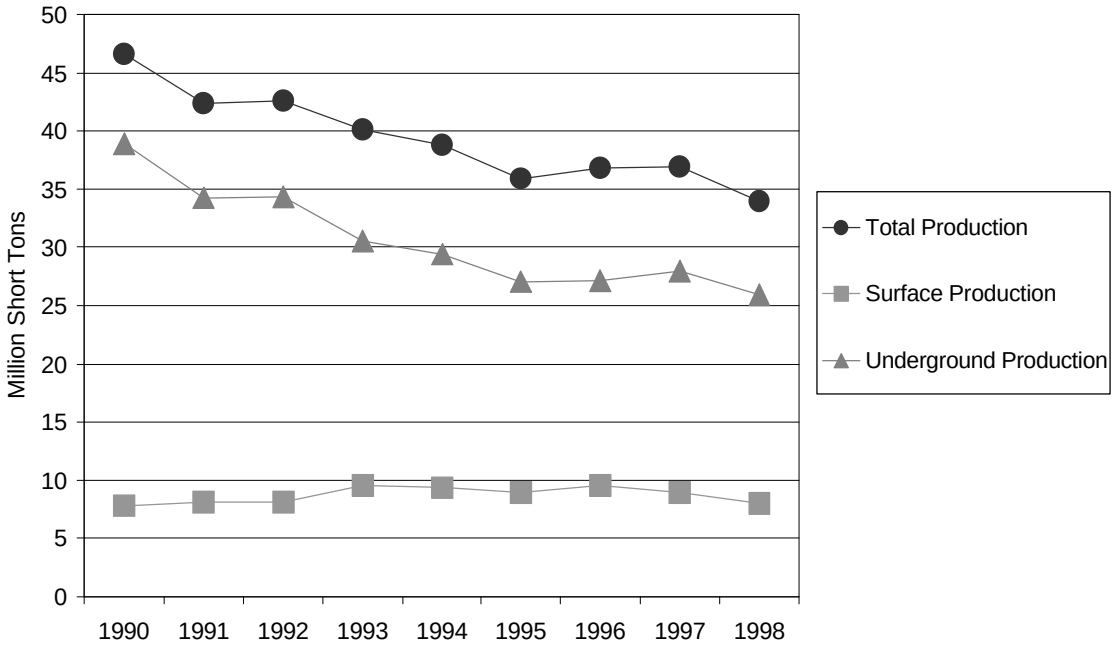

Figure 22: Virginia Production Trends (VCCER, 1999)

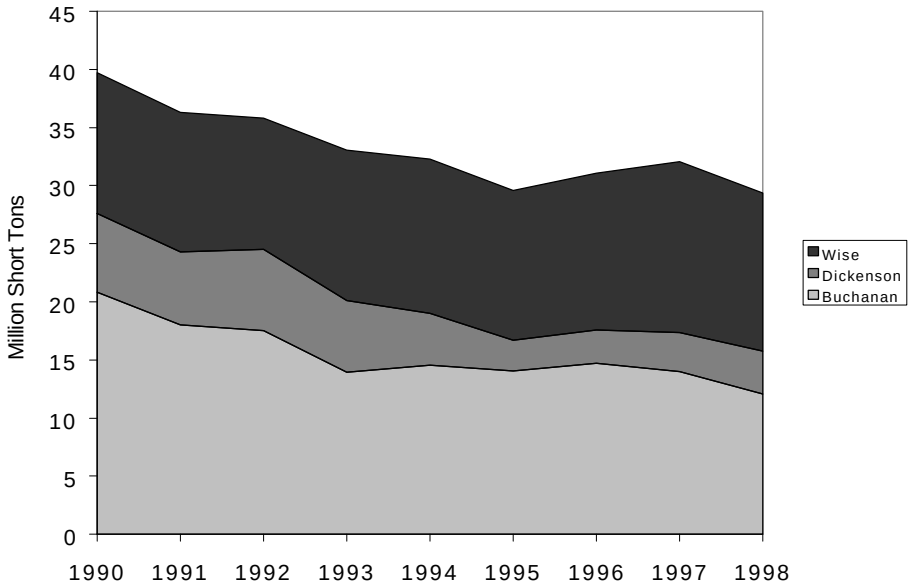

Figure 23: Production in Virginia's High Production Counties (VCCER, 1999)

The above coal production trends are not indicative of a decreasing reserve base, but rather reflect the difficult mining conditions, type of the reserve (i.e., thin seams), and the low market prices. In fact, a recent study has indicated that coal reserves in Virginia are more significant than originally thought (Table 5, Westman et al., 1999).

Table 5: Virginia's Coal Reserves (Westman et al., 1999)

County	Production through 1997 (million short tons)	Surface Reserves (million short tons)	Underground Reserves (million short tons)	Total Reserves (million short tons)	Percent Initial Mined
Buchanan	730.5	79.4	287.2	366.6	66.6
Dickenson	336.5	159.0	380.9	539.9	38.4
Lee	116.0	27.5	19.0	46.5	71.4
Russell	129.2	17.7	114.4	132.1	49.5
Scott	1.6	20.8	13.9	34.6	4.5
Tazewell	192.6	4.2	31.1	35.3	84.5
Wise	666.3	89.5	357.0	446.5	59.9
Total	**2,172.8**	**398.1**	**1,203.4**	**1,601.5**	**57.6**

The overall productivity of the coal industry has remained at high levels. Figure 24 shows the increases in underground and overall productivity. This figure also shows a decrease in surface productivity, which accounts for 24% of the overall production.

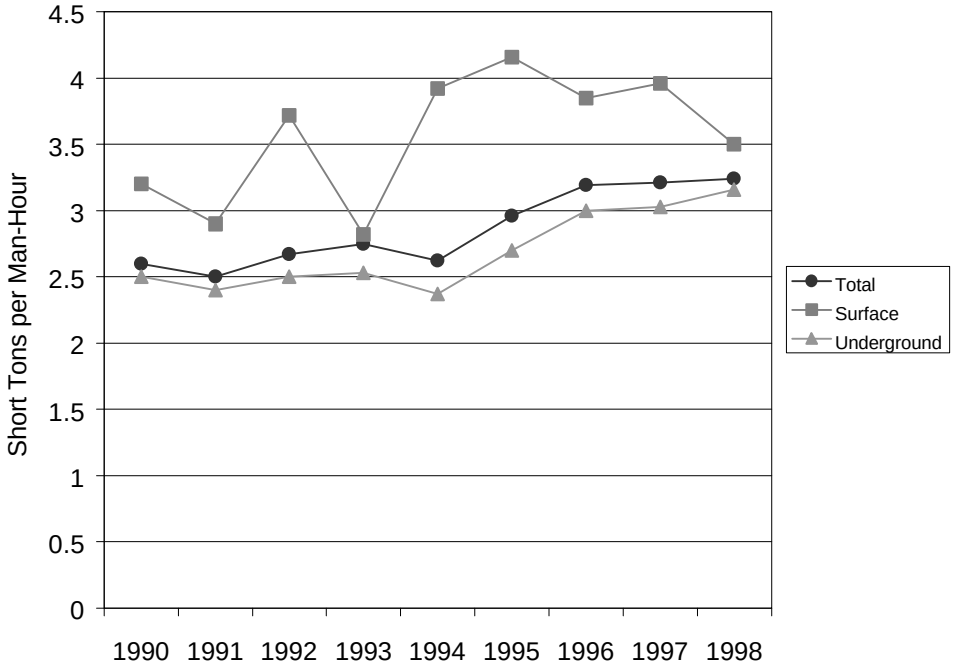

Figure 24: Virginia Mine Productivity (short tons per man-hour) (VCCER, 1999)

Socio-Economic Impacts of the Coal Industry in Virginia

Employment in Southwest Virginia

The coal mining industry has a pronounced effect on the Virginia economy. Coal producing counties see a large portion of this effect. These counties are traditionally less economically diverse than other counties in the state and depend largely on coal mining to maintain their economic existence. As shown in Table 6 and 7, in 1998 coal mining directly employed approximately 11% of the total workforce in these counties and contributed approximately 20% of the total wages. In Russell and Lee Counties, the average mining weekly wages are 100% higher than the average weekly wages. This average includes mining, so the difference between mining wages and non-mining wages is even greater. The loss of 10 coal mining jobs is the same as losing 20 typical jobs on an equivalent wage basis.

Table 6: County Employment Data, December 1998 (VEC, 1999)

County	Average Total Employment	Average Mining Employment	Percent of Workforce
Wise	12,987	2,174	16.7
Tazewell	16,198	560	3.5
Russell	8,435	429	5.1
Lee	5,198	297	5.7
Dickenson	3,276	478	14.6
Buchanan	8,528	2,001	23.5
Total	**54,622**	**5,939**	
Average			**10.9**

Table 7: County Wage Data, December 1998 (VEC, 1999)

	Quarterly Gross Wages			Average Weekly Wage per Employee			
County	Total	Coal Mining	Mining % of Total Wages	All Industries	Coal Mining	% Increase of Mining Wage Over Average County Wage[3]	Equivalent Loss of Average Workers' Wages to Loss of 10 Miners[4]
Wise	$89,243,103	$25,211,096	28%	529	888	68	16.8
Tazewell	$90,507,386	$5,740,516	6%	430	789	83	18.3
Russell	$51,811,658	$5,556,908	11%	472	996	111	21.1
Lee	$30,356,181	$3,636,329	12%	449	899	100	20.0
Dickenson	$20,104,292	$5,282,450	26%	472	828	75	17.5
Buchanan	$59,840,914	$22,692,715	38%	540	897	66	16.6
Total	**$341,863,534**	**$68,120,014**	**20%**				
Average				**482**	**882**	**83**	**18.3**

[3] This represents the percent change between the average weekly income and the average miner's weekly income.

[4] This shows the equity between the miner and the average worker.

The reliance on coal mining is even greater in the higher producing counties of Buchanan, Wise, and Dickenson. Coal mining directly employed 23% of all the workers in Buchanan County, while paying 38% of all the wages. Roughly 17% of the total workforce and 28% of the total wages in Wise County were supplied by coal mining. Dickenson County shows similar effects, with 15% of its total workforce and 26% of its wages derived directly from coal mining. In the coal-producing counties, the mining wages are roughly 35% higher than the average wage for that area. On an equivalent income basis, the loss of 10 miners (workers employed at the mine site as defined by the VEC) is equivalent to losing 18 general workers (all workers in the county including the miners). The equivalence is based on the average monthly income as collected by the VEC, (see Table 7).

Figure 25 demonstrates that Coal Mining, at 11%, is Southwest Virginia's fourth largest employment sector, behind Trade (24%), Government (23%), and Services (18%). Figure 26 is a similar study using eight non-coal mining counties from different economic regions in Virginia. The counties of Alexandria and Fairfax were used to represent Northern Virginia. Chesterfield and Henrico counties were chosen to represent Central Virginia. The cities of Virginia Beach and Norfolk represent Tidewater. Montgomery and Bland counties represent Southwestern Virginia. In this composite, Services grows to employ 36% of the workers, Trade continues to employ 24% of the workers, and Government declines to employ 15% of employees.

The six coal-producing counties all had unemployment rates that ranked in the top seven in the state in 1998 (Figure 27). Virginia's top coal producing counties are Wise, with 10.3% unemployment, Buchanan at 14.1%, and Dickenson at 15.7%. They are ranked 4, 2, and 1, respectively, in unemployment. The state average for 1998 was 2.9%. Because this region relies strongly on coal mining for employment and wages, and because excessive unemployment currently plagues the region, coal mining is critical to the economy of Southwest Virginia.

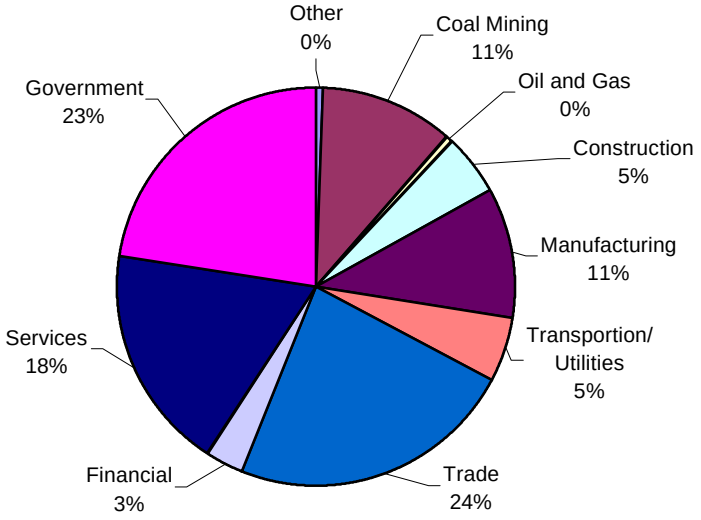

Figure 25: Percentage of Total Employment in Southwest Virginia by Sector[5] (VEC, 1999)

[5] "Other" consists of Agriculture/Forestry, Metal and Industrial Mining.

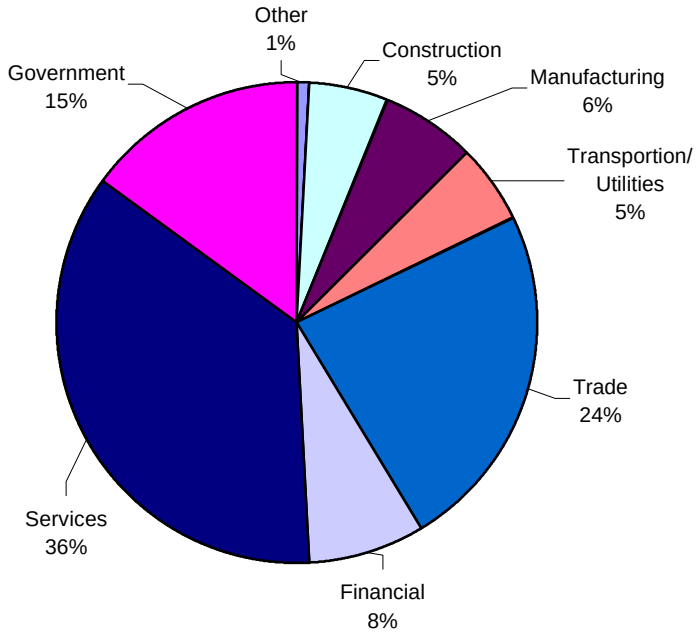

Figure 26: Percentage of Total Employment by Sector - Virginia Composite[6] (VEC, 1999)

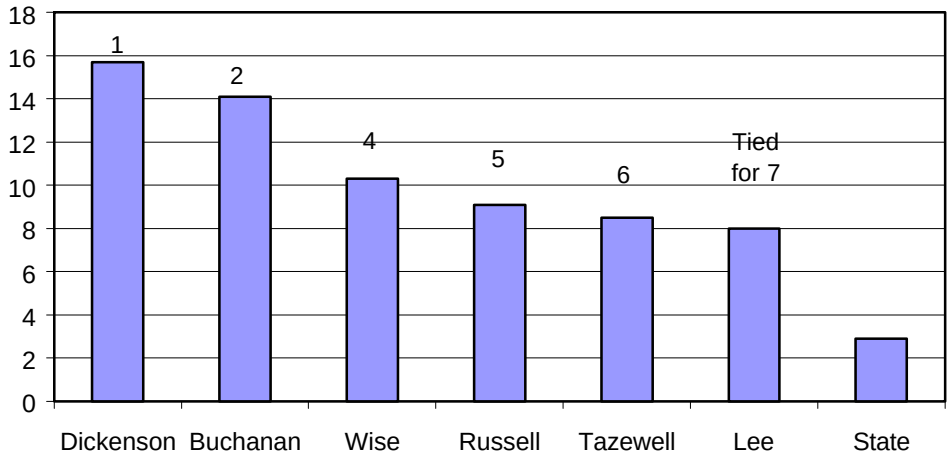

Figure 27: 1998 Unemployment Percentage and Ranking among Virginia Counties[7] (VEC, 1999)

[6] Composite consists of Alexandria County, Fairfax County, City of Virginia Beach, City of Norfolk, Montgomery County, Bland County, Chesterfield County, and Henrico County. Employment in the "Coal Mining" and "Oil and Gas" sectors is very close to zero, compared to overall employment in Virginia, so small that these categories do not appear in the chart. "Other" includes Agriculture/Forestry, Metal and Industrial Mining.

[7] Lee County is tied for 7th place with Surrey County, which is not a coal-producing county.

Total Economic Impact on Virginia

The economic benefits of coal mining are not limited to Southwest Virginia. The entire state of Virginia benefits from the "ripple" or "multiplier" effects of mining. The coal mining industry relies heavily on and contributes significantly to the transportation industry in Virginia. Virginia coal is mined using tools, electricity, and machines made in Virginia. Gas produced at the coal mine is piped to heat Virginia homes and produce Virginia power. The coal is transported on Virginia railroads, to Virginia power plants and to the port at Hampton Roads. In essence, there is a direct effect from coal mining on power plants, heavy machinery manufacturers, hardware manufacturers, vehicle manufacturers, computer/electronics manufacturers, transportation, supply companies, lawyers, consultants, schools (all grades including college), and so forth.

The Multiplier Effect, or Value-Added benefit, that industries contribute to general regional economies, is calculated by the U.S. Department of Commerce (DOC) for various regions of the country and for all major industries. This information for the mining industry is published in the Bituminous Coal Underground Mining and the Bituminous Coal and Lignite Surface Mining reports.

The DOC calculates that the coal mining industry in Virginia contributed $955 million to the Virginia economy in 1997, in the form of Value-Added benefit. Direct production wages during that period were $206 million, thus the Multiplier Effect was $4.63 for every dollar paid in gross wages to coal miners in Virginia. Gross wages are reported prior to deductions for payroll taxes, such as federal withholding, FICA, workers compensation and state and federal unemployment taxes.

The methodology that the DOC uses in measuring the Value-Added benefit for the mining industry incorporates the sum of the value of coal shipments and services plus capital expenditures, less the sum of the costs of supplies, installed machinery, fuel, electricity and contract work. Other appropriate adjustments are made as required.

The Mineral Industries Census Report is published every five years, starting with 1988. Statistical analysis of the data available from the 1988, 1992, and 1997 reports shows a strong correlation between production, production wages, and total economic impact. The correlation coefficient between production and total economic impact was found to be 0.87, which is significant. Every ton of coal mined in Southwest Virginia contributes approximately $27.11 to Virginia's economy, thus this figure can be assumed as the "Value Added Multiplier." Similarly, every dollar spent by a mining company on a production worker in Southwest Virginia contributes approximately $4.64 to Virginia's economy. Table 8 summarizes wage multipliers for 1988, 1992, and 1997.

Table 8: Value Added Multiplier Derivations (DOC, 1999)

	Actual Production (ton)	Production Wages ($)	Value Added[8] (Million $)	Value Added Production Multiplier ($/ton)	Value Added Wage Multiplier ($/$)
1988	46,359,096	263,140,000	1,205	25.99	4.58
1992	42,513,000	265,019,297	1,249	29.37	4.71
1997	36,889,000	206,296,424	955	25.90	4.63
Weighted Average				**27.11**	**4.64**

Figure 28 illustrates the estimated total economic impact of coal mining in Virginia along with production and production wages. The total impact between years not studied by the Census Report was estimated by multiplying production for that year by 27.11 and wages for that year by 4.64 and averaging the results. This average utilizes the correlation discovered previously to predict the total economic impact. This is assumed to be a straight-line correlation due to the short time period investigated in this report.

''Value-Added'' avoids the duplication in the figure for value of shipments and receipts that results from the use of products of some establishments as supplies, energy sources, or materials by others. Moreover, it provides a measure of value added not only in mineral production but also in the development of mineral properties. Value added is considered to be the best value measure available for comparing the relative economic importance of mining among industries and geographic areas.

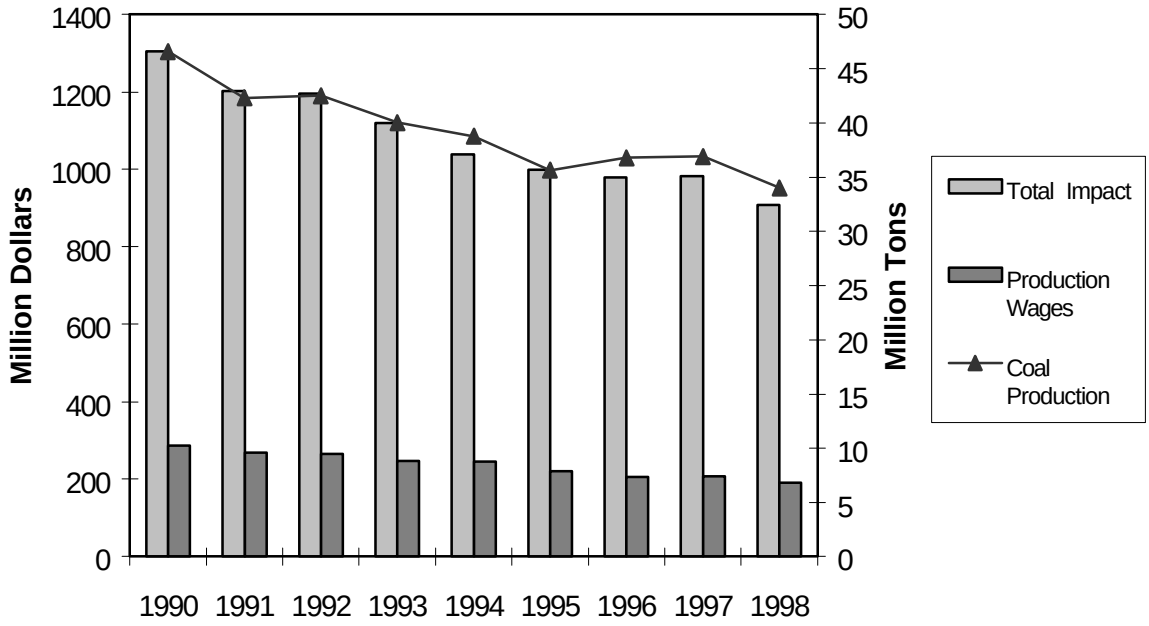

Figure 28: Estimated Total Economic Impact of Coal Mining in Virginia (DOC, 1992 & 1999; VCCER, 1999)

[8] U.S. Department of Commerce, includes "ripple effects"

Estimating the Effects of Virginia's Coalfield Employment Enhancement Tax Credit

The Coalfield Employment Enhancement Tax Credit was ratified in 1995 for enactment in 1996. The credit provides an economic incentive for the Virginia coal industry to increase production by pursuing thinner and more challenging seams. Appendix B: Coalfield Employment Enhancement Tax Credit contains the text of the legislation. The tax credit effects all mining companies, but especially those engaged in underground mining of low seams. As current and future production continues to deplete the thicker, less challenging, and cheaper to operate seams, the proportion of coal resources of the thin seam variety will continue to increase. This credit provides a $2 tax credit for every ton of thin seam coal mined underground in Virginia. The credit helps to offset the additional cost associated with underground thin seam coal mining and has a significant impact in expanding the mineable reserve base in Virginia (Westman et al., 1999). In addition, the credit gives some incentive for all coal produced and is proportional to the jobs preserved.

Figure 29 shows Virginia coal production from 1975 through the present, along with projections based on pessimistic and optimistic economic conditions. All show the downward sloping production trend projected into the future. In 1995, actual production approached the pessimistic projection. In 1996 and 1997, actual production converged to the optimistic projection. The 1998 and 1999 actual production falls between the two projections.

Figure 30 shows Virginia coal production trends during the 1990s. The figure demonstrates two linear models, a pre-tax credit (1990–1995) and a post-tax credit (1996–1999) relationship. Both trends are declining, but the post–tax credit slope is declining at a slower rate than the pre–tax credit trend. This demonstrates a positive increase in production levels. Thus, Figure 30 illustrates that, after the implementation of the tax credit, production levels have increased and the negative growth rate of the 1990s has decelerated.

Table 9 measures the difference between the actual tonnage produced and the tonnage projected using the pre-tax credit trend line. The difference is the additional tons produced for that year. (Note: This difference may be even more significant, because the sudden drop of the export market was not anticipated when projecting coal production assuming pre-tax credit trends). This difference can then be multiplied by the Value Added Production Multiplier to estimate the additional total economic impact at the increased production levels. Both the additional tonnage and total economic impact can be summed over the 1996–1999 period. During these first four years of the tax credit, Virginia Coal mines have produced an additional 14.52 million tons and added an additional $393.60 million to Virginia's economy, not adjusting for inflation.

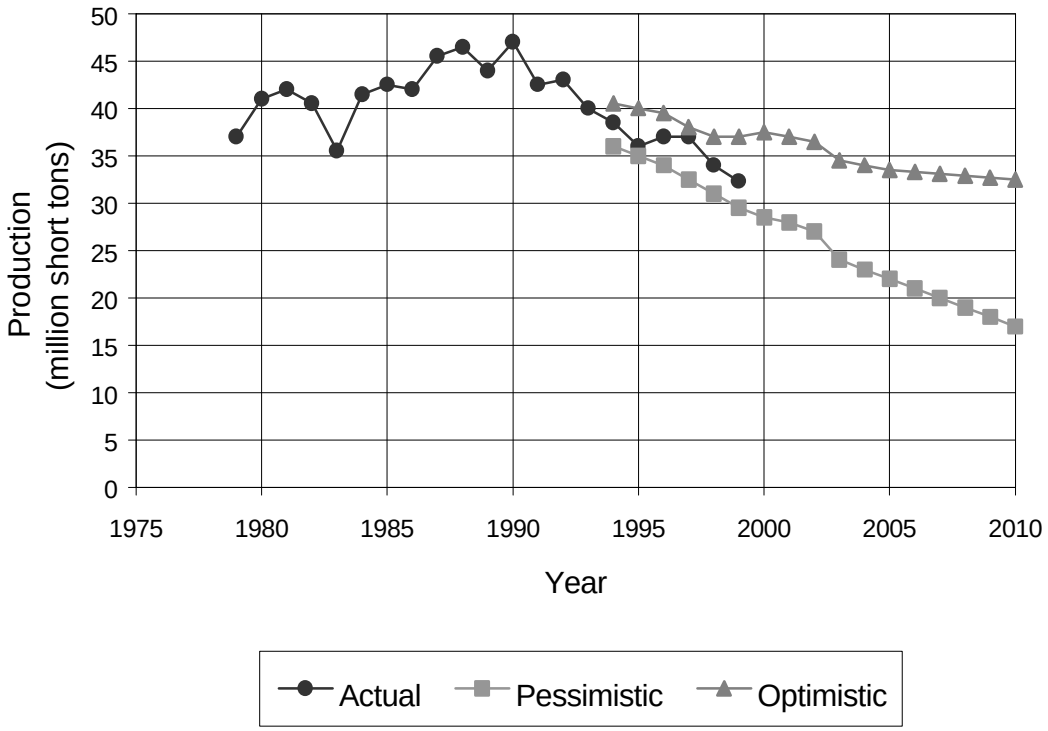

Figure 29: Virginia Coal Production Assuming Optimistic and Pessimistic Economic Conditions (Modified after Crabtree, 1995)

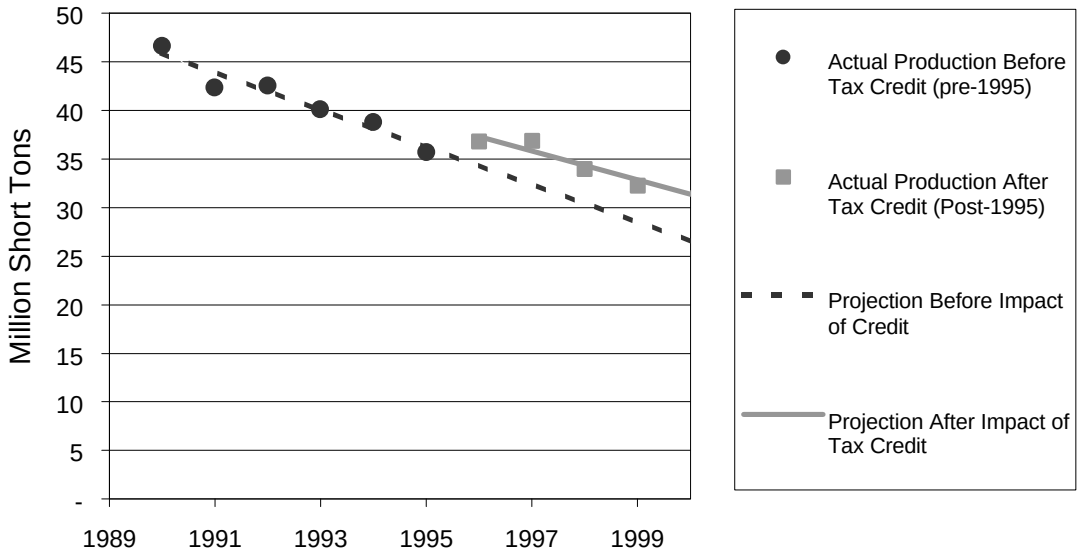

Figure 30: Virginia Coal Production Trends (VCCER, 1999)

Table 9: After-Tax Credit Analysis (VCCER, 1999; DOC, 1992 & 1999)

Year	Actual Production (million short tons)	Projection Using Before-Tax Credit (Pre-1995) Trendline	Additional Tonnage (Actual - Projected)	Additional Value Added Impact (Million $)
1990	46.64			
1991	42.34			
1992	42.56			
1993	40.09			
1994	38.80			
1995	35.67			
1996	36.78	34.26	2.52	68.32
1997	36.89	32.32	4.57	123.83
1998	34.00	30.38	3.62	98.16
1999	32.25	28.44	3.81	103.29
Total			**14.52**	**393.60**

Conclusions

Coal mining serves an important role as the economic catalyst for Southwest Virginia, providing high paying jobs in an area crippled by unemployment. There are numerous support industries in existence only because of coal mining. The ripple effects of mining are experienced throughout the state. Every ton of coal mined in Virginia contributes $27.11 to Virginia's economy, while every dollar paid to a miner has a $4.64 impact on Virginia's economy. The tax credit has had a pronounced effect on coal production in Virginia. After the tax credit was enacted, the declining trend in coal production has slowed down, and the production levels are higher than projected. As a result of these higher production levels, an additional $394 million in total impact has been generated, millions in severance and income taxes have been produced, and numerous coal mining jobs have been preserved.

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Appendices

Appendix A: Acronyms

DOE	Department of Energy
DRB	Demonstrated coal reserve base
EIA	Energy Information Administration
IEA	International Energy Agency
Mst	Million short tons
NMA	National Mining Association
PCI	Pulverized Coal Injection
UN	United Nations
VCCER	Virginia Center for Coal and Energy Research
VEC	Virginia Employment Commission

Appendix B: Coalfield Employment Enhancement Tax Credit

§ 58.1-439.2 Coalfield employment enhancement tax credit

A. For tax years beginning on and after January 1, 1996, but before January 1, 2002, any person who has an economic interest in coal mined in the Commonwealth shall be allowed a credit against the tax imposed by § 58.1-400 and any other tax imposed by the Commonwealth in accordance with the following:

1. For coal mined by underground methods, the credit amount shall be based on the seam thickness as follows:

Seam Thickness	Credit per Ton
36" and under	$2.00
Above 36"	$1.00

The seam thickness shall be based on the weighted average isopach mapping of actual coal thickness by mine as certified by a professional engineer. Copies of such certification shall be maintained by the person qualifying for the credit under this section for a period of three years after the credit is applied for and received and shall be available for inspection by the Department of Taxation. The Department of Mines, Minerals and Energy is hereby authorized to audit all information upon which the isopach mapping is based.

2. For coal mined by surface mining methods, a credit in the amount of forty cents per ton for coal sold in 1996, and each year thereafter.

B. In addition to the credit allowed in subsection A, for tax years beginning on and after January 1, 1996, any person who is a producer of coalbed methane shall be allowed a credit in the amount of one cent per million BTUs of coalbed methane produced in the Commonwealth against the tax imposed by § 58.1-400 and any other tax imposed by the Commonwealth on such person.

C. For purposes of this section, economic interest is the same as the economic ownership interest required by § 611 of the Internal Revenue Code which was in effect on December 31, 1977. A party who only receives an arm's length royalty shall not be considered as having an economic interest in coal mined in the Commonwealth.

D. If the credit exceeds the person's state tax liability for the tax year, the excess shall be redeemable by the Tax Commissioner on behalf of the Commonwealth for ninety percent of the face value within ninety days after filing the return. The remaining ten percent of the value of the credit being redeemed shall be deposited by the Commissioner in a regional economic development fund administered by the Coalfields Economic Development Authority to be used for regional economic diversification in accordance with guidelines developed by the Coalfields Economic Development Authority and the Virginia Economic Development Partnership.

E. No person may utilize more than one of the credits on a given ton of coal described in subsection A. No person may claim a credit pursuant to this section for any ton of coal for which a credit has been claimed under §§ 58.1-433, 58.1-433.1 or § 58.1-2626.1. Persons who qualify for the credit may not apply such credit to their tax returns prior to January 1, 1999, and only one year of credits shall be allowed annually beginning in 1999.

F. The amount of credit allowed pursuant to subsection A shall be the amount of credit earned multiplied by the person's employment factor. The person's employment factor shall be the percentage obtained by dividing the total number of coal mining jobs of the person filing the return, including the jobs of the contract operators of such person, as reflected in the annual tonnage reports filed with the Department of Mines, Minerals and Energy for the year in which the credit was earned by the total number of coal mining jobs of such persons or operators as reflected in the annual tonnage reports for the year immediately prior to the year in which the credit was earned. In no case shall the credit claimed exceed that amount set forth in subsection A.

G. The tax credit allowed under this section shall be claimed according to the following schedule:

1. 50% of the credit allowed in tax year 1996 shall be claimed in tax year 1999 and the remainder in tax year 2005.

2. 50% of the credit allowed in tax year 1997 shall be claimed in tax year 2000 and the remainder in tax year 2006.

3. 75% of the credit allowed in tax year 1998 shall be claimed in tax year 2001 and the remainder in tax year 2007.

4. 75% of the credit allowed in tax year 1999 shall be claimed in tax year 2002 and the remainder in tax year 2008.

5. 100% of the credit allowed in tax year 2000 shall be claimed in tax year 2003.

6. 100% of the credit allowed in tax year 2001 shall be claimed in tax year 2004.