APPENDIX A

THE STRATEGIC ENERGY SECURITY CORPORATION:

A LEGISLATIVE INITIATIVE TO PROVIDE MARKET RISK INSURANCE FOR DOMESTIC COAL, OIL SHALE, AND BIOMASS ALTERNATIVE LIQUID FUELS PRODUCERS

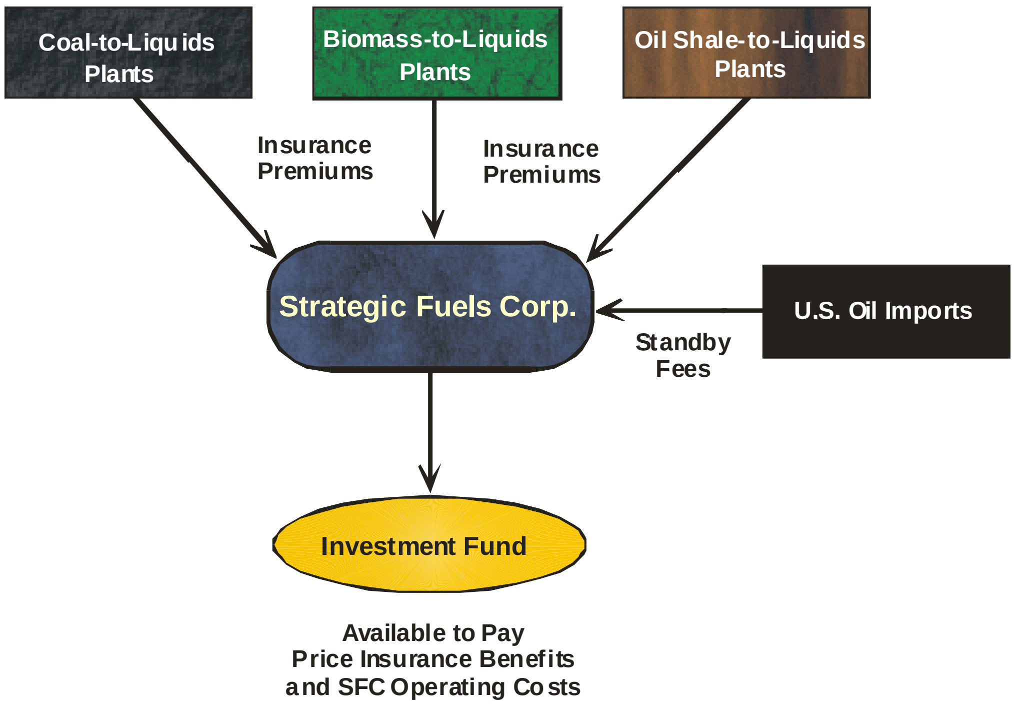
Developers of a diverse assortment of alternative liquid fuels manufacturing plants are currently on the sidelines waiting to initiate commercially viable projects, but the risk of market manipulation by OPEC and others is keeping them from committing. The oil market risk insurance program described here provides a self-funding means to overcome a significant barrier to the rapid development of a new and needed domestic liquid fuel industry. By mitigating market risk, project sponsors backed by large pools of private capital will build alternative liquid fuels plants in all 50 U.S. states, strengthening economies, creating millions of jobs, stabilizing fuel prices, and lessening U.S. dependence on foreign oil.

Concept Summary. Congress is encouraged to establish the Strategic Fuels Corporation ("SESC" or the "Corporation"), as a self-funding, self-sustaining government corporation that will administer a new alternative liquid fuels market insurance program (Figure A-1). SESC will provide the following functions: (1) collect insurance premiums from companies that "opt in" to the SESC insurance program; (2) invest net premiums (after administrative costs) in an insurance fund for future payout to program members if and when necessary; (3) facilitate market insurance payments to members if oil prices fall below a defined "Low Trigger Price," as described below; and (4) administer the collection of "standby" insurance fees, to be levied on imported oil if oil prices fall below the "Low Target Price" *and* the accumulated investment pool of insurance premiums (including investment returns thereon) is exhausted.

The primary function of the SESC program will be to insure viable markets prices for qualifying alternative liquid fuel plants in the event oil prices fall below a designated "Low Trigger Price" as defined below and in Figure A.2. This will be accomplished by providing insurance payments to insured plant owners if any oil products from their plants sell at prevailing market prices that are less than the Low Trigger Price on a crude oil equivalent basis. By way of example, if an SESC insured plant sells 300,000 barrels of diesel fuel for the crude oil equivalent prevailing market price of $45 per barrel, the insurance payment to the plant owner would be $1,500,000, computed as $50/bbl (Low Trigger Price) less $45/bbl (sale price of product on crude oil equivalent basis), times 300,000 barrels. Note: if the alternative fuel excise tax credit is operational (see below), the insurance payment is not available until the prevailing market price falls below $30 per barrel.

Figure A-1

STRATEGIC ENERGY SECURITY CORPORATION FUNCTIONS



Source: Southern States Energy Board, 2006.

<u>Sources and Use of Proceeds</u>: There will be several sources/levels of funding for this program. Each is described below.

<u>Seed Capital</u>. A one-time appropriation of $5.0 million provided by Congress to establish, staff and organize the SESC, and to cover ongoing administrative costs for an initial period until adequate member-paid premiums are received that allow the Corporation to become self-funding.

<u>Opt-in Premiums</u>. Plant developers will be required to pay a one-time up-front "Opt-in Premium" to insure a qualifying plant, calculated as two percent of the total capital cost of the plant. For example, to secure SESC insurance for a plant costing $800 million, the plant owner would pay an Opt-In Premium of $16 million. For a nominal cost, "a conditional letter of intent to insure" will be issued by SESC for a qualified project, locking in insurance while capital is raised for the project. Once financing is secured, a "commitment fee" portion of the Opt-In Premium will be payable to the SESC, with the balance of this Premium placed in an escrow account. When the plant begins operation, the remaining portion of the Opt-in Premium will be due and released from the escrow account to the SESC. Premium proceeds will be invested in

the SESC insurance fund, available to pay future price insurance benefits, if and when required. Costs to operate the SESC will be drawn from the insurance fund as well.

Operating Premiums. Once an insured plant begins operation, an Operating Premium will become payable, and this fee will be set at two percent of the price of all liquid fuel products sold. Proceeds will be invested in the SESC insurance fund, available to pay future price insurance benefits, if and when required.

Windfall Premiums. These premiums will be paid along with Operating Premiums whenever crude oil prices rise above the High Trigger Price level (assumed to be $65 for purposes of discussion -- see Figure A-2). Windfall Premium rates will be progressive, based on the level of crude oil prices above the High Trigger Price. They will be computed as follows, using the progressive premium rate table shown in Table A-1.

Spot Crude Oil Price/bbl - $65
x
Applicable Windfall Premium Rate
x
Barrels Sold During Period
=
Windfall Premium

Table A-1 presents the progressive premium rates proposed. The crude oil price ranges in this table are presented for discussion purposes and are subject to adjustment in the authorizing legislation.

Table A-1
Proposed Windfall Premium Rates

Crude Oil Price (2007 $/bbl)	Windfall Premium Rate
$65 - $74.99	15%
$75 - $84.99	25%
$85 +	35%

Source: Southern States Energy Board, 2006.

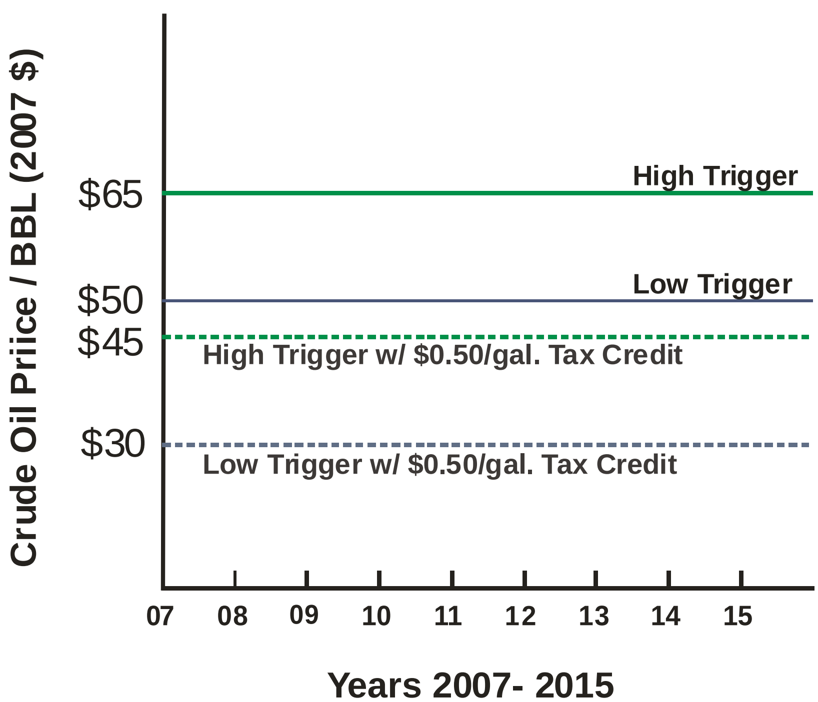
Windfall Premiums will be allocated as follows: ¾ of proceeds invested in the SESC insurance fund, available to pay future price insurance benefits, if and when required; and, ¼ of proceeds distributed to LIHEAP, or to another low-income fuel assistance program established to help needy Americans pay for fuel.

National Security Standby Insurance Fees: If oil prices fall below the Low Trigger Price level for more than 30 days, and funds in the SESC insurance pool are exhausted by payment of insurance benefits, a National Security Insurance Fee will then be applied to imported oil (crude and products) to enable ongoing market insurance benefit payments to SESC members. This fee will be assessed on a monthly basis, if and when required, and computed as the amount necessary to enable payment of SESC price insurance benefits for that month. The U.S. currently the imports approximately 13 million barrels of oil (crude and products) per day. Consequently, if and when National Security Insurance fees are required, they should not have a significant burden on oil prices. This is evident in the following example. Assume that oil prices fell to $40 per barrel, the Low Trigger Price was $50, and the SESC investment pool had been exhausted. Further, assume that there are 1.0 million barrels per day of alternative liquid fuels production covered under SESC price insurance, and 13 million barrels per day of oil being imported. The National Security Standby Insurance Fee would be calculated as follows: (Low Trigger Price – Spot Crude Price/bbl) x (Avg. SESC Insured Production per Day/Avg. Imported Oil per Day). Using the assumptions above, this fee would be only $0.769 /bb, computed as ($50 - $40) x (1 MM bpd / 13 MM bpd) = $0.769 per barrel – or about two cents per gallon.

Figure A-2

STRATEGIC ENERGY SECURITY CORPORATION

High and Low Triggers



Source: Southern States Energy Board, 2006.

APPENDIX B: COAL RESOURCES:

RETHINKING U.S. COAL RESERVES AND RESOURCES

Introduction

How much U.S. coal is available for recovery in the near, intermediate and long-term is important knowledge for decision makers as they attempt to guide our country toward energy security and independence. America is endowed with the largest coal reserves in the world. Recoverable reserves are estimated to be 270 billion tons by the Energy Information Administration (EIA). In 2005 the U.S. produced 1.13 billion tons of coal, second only to China. Based on EIA's 270 billion ton estimate, America has more than 200 years of coal at today's production rate. Even if production were to be doubled, the recoverable reserves would last for more than a century.

This chapter presents an overview of U.S. coal reserves and resources. Reserves and resources are discussed together because resources are the deposits of coal in such a condition that economic extraction is currently or may become feasible. Reserves are a special subset of resources that can be economically mined at the time of determination. The US has large amounts of both reserves and resources. This report will describe the importance of these resource-reserve categories.

It also offers evidence that the widely referenced EIA reserve estimates understated America's true coal potential. Decision makers frequently refer to the EIA 270 billion ton recoverable reserve estimate as being America's coal endowment but the EIA total coal resource for the U.S. is nearly 4 trillion tons and the Demonstrated Reserve Base (DRB) is nearly 500 billion tons. Clearly the U.S. endowment of coal is enormous. In fact there is evidence that the 500 billion ton DRB better approximates U.S. coal resources that will ultimately be recovered when advancements in technology, coal field growth, new discoveries, and other dynamics are taken into account. This report will demonstrate this evidence.

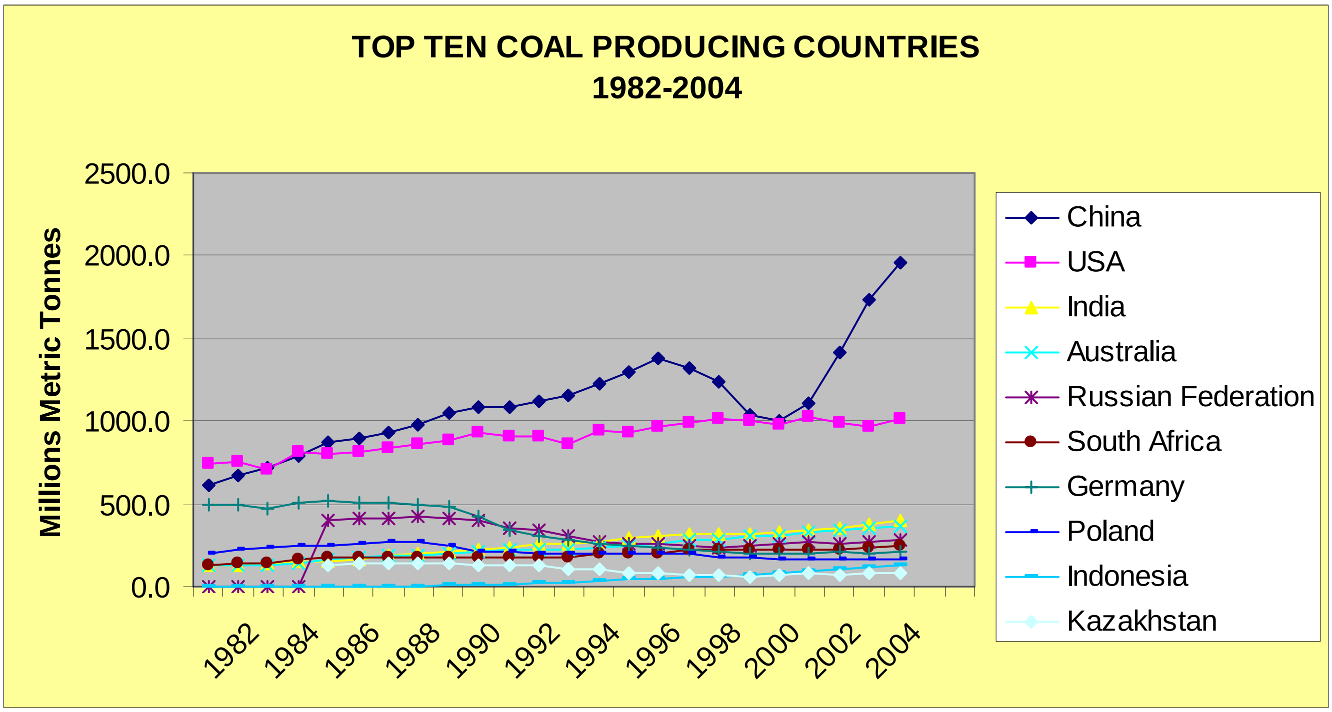
The purpose of this report is to provide a clear picture of the magnitude of the U.S. coal endowment. Methods and limitations to EIA and USGS approaches to coal reserve estimation are discussed and recommendations are made to improve these methods.

As part of the research for this report, a questionnaire was sent to coal geologists at state geological surveys or other state agencies that assess coal resources, to gather current expert knowledge of each state's coal resources. The specific goal of this survey was to evaluate EIA's DRB versus state Identified resources. Officials of the USGS and the EIA were also interviewed to gain their perspective. Results from this survey are discussed in "State-by-State Coal Resource Survey Results." The survey questionnaire, and complete survey responses, are presented in Appendix 1 to this report.

Inspiration From China

China has not only recognized the strategic significance of its coal resources, it is acting aggressively to realize the full potential of this low cost, multi-use fuel and feedstock. China is utilizing coal as a primary fuel source for the production of electricity and steel. They have also taken the lead in the world with regard to coal-to-liquids and coal gasification initiatives. Take a look at Chinese coal production growth between 2000 and 2004 in Figure 1 below. This new world competitor plans to add as much as another billion tons of annual coal production by 2020.[1]

Figure 1.

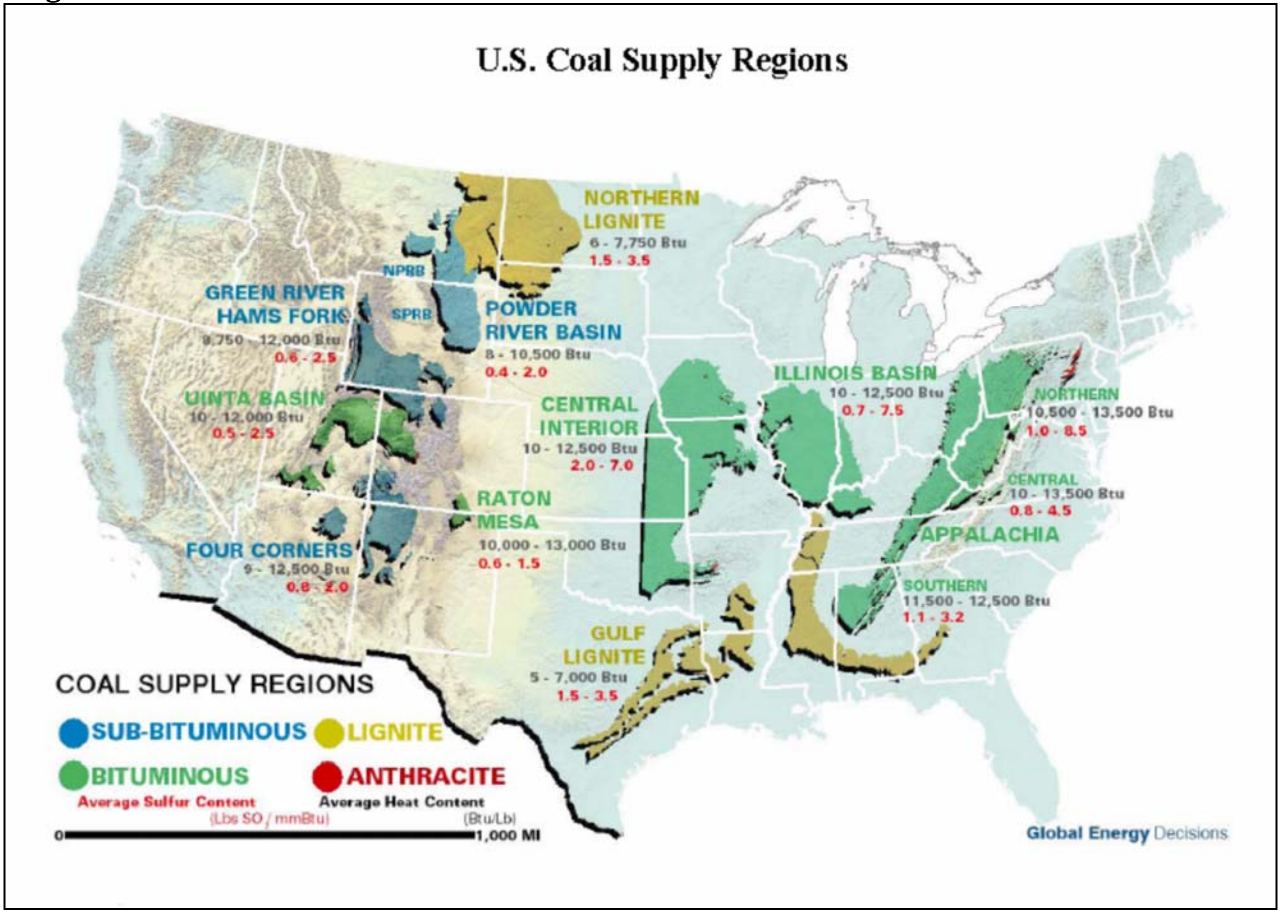


Source: "BP Statistical Review of World Energy 2005," [http://www.bp.com/genericsection.do?categoryId=92&contentId=7005893], June 14, 2005

DOE EIA Coal Reserves and Resources Estimates

The coal fields of the U.S. are vast, diverse, and well distributed across the country. The DOE reports coal deposits of one or more coal ranks (bituminous, subbituminous, lignite and anthracite) in thirty-three states, as shown in the map of major U.S. coal fields (Figure 2) below.

Figure 2



Source: The National Coal Council, "Coal: America's Energy Future," May 2006, Pg. 99

Below is a summary of current U.S. coal reserve/resource estimates by category, published by the DOE EIA. These estimates are discussed in some detail throughout this chapter.

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DOE EIA COAL RESERVE/RESOURCE ESTIMATES (2004)

Estimated Recoverable Reserves: 267.3 billion tons [2]

Demonstrated Reserve Base: 494.4 billion tons [3]

Identified Resources: 1,730.9 billion tons [4]

Total Resources: 3,968.3 billion tons [5]

In general terms, Estimated Recoverable Reserves (ERR) are held to be the portion of the Demonstrated Reserve Base that will be recovered by mining. The Demonstrated Reserve Base (DRB) is comprised of "in-place" coal that meets certain criteria of measurement reliability, and is found within defined depths and in coalbed thicknesses considered technologically minable at the time of determination. An estimate is then made as to what percentage of the demonstrated base are accessible and economically recoverable by current mining methods under existing regulatory limits. EIA estimates that approximately 17% of the DRB is inaccessible for mining, and that 34% of the accessible portion would be unrecovered or lost during mining, leaving 54% of the DRB as potentially recoverable. This equates to 268 billion tons of recoverable coal using the recent 494 billion ton DRB estimate.

The "Coal Reserve and Resource Estimate Methodologies" section of this chapter contains definitions and descriptions of primary coal reserve measurement classifications, terms, and guidelines. Subsequent sections, "Limitations of DOE EIA Estimates" and "State-by-State Coal Resource Survey Results" present additional data, analysis and observations about the EIA's coal reserve projections and methodology.

Table 1 (below) shows EIA 2004 figures for "Estimated Recoverable Reserve" and "Demonstrated Reserve Base" estimates by state and mining method. These numbers are presented for underground and surface mineable coal, and as combined totals.

Table 1. Estimated Recoverable Reserves, and Demonstrated Reserve Base by Mining Method, 2004 (Million Short Tons) [6]

	Underground Minable Coal		Surface Minable Coal		Total	
Coal Resource By State	Estimated Recoverable Reserves	Demonstrated Reserve Base	Estimated Recoverable Reserves	Demonstrated Reserve Base	Estimated Recoverable Reserves	Demonstrated Reserve Base
Alabama	521	1,034	2,285	3,208	2,806	4,242
Alaska	2,745	5,423	545	689	3,291	6,112
Arizona	-	-	5	7	5	7
Arkansas	127	272	101	144	228	417
Colorado	6,050	11,529	3,748	4,764	9,798	16,293
Georgia	1	2	1	2	2	4
Idaho	2	4	-	-	2	4
Illinois	27,944	87,972	10,075	16,557	38,019	104,529
Indiana	3,630	8,764	451	771	4,080	9,534
Iowa	807	1,732	320	457	1,127	2,189
Kansas	-	-	681	973	681	973
Kentucky Total	7,488	17,202	7,516	13,023	15,004	30,225
Eastern	716	1,282	5,244	9,389	5,960	10,671
Western	6,772	15,920	2,273	3,634	9,044	19,554
Louisiana	-	-	316	427	316	427
Maryland	320	584	46	67	366	652
Michigan	55	123	3	5	59	128
Mississippi	-	-	-	-	-	-
Missouri	689	1,479	3,158	4,511	3,847	5,990
Montana	35,922	70,958	39,067	48,322	74,989	119,280
New Mexico	2,848	6,171	4,086	6,001	6,934	12,172
North Carolina	5	11	-	-	5	11

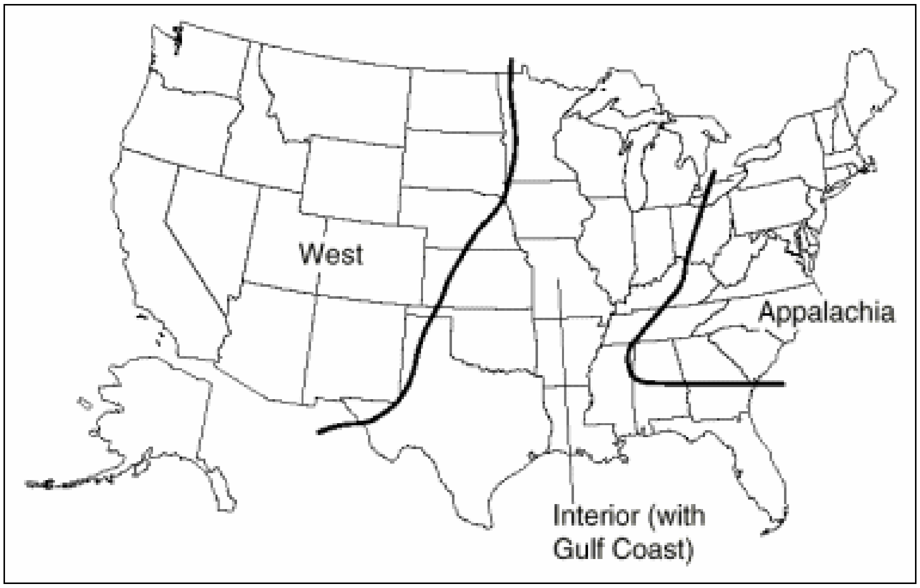
North Dakota	-	-	6,935	9,090	6,935	9,090
Ohio	7,733	17,577	3,774	5,765	11,507	23,342
Oklahoma	574	1,232	227	325	801	1,557
Oregon	7	15	2	3	9	17
Pennsylvania Total	10,768	23,330	1,055	4,267	11,822	27,597
Anthracite	340	3,844	420	3,356	760	7,200
Bituminous	10,428	19,486	635	911	11,062	20,397
South Dakota	-	-	277	366	277	366
Tennessee	281	513	180	266	462	779
Texas	-	-	9,578	12,442	9,578	12,442
Utah	2,538	5,177	212	268	2,750	5,445
Virginia	653	1,163	369	576	1,022	1,740
Washington	674	1,332	7	8	681	1,341
West Virginia	15,673	29,366	2,431	3,854	18,104	33,220
Wyoming	22,950	42,501	18,853	21,824	41,804	64,325
U.S. Total	**151,007**	**335,468**	**116,305**	**158,982**	**267,312**	**494,450**
W = Withheld to avoid disclosure of individual company data.						
NA = This estimated value is not available due to insufficient data or inadequate data/model performance.						
Note: · Recoverable coal reserves at producing mines represent the quantity of coal that can be recovered (i.e. mined) from existing coal reserves at reporting mines. EIA's estimated recoverable reserves include the coal in the demonstrated reserve base considered recoverable after excluding coal estimated to be unavailable due to land use restrictions or currently economically unattractive for mining, and after applying assumed mining recovery rates; see “Coal Reserve and Resource Estimate Methodologies” for criteria. The effective date for the demonstrated reserve base, as customarily worded, is "Remaining as of January 1, 2005." These data are contemporaneous with the Recoverable reserves at Producing Mines, customarily presented as of the end of the past year's mining, that is in this case, December 31, 2004. The demonstrated reserve base includes publicly available data on coal mapped to measured and indicated degrees of accuracy and found at depths and in coalbed thicknesses considered technologically minable at the time of determinations; see “Coal Reserve and Resource Estimate Methodologies” for criteria. Excludes silt, culm, refuse bank, slurry dam, and dredge operations except for Pennsylvania anthracite. Excludes mines producing less than 10,000 short tons, which are not required to provide data and refuse recovery.						
Data Source: Energy Information Administration Form EIA-7A, "Coal Production Report," and U.S. Department of Labor, Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine Employment and Coal Production Report," and EIA estimates. http://www.eia.doe.gov/cneaf/coal/page/acr/table15.html						

U.S. coal resources are widely distributed geographically. Approximately 21% of U.S. coal resource lies in the Appalachian region; 32% in the Interior region; and 47% in the Western region (see the Figure 3 region map below). Note that *Eastern* Kentucky is included in the Appalachian region, while *Western* Kentucky (on the Eastern edge of the Illinois Basin) is counted in the Interior region.

U.S. deposits are found in four major types, also known as “rank”. Anthracite comprises approximately 1.5% of the DRB; bituminous 53%; subbituminous 37%; and lignite 8.5%. The majority of our reserve base is recoverable by underground methods (about 335 billion tons, or 68%), with surface mineable measures making up the rest (158 billion tons or 32%).

The following map (Figure 3) highlights the three coal regions often used to describe where coal occurs and production originates.

Figure 3. U.S. Coal Regions



Source: Energy Information Administration

The EIA's current Estimated Recoverable Reserve (EER) projection of approximately 270 billion tons is likely the most frequently cited measure of "U.S. coal reserves." The ERR is a calculated percentage of the Demonstrated Reserve Base (DRB), currently estimated to be about 54% of the DRB average for the entire U.S.

As previously noted, one objective of this reserve analysis is to determine whether the EER represents an accurate measure of the nation's coal potential, as many decision makers believe. The state coal survey conducted for this report clearly indicates that the 2004 EIA estimates are viewed to be understated (see "State-by-State Coal Resource Survey Results"). The report section entitled "Limitations of DOE EIA Estimates" offers analysis and insight as to why the ERR estimates fall short of providing a good measure of ultimately recoverable U.S. coal reserves.

Using the EIA estimates, the U.S. is endowed with almost two times the coal resources of the Russian Federation, the second largest international reserve holder. World coal reserve estimates are presented by country in Table 2 (below). One interesting statistic is that China has only about half of the coal resources of the U.S., yet they produced approximately 2.2 billion tons in 2005 (double U.S. production levels), and have committed to increase output to as much as 3.0 billion annual tons by 2020.

Note that the estimates in Table 2 (below) were compiled by the World Coal Council and are in metric tones. To convert to U.S. tons, multiply by 1.10229.

Table 2

Coal: Proved Reserves at End of 2004 [7] (million metric tonnes)					
Table in millions of metric tonnes.	Anthracite and bituminous	Subbituminous and Lignite	Total	Share of total	Reserve-to-Production (R/P) ratio in years of reserves.
USA	111338	135305	246643	27.10%	245
Russian Federation	49088	107922	157010	17.30%	*
China	62200	52300	114500	12.60%	59
India	90085	2360	92445	10.20%	229
Australia	38600	39900	78500	8.60%	215
South Africa	48750	-	48750	5.40%	201
Ukraine	16274	17879	34153	3.80%	424
Kazakhstan	28151	3128	31279	3.40%	360
Other Europe & Eurasia	1529	21944	23473	2.60%	341
Poland	14000	-	14000	1.50%	87
Brazil	-	10113	10113	1.10%	*
Germany	183	6556	6739	0.70%	32
Colombia	6230	381	6611	0.70%	120
Canada	3471	3107	6578	0.70%	100
Czech Republic	2094	3458	5552	0.60%	90
Indonesia	740	4228	4968	0.50%	38
Turkey	278	3908	4186	0.50%	87
Greece	-	3900	3900	0.40%	55
Hungary	198	3159	3357	0.40%	240
Pakistan	-	3050	3050	0.30%	*
Other S. & Cent. America	992	1698	2690	0.30%	*
Bulgaria	4	2183	2187	0.20%	84
Thailand	-	1354	1354	0.10%	67
Mexico	860	351	1211	0.10%	135
Other Africa	910	174	1084	0.10%	490
North Korea	300	300	600	0.10%	21
New Zealand	33	538	571	0.10%	115
Spain	200	330	530	0.10%	26
Zimbabwe	502	-	502	0.10%	154
Romania	22	472	494	0.10%	16
Venezuela	479	-	479	0.10%	53
Middle East	419	-	419	◆	399
Japan	359	-	359	◆	268
Other Asia Pacific	97	215	312	◆	34

United Kingdom	220	-	220	◆	9
Vietnam	150	-	150	◆	6
South Korea	-	80	80	◆	25
France	15	-	15	◆	17
* More than 500 years					Source: World Energy Council
◆ Less than 0.05%					
Notes:					
Proved reserves of coal - Generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known deposits under existing economic and operating conditions.					
Reserves/Production (R/P) ratio - If the reserves remaining at the end of the year are divided by the production in that year, the result is the length of time that those remaining reserves would last if production were to continue at that level.					

Note: 1 metric tonne = 1.10229 U.S. tons and 1 U.S. ton = 0.9072 metric tones.

Coal Reserve and Resource Estimate Methodologies

In order to use coal resource estimates for decision making, it is important to understand the methodologies and assumptions that underlie them.

Coal resource evaluations and estimation have been conducted by state and federal geological surveys periodically since the beginning of the industrial revolution. Studies are typically sponsored by policy makers in times of national need, such as the Arab Oil Embargo of the early 1970's. This has resulted in new resource estimates every 25 to 50 years.

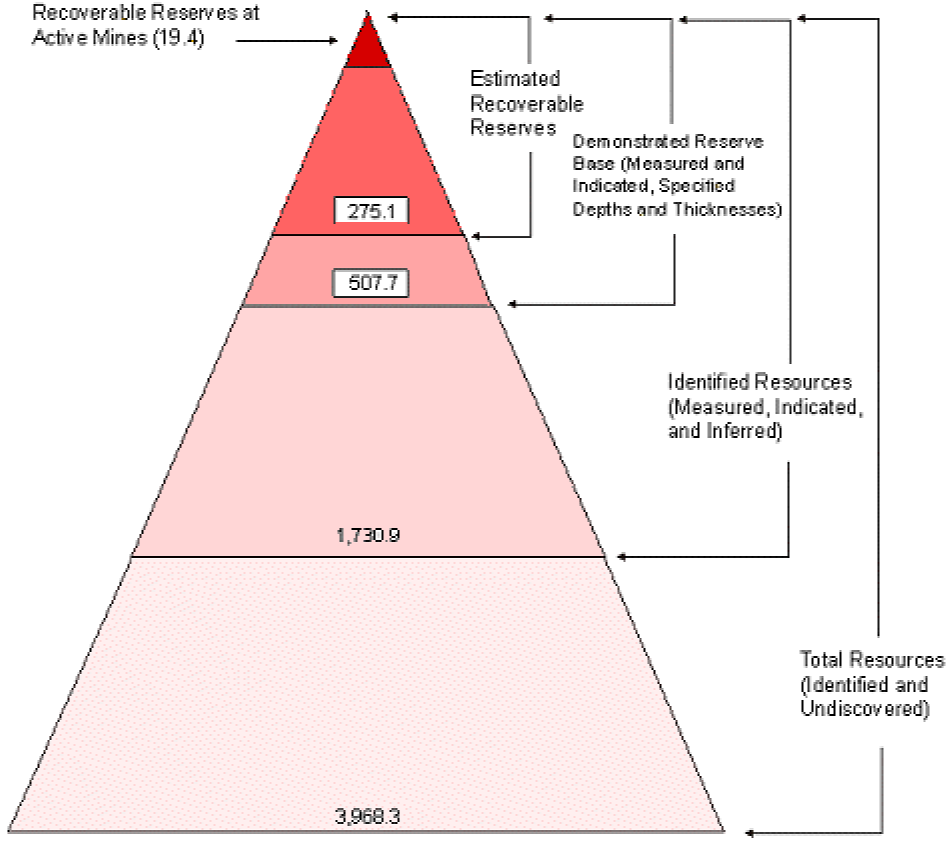
The U.S. Bureau of Mines (USBOM) and the U.S. Geological Survey (USGS) played central roles in coal resource estimates as facilitators of congressionally funded programs for geologic mapping in the nation, and as technical advisors to the states. In 1983, the USGS published guidelines and accepted methodology for calculating coal resources in Coal Resources Classification System of the U.S. Geological Survey, also known as USGS Circular 891.[8] These methods are almost uniformly used by practitioners in the U.S., including the DOE EIA and the state geological surveys. They are described in some detail below.

Current Coal Resource Classification System.

The pyramid graphic below (Figure 4) presents a visual characterization of how coal resources are classified in the U.S. From top to bottom, the pyramid generally represents reserves/resource estimates by diminishing degree of confidence in data reliability and mineability characteristics. The top two categories, "Recoverable Reserves at Active Mine" and "Estimated Recoverable Reserves," are estimates of tonnage that is available to be recovered by current mining practices. The lower categories are estimates of "in-place" coal resources, before applying a recovery factor.

The Figure 4 resource pyramid is based on older data. Although dated, the graphic has been included to in introduce the current approach to classifying coal reserve and resources.

Figure 4. Delineation of U.S. Coal Resources and Reserves (billions of short tons)[9]



Notes: Resources and reserves data are in billion short tons. Darker shading in the diagram corresponds to greater relative data reliability. The estimated recoverable reserves depicted near the top of the diagram assume that the 19 billion short tons of recoverable reserves at active mines reported by mine operators to the Energy Information Administration (EIA) are part of the same body of resource data. This diagram portrays the theoretical relationships of data magnitude and reliability among coal resource data. All numbers are subject to revision with changes in knowledge of coal resource data.

Data Sources: The DRB estimate was compiled by the EIA as of January 1, 1997. Estimated recoverable reserves were compiled in EIA's Coal Reserves Data Base (CRDB) program. Recoverable reserves at active mines were reported in EIA's Coal Industry Annual, 1996. Identified resources and total resources are estimates as of January 1, 1974, compiled and published by the U.S. Geological Survey in Coal Resources of the United States, January 1, 1974.

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Definitions of Terms.[10 11]

Recoverable Reserves at Producing (Active) Mines: The amount of in situ coal that can be recovered by mining existing reserves at mines reporting on Form EIA-7A. This reserve category is not especially meaningful.

Estimated Recoverable Reserves: This category is calculated from the Demonstrated Reserve Base (the DRB as defined below). A recovery factor is applied to the DRB to estimate recoverable reserves. The recovery factor is derived from actual mining practices in the active mining district. Estimated recoverable reserves include the coal in the "in-place" demonstrated reserve base that is considered to be accessible to the mining industry, technologically mineable, and can be recovered by the prevailing mining methods for a region. Accessibility factors relate to limitations to mining due to regulatory and land use constraints. Technological limitations may be regulatory (required mine buffers) or other physical barriers to mining. Recovery percentages are estimated according to mining method. Surface mining regions have higher recovery rates, longwall mines have intermediate rates, and conventional and continuous underground mining areas have the lowest recovery rates.

The ERR recovery rate averages 54 percent of the DRB for the nation, with a range between 36 and 77 percent for individual states. Table 3, presented later in this chapter, sets forth DOE's estimated average recovery rates for each state.

Demonstrated Reserve Base: Represents that portion of identified coal resources from which reserves are calculated. A collective term for the sum of coal in both measured and indicated resource categories of reliability which represents 100 percent of the coal in these categories in place as of a certain date. Includes beds of bituminous coal and anthracite 28 inches or more thick and beds of subbituminous coal 60 inches or more thick that occur at depths to 1,000 feet. This includes beds of lignite 60 inches or more thick that can be surface mined. Includes also thinner and/or deeper beds that presently are being mined or for which there is evidence that they could be mined commercially at this time.

The demonstrated reserve base includes publicly available data on coal mapped to measured and indicated degrees of certainty and found at depths and in coalbed thickness considered technologically minable at the time of determination. In most cases, the DRB begins with Identified Resources and then excludes coal in certain resource categories. For example, the DRB includes only bituminous coal greater than 28 in thick (subbituminous and lignite greater than 5 feet that is surface mineable). DRB coal must be less than 1000 ft in depth for bituminous and subbituminous coals, or 500 ft for lignite. Only coal within ¾ mile of a thickness measurement is included in the DRB. It is also periodically reduced to account for historical mining production or increased as a result of additions of new data or mining activity in areas outside the DRB. In cases where state estimates used different classifications than Circular 891 or lack certain categories (e.g., not all estimates include overburden data), the EIA devised methods for estimating these categories. The current DRB is about 15% of total Identified Resources.

Identified Resources: Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements. Included are beds of bituminous coal and anthracite 14 inches or more thick and beds of subbituminous coal and lignite 30 inches or more thick that occur at depths to 6,000 feet and whose existence and quantity have been delineated within specified degrees of geologic assurance as measured, indicated, and inferred (see definitions below).

USGS Circular 891 specifies the criteria for subdividing coal resources on the basis of coal rank, total coal thickness, overburden thickness, and confidence of the estimate. Confidence of the estimate is based on proximity to coal thickness measurements (from outcrops, drill holes, logged wells and mine measurements), and is determined by scribing circles of increasing diameter around thickness locations used for preparing the estimate. This categorization is especially significant, because recoverable coal in the Identified Resources classification may be excluded from the DRB estimate due to wide spacing of measurement data (see Figure 5). This is perhaps one of the biggest shortcomings of the EIA classification system.

Undiscovered Resources: Unspecified bodies of coal surmised to exist on the basis of broad geologic knowledge and theory but not specifically drilled or measured in the field. Undiscovered resources include beds of bituminous coal and anthracite 14 inches or more thick and beds of subbituminous coal and lignite 30 inches or more thick that are presumed to occur in unmapped and unexplored areas to depths of 6,000 feet. The speculative and hypothetical resource categories (defined below) comprise undiscovered resources. In remote areas in the U.S. such as Alaska huge amounts of coal in this category are known to exist.

Hypothetical Resources: Undiscovered coal resources in beds that may reasonably be expected to exist in known mining districts under known geologic conditions. In general, hypothetical resources are in broad areas of coalfields where points of observation are absent and evidence is from distant outcrops, drill holes, or wells. Exploration that confirms their existence and better defines their quantity and quality would permit their reclassification as identified or demonstrated resources. Quantitative estimates are based on a broad knowledge of the geologic character of a coal bed or region. Measurements of coal thickness are more than 6 miles apart. The assumption of continuity of coal bed is supported by geologic models not direct measurements.

Speculative Resources: Undiscovered coal in beds that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in deposits that remain to be recognized. Exploration that confirms their existence and better defines their quantity and quality would permit their reclassification as identified resources.

The following Figure 5 diagrams how the elemental measurements of coal reserve certainty, “measure resources,” “indicated resources,” and “inferred resources,” are applied in the coal fields. These three measurements form the foundation of current coal reserve and resource estimation in the U.S. Definitions of each measurement follow Figure 5.

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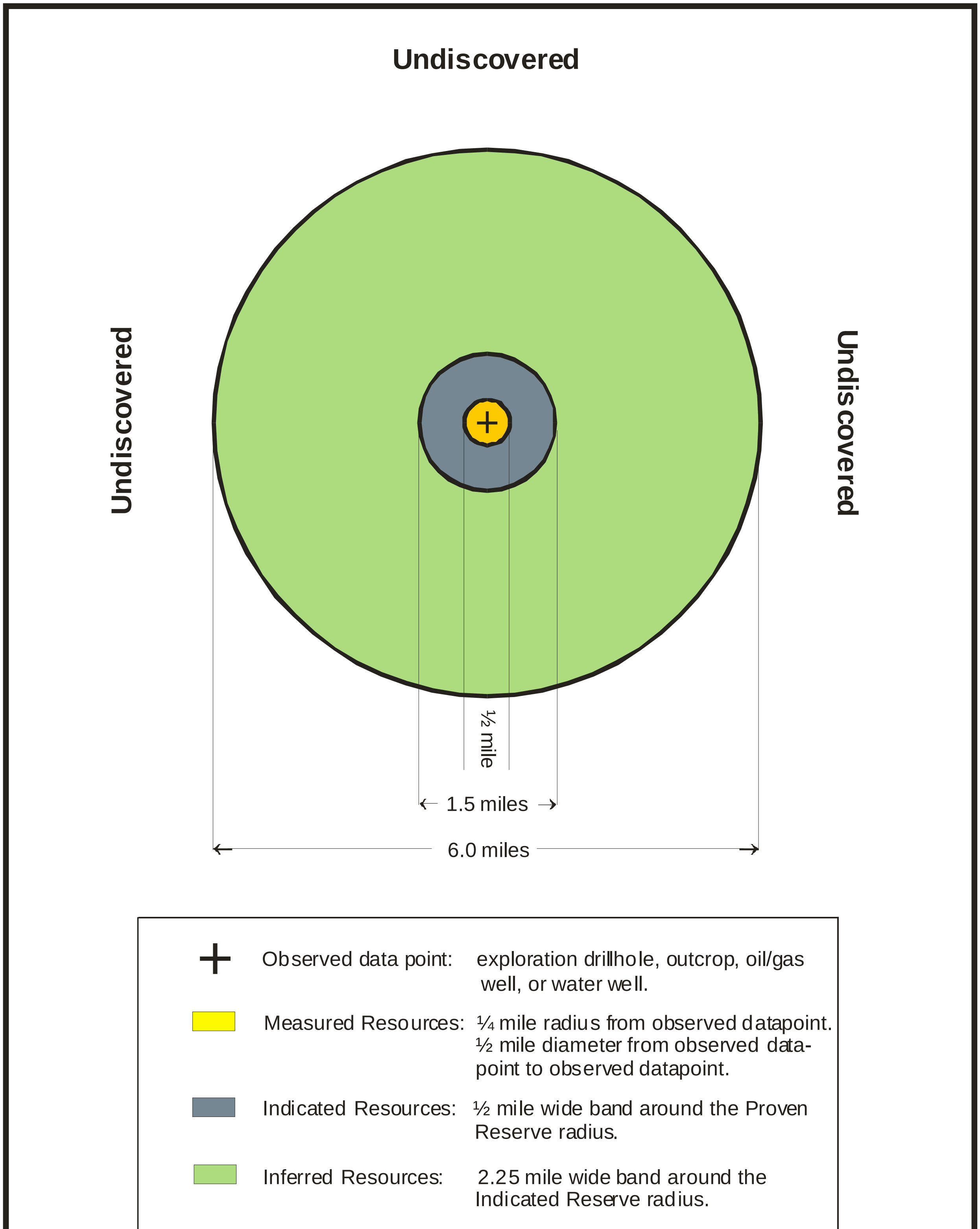
Figure 5. Measured, Indicated and Inferred Areas Around a Coal Observation/Exploration Point



Source: A. J. Mayer International

years, and the rate of change is accelerating. Methods need to be developed to project improvements in technology as they relate to the expanding coal reserve recoverability.

Only Surface Mining Reserves Assumed for Lignite

The EIA only includes surface mineable reserves for lignite coals. Excluding underground mineable lignite overlooks billions of tons of potential in North Dakota, Texas, Montana, Mississippi, and other lignite bearing states. Underground mining technology advancements, and market needs are expected to allow for the ultimate recovery of some of these vast coal measures currently not included in the DRB.

Static and Not Dynamic Approach

Reserve growth through exploration, discovery, and technological evolution are believed to be inevitable. These dynamic forces should be taken into consideration in order to provide meaningful estimates of ultimately recoverable coal over the intermediate and long-term. Material changes in land use restrictions (as a result of increased National will to become more energy secure and independent, for example) are also possible, and should be considered, as well.

State-by-State Coal Resource Survey Results

All thirty-three states reported by the EIA to have coal resources were surveyed as part of this study to determine, among other things, whether each believed the EIA Demonstrated Reserve Base (DRB) was representative for their state. This survey, and all responses, are presented in Appendix 1 to this report.

Attached to each state survey was a table containing (1) the EIA 2004 DRB estimate for each state and (2) Identified Resources (based on state data) contained in the 2002 Keystone Industry Coal Manual.[17] One of the questions asked in the survey was whether the EIA DRB or the Keystone Identified Resource projection best reflected the state's current estimate of the actual DRB.

A narrative discussing select survey results follows, beginning with reserve highlights. The color coding in Table 4 corresponds with the right-hand column of Table 3.

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State Reserve Estimate Highlights

Thirty-three states were surveyed and nineteen states responded. Of the responses:

Color Code for Table 3.

Table 4. State Responses

and — 9 states provided DRB estimates exceeding current EIA estimates by 275 billion tons.

2 states, Alaska and Louisiana, indicated that “Identified Resources” as published in the Keystone Coal Industry Manual[18] , was a better indicator of the DRB.

7 states noted that their estimate of the DRB exceeds the EIA estimate, but gave no number.

and — 16 states in total indicated that the DRB should be higher than the EIA estimate.

1 state, Virginia, reported that the EIA DRB was representative.

1 state, Illinois reported a slightly lower numeric estimate DRB estimate than the EIA.

1 state, Pennsylvania, provided an indication that the EIA DRB for their State was overstated.

Sixteen of the 19 responding states indicated that the EIA DRB was understated, representing 84% of the returned surveys. One state indicated that the EIA DRB was representative. And two states out of 19 indicated that the EIA estimate was too high.

The right hand column of Table 3 (below) contains the state responses to the questionnaire with respect to whether they felt the DRB or Identified Resources was the best estimate of the state’s coal resources. Most states responded that the DRB was the closest figure, but that it excluded some resources that would be mineable. The label “> DRB” implies that the state would use a number somewhat greater than the DRB, but significantly less than the Keystone value (author’s interpretation in some cases).

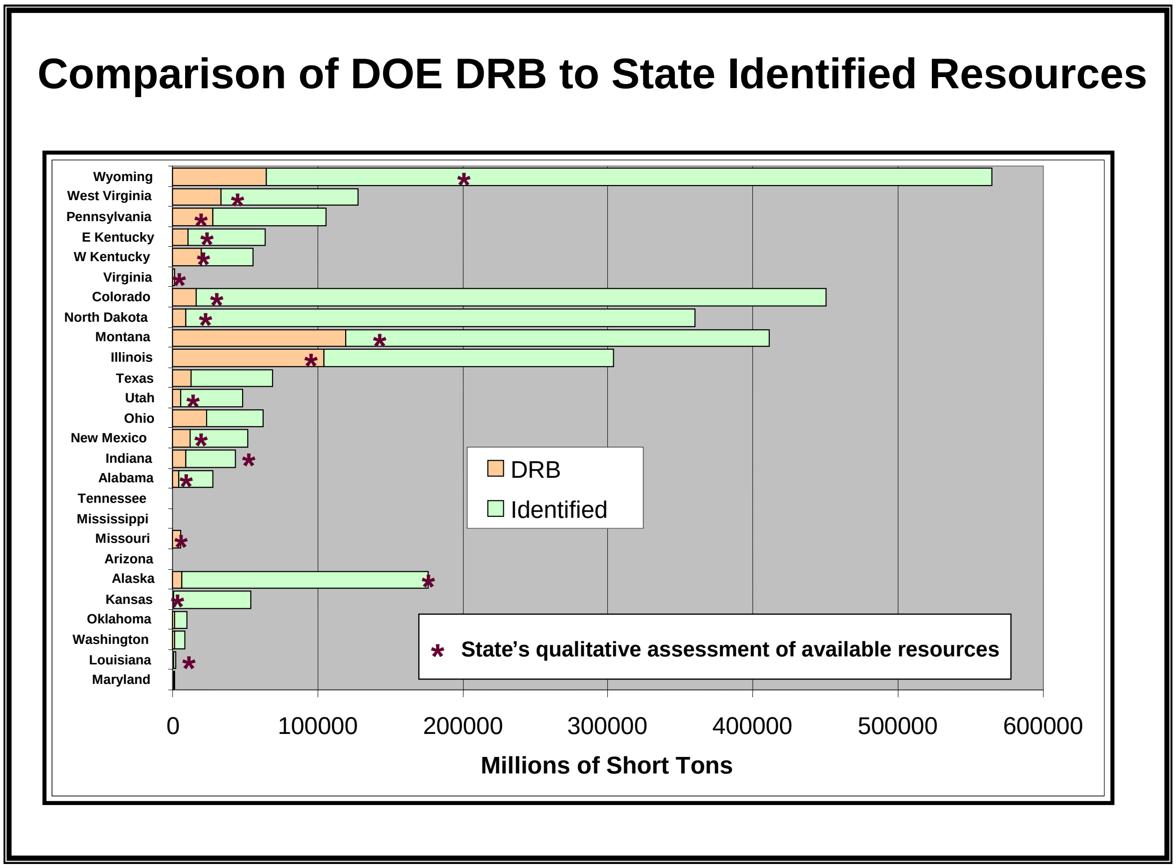
TABLE 3. STATE-BY-STATE COAL RESERVE ANALYSIS (in millions unless otherwise noted)

State	2004 EIA Production (000s)	2004 EIA Estimated Recoverable Reserves (ERR)	2004 EIA ERR/DRB %	2004 EIA Demonstrated Reserve Base (DRB)	Current State-DRB Estimate	Difference Between EIA and Current State-DRB	DRB Adjustment Assuming EIA Recovery %	2002 Identified Resources (Keystone [19])	State Response to 2004 EIA DRB or Keystone Identified Resource
Wyoming	396,493	41,804	64.99%	64,325				1,431,430	> 2004 EIA DRB
West Virginia	147,993	18,104	54.50%	33,220				94,618	> 2004 EIA DRB
Kentucky Total	114,244	see Kentucky, Eastern and Western							
Kentucky, Eastern	90,871	5,960	55.85%	10,671	18,900	8,229	4,596	53,400	18.9 BT *
Pennsylvania	65,996	11,822	42.84%	27,597				78,000	< DRB
Texas	45,863	9,578	76.98%	12,442				56,384	No response
Montana	39,989	74,989	62.87%	119,280				291,600	> 2004 EIA DRB
Colorado	39,870	9,798	60.14%	16,293	20,000	3,707	2,229	434,000	> 20 BT
Indiana	35,110	4,080	42.79%	9,534	59,500	49,966	21,383	34,059	59.5 BT
Illinois	31,853	38,019	36.37%	104,529	96,000	-8,529	-3,102	199,151	96 BT (available)
Virginia	31,420	1,022	58.74%	1,740				NA	DRB
North Dakota	29,943	6,935	76.29%	9,090	25,000	15,910	12,138	350,911	25 BT
New Mexico	27,250	6,934	56.97%	12,172				39,466	> 2004 EIA DRB
Kentucky, Western	23,373	9,044	46.25%	19,554	34,300	14,746	6,820	36,022	34.3 BT *
Ohio	23,222	11,507	49.30%	23,342				39,470	No response
Alabama	22,271	2,806	66.15%	4,242				23,461	> 2004 EIA DRB
Utah	21,746	2,750	50.51%	5,445				42,560	> 2004 EIA DRB
Arizona	12,731	5	71.43%	7	21,250	21,243	15,174	NA	21.25 BT
Washington	5,653	681	50.78%	1,341				6,861	No response
Maryland	5,225	366	56.13%	652				852	No response
Louisiana	3,805	316	74.00%	427	1,700	1,273	942	1,700	Identified
Mississippi	3,586	0	50.00% est.	0	5,000	5,000	2,500	NA	5 BT
Tennessee	2,887	462	59.31%	779			0	NA	No response
Oklahoma	1,792	801	51.45%	1,557			0	8,068	No response
Alaska	1,512	3,291	53.84%	6,112	169,824	163,712	88,151	169,824	Identified
Missouri	578	3,847	64.22%	5,990	7,630	1,640	1,053	NA	4.9 BT recoverable
Kansas	71	681	69.99%	973				53,000	>DRB (no underground)
Arkansas	7	228	54.68%	417					No response
Georgia	0	2	50.00%	4					No response
Idaho	0	2	50.00%	4					No response
Iowa	0	1,127	51.48%	2,189					No response
Michigan	0	59	46.09%	128					No response
North Carolina	0	5	45.45%	11					No response
Oregon	0	9	52.94%	17					No response
South Dakota	0	277	75.68%	366					No response
TOTALS		267,311	54.06%	494,450		276,897	151,884		

Notes to Table 3:

EIA Production by State: EIA "Coal Production and Number of Mines by State and Mine Type," 2004
http://www.eia.doe.gov/cneaf/coal/page/acr/table1.html
EIA Estimated Recoverable Reserves (ERR) and Demonstrated Reserve Base (DRB):
http://www.eia.doe.gov/cneaf/coal/page/acr/table15.xls
Identified Resources: Reported by the states to the Keystone Coal Industry Manual, 2002[(2)]
* Kentucky Geological Survey estimate of ultimate DRB, or resources ultimately available to mine. Does not strictly conform to USGS Circular 891 DRB guidelines.

Table 5.



The following are selected highlight responses to the State Questionnaire, and comments and observations based on these responses.

Concerning the DRB and the ERR

In the case of the DRB, and consequently the ERR, it is clear that there is a substantial amount of coal in the U.S. that is not reported in these estimates because (1) the public agencies responsible for the work do not have access to all the information that is potentially available, and (2) large areas with coal resources do not have coal data points with close enough spacing to be consider in the DRB. EIA periodically revises its estimates because coal is being mined in areas that are not included in the DRB. It is very conceivable that the DRB (and ERR) could double in magnitude if more coal exploration data were made available by the private sector, aggressive public coal resource programs were commission and funded, and if different criteria for reliability and depth were applied. At least in some regions where the continuity of coal beds is more uniform and current technology has demonstrated the ability to develop coal at greater depths than considered. A review of the assumptions used in deriving the DRB is called for. See "Recommendations."

There is a reasonable consensus among the respondents that the DRB represents a minimum estimate of the Nation's coal endowment. Many states are aware of coal that is currently being mined or could be mined in the future that is not reported in the DRB. In some cases, current mining practices suggest that the DRB criteria should be revised. For example, in the eastern U.S.,coal is routinely mined at depths greater than 1000 ft, the maximum overburden allowed for the DRB.

The most problematic issue relates to the classification of resources by confidence of the estimate. While USGS Circular 891 permits practitioners to specify customized dimensions for reliability circles to reflect the variability of the deposits, most states use the recommended ¼-, ¾-, and 3-mile data spacing to facilitate comparisons with other estimates. Although standards are a worthy goal, the end result excludes resources from the demonstrated category where it would be reasonable to include them in the estimate. Many of the respondents noted this issue.

At the same time, most states recognize that Identified Resources contain much coal that is either too thin or deep to mine using current technology. This review suggests that the DRB is in the right order of magnitude, but that it needs to be adjusted to resolve the issues discussed above. The amount of this adjustment is uncertain, but conceivably could be on the order of several hundred billion tons.

States having the greatest remaining resources—Wyoming, Montana, Alaska, and Illinois—do not perceive the discrepancy between the DRB and Identified Resources to be a serious issue because either estimate is sufficient to support the objectives of increasing coal production. Yet, the potential for upgrading the DRB to a higher magnitude is greatest among these states.

Coal Quality Assessments

While the DRB is subdivided according to basic coal quality parameters (rank and sulfur content) the questionnaire indicates that few states assess their resources for quality because of inadequate data. Presumably the DRB estimates utilized an indirect method of assigning quality to the state's resource allocations. Most respondents also indicated that basic coal quality parameters are no longer sufficient for characterizing the utilization and environmental parameters for coal and these additional analyses are even sparser. Coal quality data collected by the industry is often sensitive and companies are reluctant to release the records for public assessments.

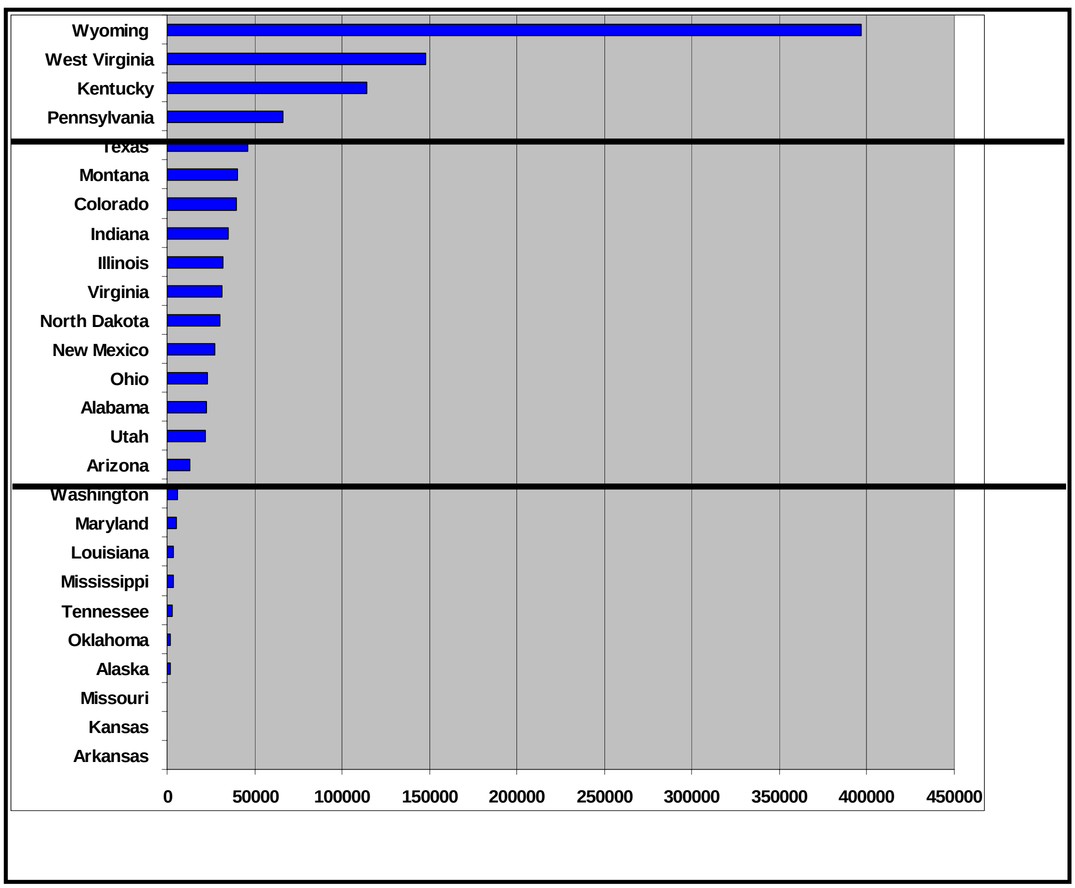
Coal quality assessment is especially difficult in the eastern region where deposits are more variable and site specific data is critical for evaluation. Interior region states typically have higher sulfur coal, however low sulfur coals do occur and their presence can, in some cases, be determined using proxy geologic criteria, such as the depositional character of the associated rock strata, resulting in reduced data requirements. States with lignite resources do not assess quality, and have little data to do so.

Respondents from western states differed with respect to the level of quality assessment that could be accomplished, but most indicated that the quality of their deposits was uniformly high, especially with respect to Clean Air Act parameters. Consequently, they did not consider that quality assessment was a pressing concern.

Increasing Coal Production

Evaluating the future potential for states to increase coal production for liquid fuel conversion is certainly influenced by current production levels by state. The following EIA data ranks coal production and the numbers of mines for the year 2004. States are grouped in three categories; major producer (greater than 50 million short tons), moderate producer (between 15 and 50 million short tons), and minor producer (less than 15 million short tons). Wyoming could be considered a super producer, because it is in a class of its own. An analysis of production trends over time for each state would be instructive, but is beyond the scope of this report.

Figure 6. 2004 coal production rankings for the US in thousands of short tons.



Source: http://www.eia.doe.gov/cneaf/coal/page/acr/table1.html

It is believe that such a manpower intensive endeavor should be refocused to provide not only short-term but also intermediate and long-terms estimates of recoverable U.S. coal. The following recommendations support this objective.

New Approach to Resource Estimation Indicated

There are virtually trillions of tons of coal resources in the U.S. that are not counted in our Nation's most cited estimates of the coal endowment. Inferred and Undiscovered categories are not included in the DRB. Coal located at a depths of greater than 1,000 feet is generally excluded, although coal is now being mined in some U.S. regions at substantially greater depths. Land-use, technological, and environmental restrictions eliminate billions of additional tons from our resource base, although some of this coal will definitely become accessible in the future through technological advancements and policy and regulatory changes.

Clearly, major percentages of coal resources not currently included in the estimated recoverable base will ultimately prove to be recoverable. Conversely, portions of the tonnage reported in the reserve base will not ultimately be mined. In the net analysis, however, the current methodology is believed to substantially understate the potential of the U.S. coal endowment.

In order to give decision makers a more accurate picture, the system should be improved. One possibility is an evaluation and reporting approach that offers multiple levels of Estimated Recoverable Reserves (ERR). Below are three categories for consideration.

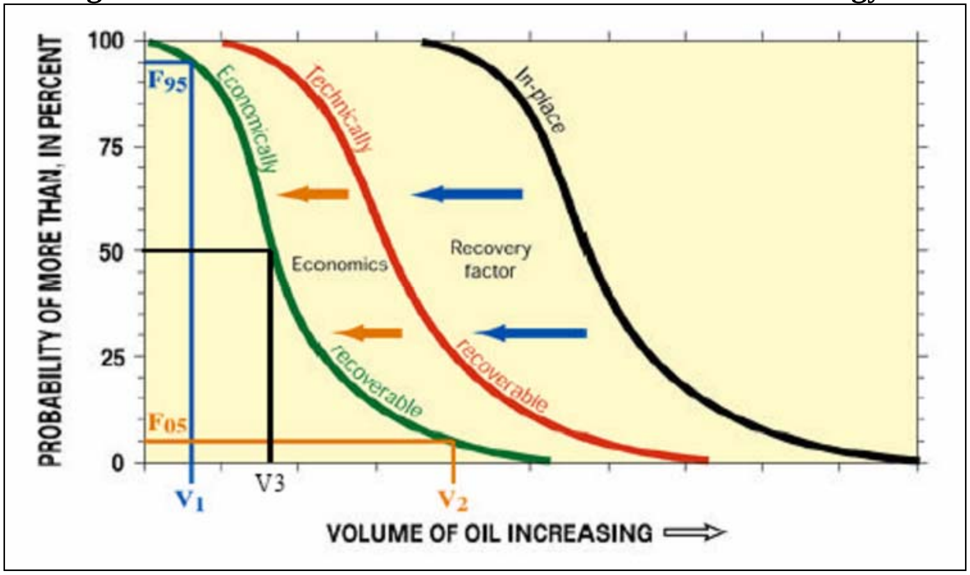
- Base Case (shorter-term focus, incorporating some reserve growth)
- ERR Intermediate-term Case (incorporating more reserve growth)
- ERR Long-Term Case (ultimately recoverable reserves, life of resource focus).

The USGS describes quantities of oil resources in terms of probabilities. Figure 7, below, shows estimated quantities of oil that might be economically recoverable in terms of the 95th percentile (19 in 20), expected mean value, and 5th percentile (one in 20) probabilities of exceeding a stated quantity.

Three measures of reserves are shown: (1) oil in-place--the amount of resource in the ground without regard to whether the oil can be technically recovered; (2) technically recoverable oil--representing the quantity of oil in place that is recoverable using current technology without regard to costs or profits; and (3) economically recoverable oil--the quantity of technically recoverable oil that can be recovered based on exploration, production and transportation costs, plus a 12 percent profit margin. In this example, there is a 95% chance of at least volume V_1 of economically recoverable oil, a 50% chance of at least volume V_3, and a 5% chance of at least V_2 of economically recoverable oil.

We believe a similar approach would be valuable for coal reserve estimation. Reserve probability curves could be developed for each of the three cases listed above (Base, Intermediate, and Long-term), to provide a dynamic framework for planning and decision making.

Figure 7. Probabilistic Oil Reserve Estimation Methodology [21]



Exploration Programs and Methods. Federal and state funding should be authorized and appropriated to provide for more exploration of Inferred and Undiscovered Resource areas. In addition, scientific methods should be developed to make scientific predictions of recoverable reserves in Inferred and Undiscovered areas.

Restricted Reserves Highlighted by Restriction Category. From a policy perspective, it would be very valuable to understand how much coal is restricted from mining, and why. Future coal estimates should be compiled to show each primary category of mining restriction, and lost tonnage associated therewith, on at least a state-by-state basis.

Technology. Technological improvements should be incorporated into the resource assessment framework. Technology will continue to increase access to resources categorized an inaccessible. History has shown that advances in oil and gas drilling technology, for example, such as remote sensing methods, have dramatically increased industry's ability to access resources in an environmentally friendly manner. The continuing development of coal recovery technologies will certainly expand access, perhaps dramatically.

Research. Improved coal production, beneficiation, reclamation, transportation and utilization methods can and will increase recoverable coal reserves. Improved methods to recover greater percentages of in-place coal, mine at greater depths, extract from thinner seams, and have create less environmental impact, are just some examples of how technology will drive reserve growth.

It is recommended that Federal, state and local programs, and programs sponsored by private businesses, be encouraged to improved coal mining related technologies.

Appendix F: Fact Sheet: U.S. Oil Shale Economics

DOE Office of Petroleum Reserves

What are the Economic Requirements for Oil Shale Feasibility?

- Oil shale technologies must be demonstrated at commercial scale before definitive capital and operating costs of oil shale projects will be known.
- Oil shale projects must demonstrate capability to achieve a minimum rate of return at expected sustained average world oil prices.

What are the Major Cost Elements of Oil Shale Projects?

For Mining and Surface Retorting:

- Mine development: surface or underground
- Retorting & upgrading facilities: design, manufacture, and construction of facilities
- Infrastructure: roads, pipelines, powerlines, utilities, storage tanks, waste treatment and pollution control.

For In-Situ (underground) Processing:

- Subsurface facilities: wells or shafts to access and heat the shale, recover liquids and gases, and isolate and protect subsurface environments.
- Surface facilities: production pumps and gathering systems, process controls, and upgrading facilities.

How Big is a Commercial Scale Project?

- Commercial oil shale projects could range in size from 10,000 to 50,000 barrels per day for surface retorts to as much as 300,000 barrels per day for full-scale in-situ projects.

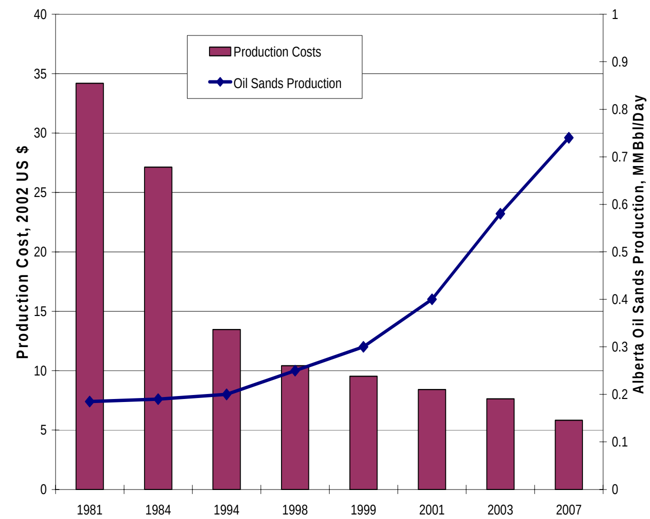
How Much Will Commercial Scale Projects Cost?

- Cost estimates will vary according to the oil shale resource and the process selected. In the 1980s, cost estimates for a 100,000 barrel/day surface retort ranged from $8 - $12 billion (2005$)[1].
- Capital costs are expected to be less today, i.e., $3.0 to $10.0 billion (2005$).

Can Costs be Expected to Decrease Over Time?

- Yes. Capital and operating costs can be expected to decrease over time with operating experience, improved understanding, design enhancements, and improved operating efficiencies, analogous to the experience of the Province of Alberta in developing its oil sands resources.

Figure1. Tar Sand Economics and Production



Source: Oil & Gas Journal, July 14, 2003, V. 101.27

- Production costs in Alberta's tar sands have decreased by as much as 80 percent since the early 1980s. Oil shale cost reductions of 40 to 50 percent could occur as lessons from first of a kind facilities are learned and applied (Figure 1)[2].
- Mining capital costs have risen with the trend toward more mechanized mining operations. Mine operating costs have decreased significantly as mining efficiency has improved.
- Rapid industry growth may tax limited resources of skilled labor and materials and manufacturing facilities for retorting technologies and mining and processing equipment, increasing costs.

What Sustained Oil Prices are Required for Oil Shale Projects to be Economic?

- First of a kind mining and surface retorting plants may be economic, providing a minimum 15% rate of return, at sustained average world oil prices between $44 and $54 per barrel. (Table 1)
- In-situ processes may be economic at sustained average world oil prices above $30 per barrel.

Table I – Estimated Costs and Minimum Economic Prices for Oil Shale Processes (see pg.2)

Technology	Number of Tracts	Average Minimum Economic Price ($/Bbl)	Capital Costs (K$/SDB)	Operating Costs ($/Bbl)
Surface Mining	7	$44.24	$40 - $41	$12 - $13
Underground Mining	7	$54.00	$41 - $42	$16 - $17
Modified In-Situ	7	$65.21	$27 - $40	$18 - $26
True In-Situ	4	$37.75	$36 - $56	$19 - $20

What are the Potential Public Economic Benefits of Oil Shale Development?

- The Federal treasury, State and local governments, and the overall domestic economy stand to benefit from the direct contributions of a domestic oil shale industry and from the additional economic activity and growth that will result from industry development.
- Direct benefits can be measured in terms of: (1) Direct Federal revenues (from Federal taxes and the Federal share of royalties) (2) Direct state/local revenues (from State and local taxes plus the state share of Federal royalties); (3) Contributions to Gross Domestic Product (GDP) and (4) the value of avoided oil imports.
- At a sustained annual production of about 2.5 million barrels of shale oil per year the cumulative value of these benefits over a 25 year period could exceed $500 billion.

With Oil Prices at $60/ Bbl, What are the Impediments to Investment in Oil Shale?

- Large initial capital requirements
- Insufficient private tracts of high-grade oil shale
- Restricted access to resources on public lands
- Oil price uncertainty and volatility
- Technology not demonstrated at commercially-representative scale
- Competing investment opportunities, including investments in other conventional and unconventional oil and gas resources

How Have Current Oil Shale Economics Been Modeled by DOE?

- DOE has performed an analysis of the economics of oil shale. DOE developed a model to evaluate project economics for the application of oil shale technologies to selected resource tracts, and the impacts of various incentives on project economics.
- As there are no commercial facilities currently operating in the United States, capital cost and production cost data used in the analyses were updated from past technology processes and from current vender cost information to construct plausible cost scenarios.
- The analysis applied resource characterization data from surveys conducted by the U.S. Geological Survey in preparation for the 1974 Prototype Oil Shale Leasing Program. The economic analysis examined 27 USGS defined resource tracts, which were nominated by industry, to determine the most efficient technology for use at each location.
- The production cost and resource characterization data were then used to calculate minimum economic prices.
- The minimum economic price is defined as the breakeven price assuming a return on capital of 15 percent, and represents our best cost estimates for a mature industry.
- These cost estimates do not take into account research and development costs, permitting costs, land access issues, or production inefficiencies that are characteristic of first-of-a-kind plants. All of these other factors could contribute significantly to early development costs and have the potential to double production costs for the first plants.
- The model estimates cash flow for the various projects by evaluating plant capacity, development schedule, market prices for oil and natural gas, leasing royalty structure, operating costs, capital costs, and tax structure.
- Table 1, presented above, summarizes the model results for the four known extraction technologies. The average minimum economic cost shown in the table below represents the average of the breakeven prices for a given technology across the resource tracts where it is being applied.
- Capital costs are the sum of investments needed per barrel of installed capacity. These costs include investments in mining, retorting, solid waste disposal, refining and upgrading, plant utilities, and other facilities.
- Operating costs include fuel, operating and maintenance personnel, consumable equipment and other non-capital costs for mining, retorting, refining and upgrading,
- The components of both capital and operating costs are different for various technologies used for mining, retorting, and upgrading. These costs were derived from information available from a variety of sources, particularly the Prototype Leasing Program in the early 1980's. These costs were escalated to 2004 dollars using Bureau of Labor Statistics data and were further validated with current vendor quotes.

References

[1] U.S. Office of Technology Assessment. "An Assessment of Oil Shale Technologies", 1980.
[2] Oil and Gas Journal, July 13, 2003.