BNL 21995

22/
4-15-77
250 NTIS

VOLUMES AND TRANSPORTATION COSTS OF FOSSIL FUELS SHIPPED BETWEEN CENSUS REGIONS

Michael L. Shaw and Robert K. Wood

MASTER

October 1976

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It has been reproduced from the best available copy to permit the broadest possible availability.

INFORMAL REPORT

ECONOMIC ANALYSIS DIVISION
NATIONAL CENTER FOR ANALYSIS OF ENERGY SYSTEMS

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

Under Contract No. EY-76-C-02-0016 with the
UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

BNL 21995

VOLUMES AND TRANSPORTATION COSTS OF FOSSIL FUELS SHIPPED BETWEEN CENSUS REGIONS

Michael L. Shaw and Robert K. Wood
Logistics Management Institute, Washington, D.C.

October 1976

INFORMAL REPORT

Prepared for the Economic Analysis Division, National Center for Analysis of Energy Systems, Brookhaven National Laboratory by Logistics Management Institute under Subcontract No. 391492 and supported by the Administrator for Planning, Analysis, and Evaluation of the United States Energy Research and Development Administration under Contract No. EY-76-C-02-0016 in the context of the Brookhaven National Laboratory Energy Systems Studies Program.

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Economic Analysis Division
National Center for Analysis of Energy Systems
Brookhaven National Laboratory
Upton, New York 11973

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

N O T I C E

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Price: Domestic $6.00;Microfiche $3.00

TABLE OF CONTENTS

Chapter		Page
	INTRODUCTION	i
I.	COAL TRANSPORTATION COSTS	1
	Output of 1985 PIES Reference Case	10
	Procedure to Allocate Coal Production by Census Region	13
	Methodology to Distribute PIES Coal Transportation Volumes and Unit Costs by Census Region	13
II.	CRUDE OIL TRANSPORTATION COSTS	34
	Introduction	34
	Allocation of Oil Production to Census Region	40
	Transportation Between Census Regions and Refinery Regions	43
	Allocation of Refinery Capacity to Census Region	48
	Appendix II-A	57
III.	NATURAL GAS TRANSPORTATION COST	60
	Introduction	60
	Allocation of Gas Production to Census Region	65
	Transportation Between Production Regions and Consumption Regions	68
	Appendix III-A	71
	APPENDIX A. COAL SUPPLY CURVES	73
	APPENDIX B. OIL SUPPLY CURVES	133
	APPENDIX C. NATURAL GAS SUPPLY CURVES	139

INTRODUCTION

As research, development, and demonstration programs focus on specific technologies, regional analytical capability becomes increasingly important. As the implications of such technologies are clarified on a national scale, their potential implementation requirements and effects must be examined regionally. Regional variations in climatic conditions, environmental issues and problems, the supply potential and cost of various fuel forms, and the prevailing or induced patterns of energy consumption all affect the future course of such developments. Regional transportation options and the costs of transmitting present and future energy forms further influence any selective choices. Thus, a multi-regional model permits energy policies to be addressed at a regional level of disaggregation, within the constraints of national policies and supplies. Additionally, it allows greater sophistication in the analysis of the environmental and socioeconomic impacts which are generated at regional levels.

A multi-regional linear programming model of the nation's energy system is currently being developed at the National Center for Analysis of Energy Systems, Brookhaven National Laboratory. This is part of the continuing Energy Systems Studies Program supported by the Administrator for Planning, Analysis, and Evaluation, United States Energy Research and Development Administration. The two essential components providing the analytical power to such a model are an adequate representation of the regional cost structure of energy transportation and region specific resource supply functions. In support of these modeling

activities, the Logistics Management Institute (LMI) has derived the volumes and transportation unit costs of coal, crude oil and natural gas shipped between the Nation's Census Regions. LMI has also provided regional supply functions in these same resources. The volumes and costs are based upon the 1985 Reference Case of the Federal Energy Administration's Project Independence Evaluation System (PIES) Model.

The task was complicated partly by the fact that fossil fuel production in the PIES Model is not related to Census Regions and partly by the fact that the consumption of fossil fuels in PIES demand or utility regions (both of which are coincident with Census Regions) is not modeled to take place at a single location within each Region. A further complication that affects crude oil is that the PIES Model considers it to be consumed in refinery regions that are not coincident with Census Regions as are the utility and demand regions in which coal and natural gas are consumed.

The PIES Model simulates the delivery of coal, natural gas and refined products to 21 metropolitan areas throughout the nation. These areas are intended to represent the centroids of demand throughout the nation. (Crude oil is transported from production regions to seven refinery regions.) Thus, typically, each Census Region is represented by two or three metropolitan areas.

In order to reach a specific destination, coal, for example, moves either by rail or by barge along links in a transshipment network. Transfers between rail and barge and vice versa are permitted at a number of nodes in the network.

The actual route taken between a source and a destination is the route with the minimum overall cost.

It was necessary to allocate fossil fuel production in production regions to Census Regions since many of the PIES production regions extend over two or more Census Regions. It was also necessary to aggregate fuel production from the two or more production regions that fall into specific Census Regions and to determine to which Census Regions the fuel is transported.

Even though the PIES utility and demand regions coincide with Census Regions, the demand region may have two or three destinations at which consumption may be considered to take place. The costs of transportation to each of these destinations are different, and the relative volumes shipped to each destination are different. The PIES Model is at liberty to supply some destinations in a region from one source and other destinations from other sources. Indeed, the model does precisely this.

For these reasons, costs based on the per unit costs in the PIES data base would not reflect the weighted costs of transportation from one Census Region to another. Consequently, it was necessary to use an actual set of results from the model: the 1985 Reference Case.

Results in terms of volumes and unit costs of fossil fuels moved between Census Regions are shown in matrices. Coal movements are covered in Chapter I, crude oil in Chapter II, and natural gas in Chapter III.

As indicated, LMI has also provided data on fossil fuel supply curves used in the PIES Model, to include information on price and quantity increments. Coal supply curves are presented in Appendix A, oil supply curves in Appendix B, and natural gas

supply curves in Appendix C.

We would like to acknowledge the cooperation and support of our contract Technical Monitor, Dr. Richard J. Goettle of the Economic Analysis Division, Brookhaven National Laboratory.

I. COAL TRANSPORTATION COSTS

PIES COAL TRANSPORTATION NETWORK

In distributing the coal transportation volumes and unit costs from the Project Independence Evaluation System (PIES) on the basis of Census Regions for use by Brookhaven National Laboratory, LMI adapted the coal transshipment network used by the Federal Energy Administration (FEA) in its PIES Model. A brief description of the coal transshipment network follows, taken from LMI's report on the PIES Model.[1] The movement of coal by rail and barge is modeled in PIES using a transshipment model that represents the flow of materials to intermediate points enroute to their final destination. There are 19 nodes in the rail network and 16 nodes in the water network. The nodes and the corresponding Census Regions of the nodes when serving as final destination cities are identified in Table I-1.

A map of the rail network is shown in Figure I-1; the waterway network is depicted in Figure I-2. To inject coal into the network, links are provided between the coal supply region nodes and the rail and water nodes; these links are shown in Figures I-3 and I-4. To allow for rail movement of coal to ports for shipment by barge, links are included between the rail nodes and water nodes representing the same physical location. Thus, in the model, it is possible for Great Plains' coal to move by rail to St. Louis and then by water to Boston. All demands for coal are supplied by links connecting rail transshipment nodes to utility and demand region

---

1 The Integrating Model of the Project Independence Evaluation System, by Logistics Management Institute, Washington, D.C., for the Federal Energy Administration, August 1976.

TABLE I-1 TRANSSHIPMENT NETWORK NODES AND CORRESPONDING CENSUS REGIONS

T = Rail Node; W = Barge Node

Metropolitan Area	Code		Census Region[1]
Boston	T1	W1	1. Northeast
New York	T2	W2	2. Middle Atlantic
Baltimore Washington Philadelphia	T3	W3	2. Middle Atlantic (¼) and 3. South Atlantic (3/4)
Miami	T4	W4	3. South Atlantic
Pittsburgh	T5	W5	2. Middle Atlantic
Atlanta	T6	-	3. South Atlantic
Cincinnati	T7	W7	4. East North Central (1/7) and 5. East South Central (6/7)
Detroit	T8	W8	4. East North Central
Chicago	T9	W9	4. East North Central
St. Louis (MO & IL)	TA	WA	4. East North Central (10/45) and 6. West North Central (35/45)
Minneapolis St. Paul	TB	WB	6. West North Central
Kansas City (MO & KS)	TC	WC	6. West North Central
Houston	TD	WD	7. West South Central
Ft. Worth Dallas	TE	-	7. West South Central
Denver	TF	-	8. Mountain
Los Angeles	TG	WG	9. Pacific
San Francisco	TH	WH	9. Pacific
Seattle	TI	WI	9. Pacific
New Orleans	TJ	WJ	5. East South Central

Note 1: For those destination cities associated with two census regions, the fractions in parentheses represent the proportions in which coal delivered to the destination city is distributed to the two census regions. The fractions are a part of the PIES Model formulation.

FIGURE I-1. THE RAIL TRANSSHIPMENT NETWORK

(Distance in Short Line Miles/Cost in 1975 Dollars per Ton)

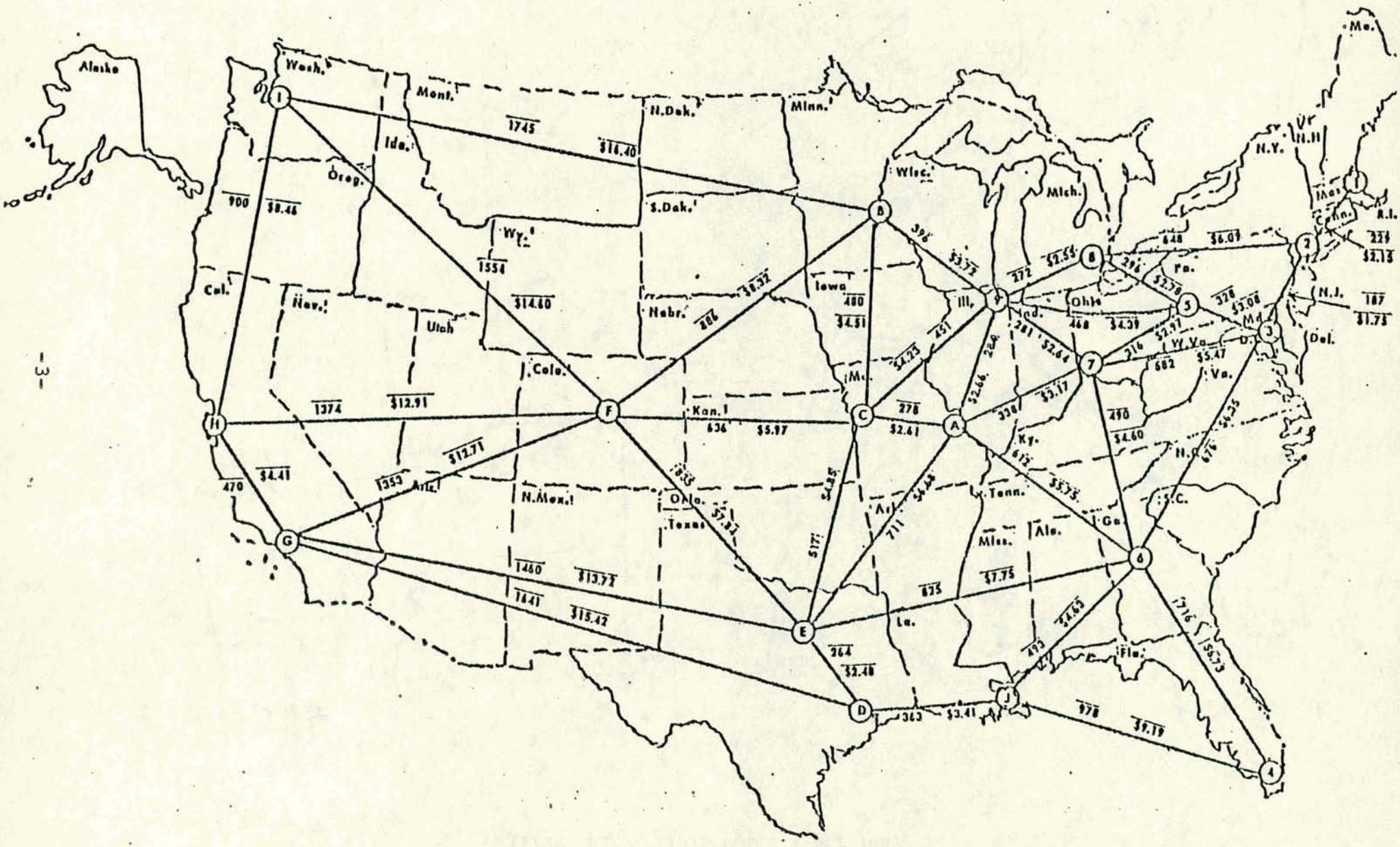


FIGURE I-2. THE BARGE TRANSSHIPMENT NETWORK

(Link Cost in 1975 Dollars per Ton)

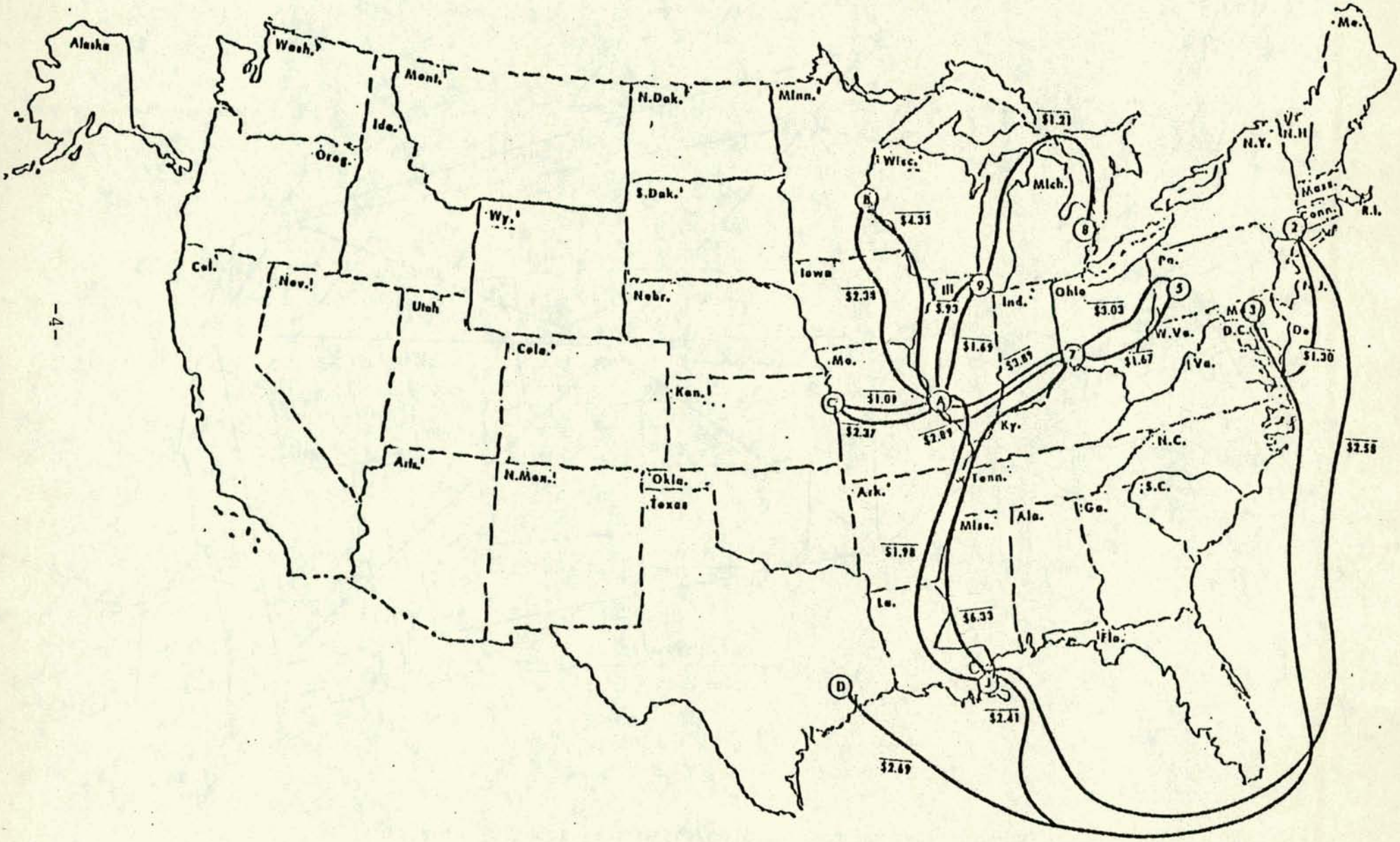
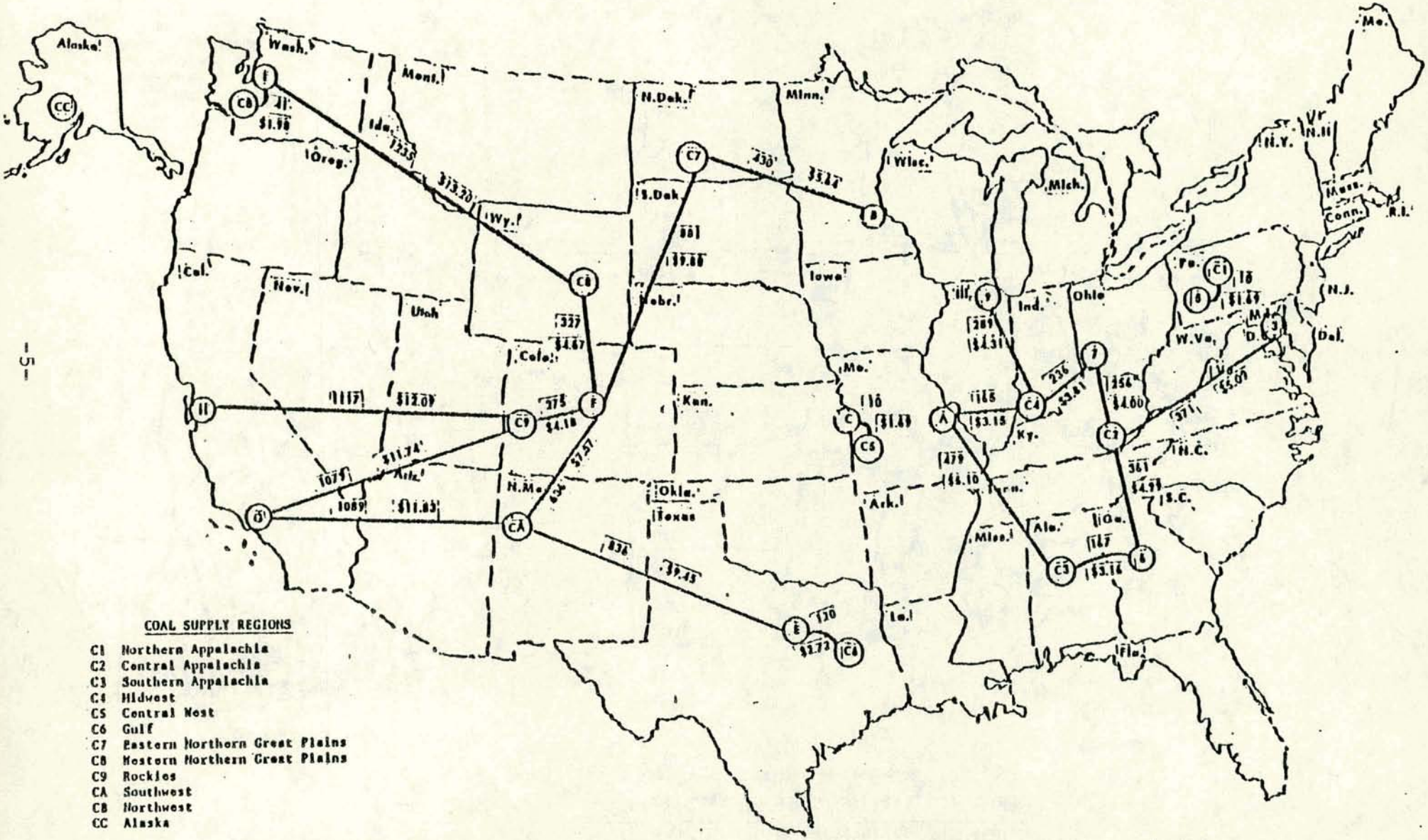


FIGURE I-3. RAIL LINKS CONNECTING COAL SUPPLY REGION CENTROIDS TO RAIL TRANSSHIPMENT NETWORK

(Distance in Short Line Miles/Cost in 1975 Dollars per Ton)

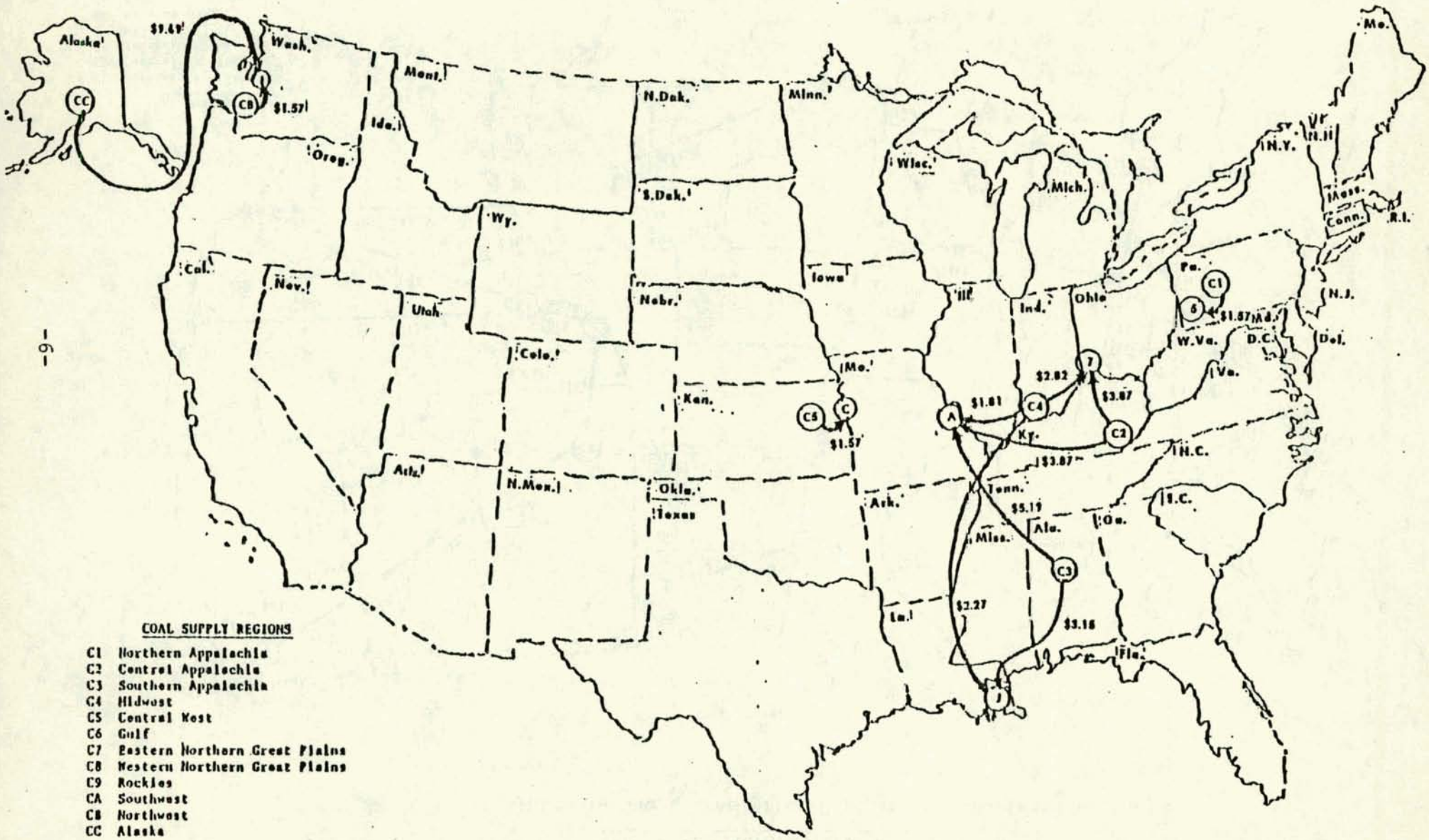


COAL SUPPLY REGIONS

- C1 Northern Appalachia
- C2 Central Appalachia
- C3 Southern Appalachia
- C4 Midwest
- C5 Central West
- C6 Gulf
- C7 Eastern Northern Great Plains
- C8 Western Northern Great Plains
- C9 Rockies
- CA Southwest
- CB Northwest
- CC Alaska

FIGURE I-4. LINKS CONNECTING COAL SUPPLY REGION CENTROIDS TO BARGE TRANSSHIPMENT NETWORK

(Link Cost in 1975 Dollars per Ton)

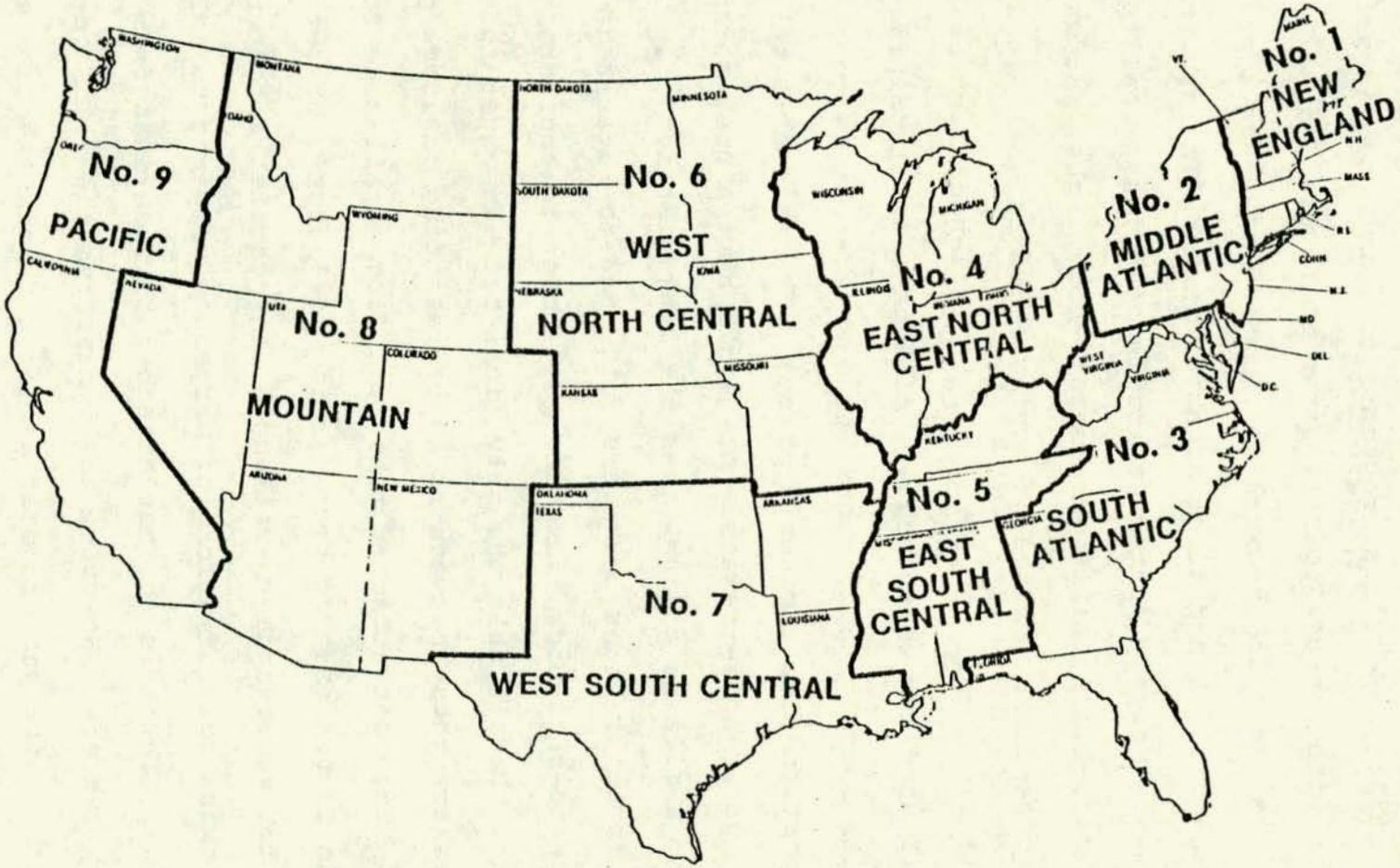


nodes. To supply coal from water nodes, links are added connecting each water node to the rail node for the same physical location. The PIES utility and demand regions, to which coal is shipped, are coincident with Census Regions, shown in Figure I-5.

The coal shipping network is composed of seven types of links: four movement links and three transfer links. The four movement links are coal supply centers to rail-node-links, coal supply centers to water-node-links, rail-node-to-rail-node links, and water-node-to water-node-links. Costs of moving a ton of coal are attached to each link. A coal supply center to rail-node-link bears the fixed rail handling charge plus a mileage charge. Similarly, a link from a coal supply center to a water-node is composed of a fixed portion plus a mileage charge. The rail-node-to-rail-nodes links and water-node-to-water-node links have a cost parameter reflecting a mileage charge times the link distance.

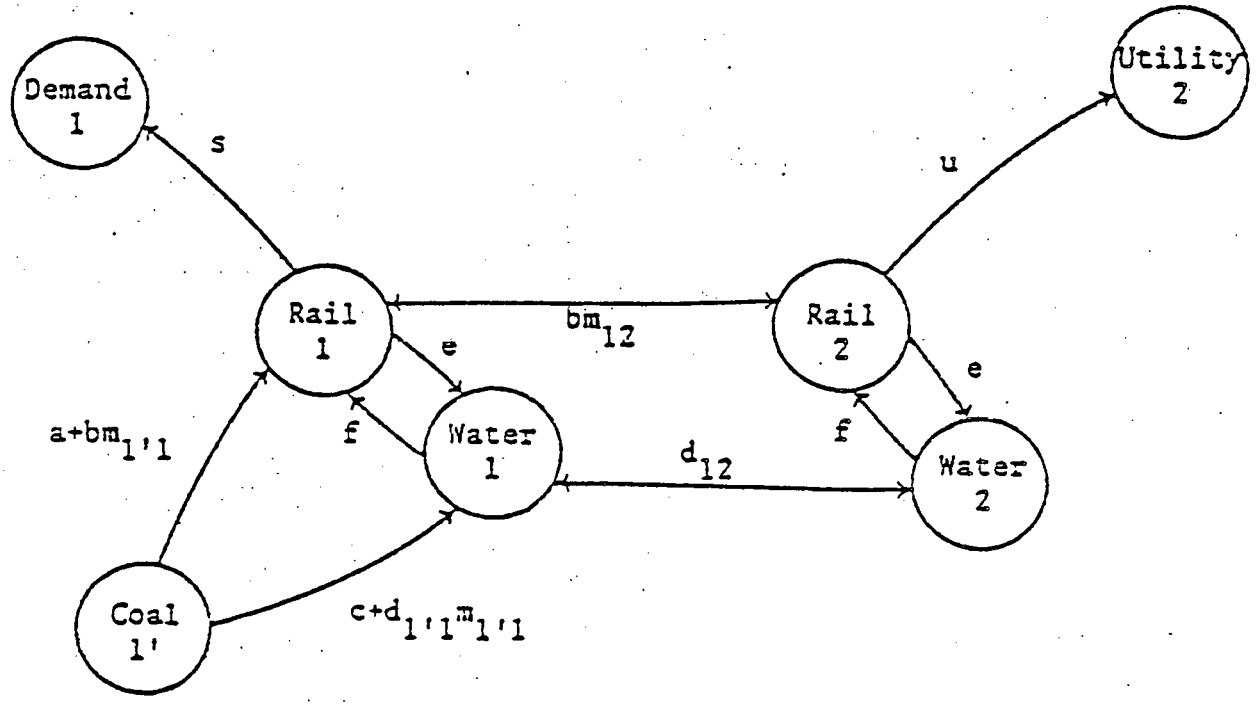
The three transfer links are rail-node-to-water-node links, water-node-to-rail-node links and rail-nodes-to-consumption-center-node links. Recall that the only links between water-nodes and rail-nodes are those between nodes representing the same physical location. The cost attached to a link from a rail-node to a water-node is the cost of transferring coal from a unit-train into barges. The water-node-to-rail-node link carries a cost representing only the extra cost of unloading barges as compared to unloading unit-trains. There is no cost attached to the links from rail-nodes to utility centers. However, the links from the rail nodes to the demand consumption centers bear a cost that represents a surcharge on unit-train cost paid by users receiving coal in smaller lots. This $2 per ton additional transportation charge for non-unit train

FIGURE I-5. CENSUS REGIONS



transshipments which carry coal for industrial use in demand regions is applied to the transportation link betwen transshipment nodes and demand regions and does not enter into the unit cost figures prepared for Brookhaven National Laboratory. Figure I-6 summarizes by presenting a small coal transshipment network with cost attached to each link.

FIGURE I-6. A REPRESENTATIVE COAL MOVEMENT MODEL



where

a	-	fix charge portion of rail rate = $1.60
b	-	mileage charge portion of rail rate = 0.0094
c	-	fixed charge portion of barge rate
d_{ij}	-	cost of shipping by water from i to j
e	-	cost of unloading hopper cars and loading barges = $0.25
f	-	cost of unloading barges in excess of unloading hopper cars = $0.20
m_{ij}	-	rail miles between i and j
u	-	cost of shipping coal from transshipment node to utility center = $0.00
s	-	cost of shipping coal from transshipment node to demand center = $2.00

The cost factor in dollars per ton mile for moving coal along links by train is based upon regression analysis of the fully allocated operating cost as a function of distance for trains operating as 100-car unit-trains. It is these unit train cost factors that are used in preparing unit costs for Brookhaven National Laboratory on the basis of Census Regions. The cost data in dollars per ton mile for moving coal by barge along the network links are based on actual shipping cost figures. As noted in Figure I-6, the transportation costs from the coal supply regions to the source transshipment node are based upon the mode, either rail or barge, by which coal is carried from the source transshipment node. The fixed-charge portion of rail and barge trip costs are applied to the transportation link between the coal supply regions and the source transshipment node. There is a 20-cent-per-ton handling charge to switch from barge to rail, a 25-cent-per-ton charge to switch from rail to barge, and no charge for shipping coal from a transshipment node to a utility center.

OUTPUT OF 1985 PIES REFERENCE CASE

In distributing the PIES coal transportation volumes and unit costs on the basis of Census Regions, we used the printed output of the results of the 1985 Reference Case (with a business as usual supply scenario and a $13 per barrel imported crude oil price) of the PIES Model, shown in Figures I-7A and 7B.

The output gives data on the unit cost and volumes shipped by rail or barge between origin and destination for each of nine types of coal found in the PIES Model. The unit cost of transportation for a shipment in dollars per ton is given in the

FIGURE I-7A COAL TRANSPORTATION OUTPUT OF 1985 PIES REFERENCE CASE

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 858AU66
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
CW COAL MI-MTU,MI-S(MT/CD)							
				RAIL OR LOCAL			
1.6900		C1 C	NORTHERN APPLACHIAN		T5 T	PITTSBURGH; RAIL	403.0
5.0900		C2 C	CENTRAL APPLACHIAN		T3 T	BALTIMORE-PHIL.; RAIL	75.4
4.9900		C2 C	CENTRAL APPLACHIAN		T6 T	ATLANTA; RAIL	76.5
3.1600		C3 C	SOUTHERN APPLACHIAN		T6 T	ATLANTA; RAIL	15.3
2.1500		T2 T	NEW YORK; RAIL		T1 T	BOSTON; RAIL	33.3
1.7500		T3 T	BALTIMORE-PHIL.; RAIL		T2 T	NEW YORK; RAIL	142.8
3.0800		T5 T	PITTSBURGH; RAIL		T3 T	BALTIMORE-PHIL.; RAIL	269.7
2.7800		T5 T	PITTSBURGH; RAIL		T8 T	DETROIT; RAIL	49.5
6.7300		T6 T	ATLANTA; RAIL		T4 T	MIAMI; RAIL	34.6
						TOTAL	1150.1
C- COAL MED-BTU,MI-S(MT/CD)							
				RAIL OR LOCAL			
2.8200		C4 C	MID-EST		W7 W	CINCINNATI; BARGE	106.8
1.8100		C4 C	MIDWEST		WA W	ST.LOUIS; BARGE	236.5
2.2700		C4 C	MIDWEST		WJ W	NEW ORLEANS; BARGE	45.5
1.6900		C5 C	CENTRAL WEST		TC T	KANSAS CITY; RAIL	25.8
.2000		W7 W	CINCINNATI; BARGE		T7 T	CINCINNATI; RAIL	106.0
.2000		W9 W	CHICAGO; BARGE		T9 T	CHICAGO; RAIL	142.3
.2000		WA W	ST.LOUIS; BARGE		TA T	ST.LOUIS; RAIL	64.1
1.6900		WA W	ST.LOUIS; BARGE		W9 W	CHICAGO; BARGE	142.3
4.3300		WA W	ST.LOUIS; BARGE		WB W	ST.PAUL-MINNAPL.; BARGE	30.1
.2000		WB W	ST.PAUL-MINNAPL.; BARGE		TB T	ST.PAUL-MINNAPL.; RAIL	30.1
.2000		WJ W	NEW ORLEANS; BARGE		TJ T	NEW ORLEANS; RAIL	45.5
						TOTAL	973.7
CX COAL LO-BTU,LO-S(MT/CD)							
				RAIL OR LOCAL			
4.6700		C8 C	WESTERN NORTHERN GREAT PLAINS		TF T	DENVER; RAIL	688.2
9.4500		CA C	SOUTHWEST		TE T	DALLAS; RAIL	21.1
9.6900		CC C	ALASKA		WI W	SEATTLE; BARGE	.3
2.5500		T9 T	CHICAGO; RAIL		T8 T	DETROIT; RAIL	43.8
3.1700		TA T	ST.LOUIS; RAIL		T7 T	CINCINNATI; RAIL	51.8
4.2300		TC T	KANSAS CITY; RAIL		T9 T	CHICAGO; RAIL	273.9
2.6100		TC T	KANSAS CITY; RAIL		TA T	ST.LOUIS; RAIL	154.1
.2500		TC T	KANSAS CITY; RAIL		WC W	KANSAS CITY; BARGE	72.1
2.4600		TE T	DALLAS; RAIL		TD T	HOUSTON; RAIL	17.6
8.5200		TF T	DENVER; RAIL		TB T	ST.PAUL-MINNAPL.; RAIL	13.5

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 858AU66
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
5.9700		TF T	DENVER; RAIL		TC T	KANSAS CITY; RAIL	540.2
7.8400		TF T	DENVER; RAIL		TE T	DALLAS; RAIL	37.6
1.9800		WA W	ST.LOUIS; BARGE		WJ W	NEW ORLEANS; BARGE	72.1
2.3700		WC W	KANSAS CITY; BARGE		WA W	ST.LOUIS; BARGE	72.1
.2000		WI W	SEATTLE; BARGE		TI T	SEATTLE; RAIL	.3
.2000		WJ W	NEW ORLEANS; BARGE		TJ T	NEW ORLEANS; RAIL	72.1
						TOTAL	2138.7
CY COAL VLO-BTU,LO-S(MT/CD)							
				RAIL OR LOCAL			
5.6400		C7 C	EASTERN NORTHERN GREAT PLAINS		TB T	ST.PAUL-MINNAPL.; RAIL	69.0
						TOTAL	69.0
CA COAL,ALL MI-S(MT-EQUIV/CD)							
CI COAL MI-BTU,LO-S(MT/CD)							
				RAIL OR LOCAL			
1.6900		C1 C	NORTHERN APPLACHIAN		T5 T	PITTSBURGH; RAIL	81.6
5.0900		C2 C	CENTRAL APPLACHIAN		T3 T	BALTIMORE-PHIL.; RAIL	288.6
4.9900		C2 C	CENTRAL APPLACHIAN		T6 T	ATLANTA; RAIL	61.3
4.0000		C2 C	CENTRAL APPLACHIAN		T7 T	CINCINNATI; RAIL	34.4
3.1600		C3 C	SOUTHERN APPLACHIAN		T6 T	ATLANTA; RAIL	23.3
2.1500		T2 T	NEW YORK; RAIL		T1 T	BOSTON; RAIL	7.7
1.7500		T3 T	BALTIMORE-PHIL.; RAIL		T2 T	NEW YORK; RAIL	121.7
2.7800		T5 T	PITTSBURGH; RAIL		T8 T	DETROIT; RAIL	23.8
6.7300		T6 T	ATLANTA; RAIL		T4 T	MIAMI; RAIL	32.5
						TOTAL	637.2
CM COAL,METALLURGICAL(MT/CD)							
				RAIL OR LOCAL			
1.6900		C1 C	NORTHERN APPLACHIAN		T5 T	PITTSBURGH; RAIL	31.0
1.5700		C1 C	NORTHERN APPLACHIAN		W5 W	PITTSBURGH; BARGE	28.6
5.0900		C2 C	CENTRAL APPLACHIAN		T3 T	BALTIMORE-PHIL.; RAIL	265.3
4.0000		C2 C	CENTRAL APPLACHIAN		T7 T	CINCINNATI; RAIL	.5
3.6700		C2 C	CENTRAL APPLACHIAN		WA W	ST.LOUIS; BARGE	30.0

FIGURE I-7B COAL TRANSPORTATION OUTPUT OF 1985 PIES REFERENCE CASE

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

PAGE 78

1985 REFERENCE CASE

MODEL..... 858AU6A
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
4.1800		C9 C	ROCKIES		TF T	DENVER; RAIL	13.1
11.7400		C9 C	ROCKIES		TG T	LOS ANGELES; RAIL	2.2
12.0900		C9 C	ROCKIES		TH T	SAN FRANCISCO; RAIL	1.1
14.4000		C9 C	ROCKIES		TI T	SEATTLE; RAIL	.4
3.1600		C3 C	SOUTHERN APPLACHIAN		T6 T	ATLANTA; RAIL	7.2
5.1900		C3 C	SOUTHERN APPLACHIAN		WA W	ST.LOUIS; BARGE	11.1
3.1500		C3 C	SOUTHERN APPLACHIAN		WJ W	NEW ORLEANS; BARGE	12.3
2.1500		T2 T	NEW YORK; RAIL		T1 T	BOSTON; RAIL	.4
1.7500		T3 T	BALTIMORE-PHIL.; RAIL		T2 T	NEW YORK; RAIL	37.2
2.7600		T5 T	PITTSBURGH; RAIL		T8 T	DETROIT; RAIL	22.5
6.7300		T6 T	ATLANTA; RAIL		T4 T	MIAMI; RAIL	2.7
4.2300		TC T	KANSAS CITY; RAIL		T9 T	CHICAGO; RAIL	4.6
8.3200		TF T	DENVER; RAIL		T6 T	ST.PAUL-MINNAPL.; RAIL	.8
5.9700		TF T	DENVER; RAIL		TC T	KANSAS CITY; RAIL	5.1
7.8400		TF T	DENVER; RAIL		TE T	DALLAS; RAIL	1.3
3.5100		TJ T	NEW ORLEANS; RAIL		TD T	HOUSTON; RAIL	.5
1.6700		W5 W	PITTSBURGH; BARGE		W7 W	CINCINNATI; BARGE	24.6
.2000		W7 W	CINCINNATI; BARGE		T7 T	CINCINNATI; RAIL	28.6
.2000		W9 W	CHICAGO; BARGE		T9 T	CHICAGO; RAIL	32.9
.2000		WA W	ST.LOUIS; BARGE		TA T	ST.LOUIS; RAIL	8.2
1.6900		WA W	ST.LOUIS; BARGE		W9 W	CHICAGO; BARGE	32.9
.2000		WJ W	NEW ORLEANS; BARGE		TJ T	NEW ORLEANS; RAIL	12.3
						TOTAL	589.2

C2 EQUAL MED-BTU.LO-S(MT/CD)

2.8200		C4 C	MIDWEST	RAIL OR LOCAL	W7 W	CINCINNATI; BARGE	39.0
4.1800		C9 C	ROCKIES		TF T	DENVER; RAIL	32.1
11.7400		C9 C	ROCKIES		TG T	LOS ANGELES; RAIL	1.7
12.0900		C9 C	ROCKIES		TH T	SAN FRANCISCO; RAIL	.8
2.5500		T9 T	CHICAGO; RAIL		T8 T	DETROIT; RAIL	32.1
4.2300		TC T	KANSAS CITY; RAIL		T9 T	CHICAGO; RAIL	32.1
5.9700		TF T	DENVER; RAIL		TC T	KANSAS CITY; RAIL	32.1
.2000		W7 W	CINCINNATI; BARGE		T7 T	CINCINNATI; RAIL	39.0
						TOTAL	209.1

CL COAL,ALL LO-S(MT-EQUIV/CD)

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

PAGE 79

1985 REFERENCE CASE

MODEL..... 858AU6A
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
CU COAL VLO-BTU.HI-S(MT/CD)				RAIL OR LOCAL			
3.5500		C6 C	GULF		TD T	HOUSTON; RAIL	16.4
2.7200		C6 C	GULF		TE T	DALLAS; RAIL	39.5
5.6000		C7 C	EASTERN NORTHERN GREAT PLAINS		T8 T	ST.PAUL-MINNAPL.; RAIL	16.7
						TOTAL	73.2
CV COAL LO-BTU.HI-S(MT/CD)				RAIL OR LOCAL			
4.6700		C8 C	WESTERN NORTHERN GREAT PLAINS		TF T	DENVER; RAIL	43.1
11.8300		C4 C	SOUTHWEST		TG T	LOS ANGELES; RAIL	16.4
1.5700		C8 C	NORTHWEST		WI W	SEATTLE; BARGE	11.0
8.4600		TI T	SEATTLE; RAIL		TH T	SAN FRANCISCO; RAIL	8.2
.2000		WI W	SEATTLE; BARGE		TI T	SEATTLE; RAIL	11.0
						TOTAL	89.7
SO SHALE OIL(MB/CD)				PIPELINE OR LOCAL			
.3720		S1 S	SHALE REGION 1		R2 R	PAD2A	300.0
						TOTAL	300.0
CD COED LIQUIDS(MB/CD)				PIPELINE OR LOCAL			
WC WEST COAST BLEND(MB/CD)				PIPELINE OR LOCAL			
.0121		C2 O 2	PACIFIC COAST STATES		R5 R	PAD5	1176.5
						TOTAL	1176.5
H2 HEAVY CRUDE,PADD2(MB/CD)				PIPELINE OR LOCAL			
.2872		G7 O 6	WESTERN GULF BASIN		R2 R	PAD2A	78.0

column of Figures I-7A and 7B. Data on the origin of a shipment are given in the next three columns: the code for and name of coal supply regions, rail or barge transshipment nodes. Data on the interim or final destination of a shipment are given in the next three columns: the code for and name of rail or barge transshipment nodes. The volume of coal in thousand tons per calendar day (MT/CD) moving in the shipment is given in the last column.

PROCEDURE TO ALLOCATE COAL PRODUCTION BY CENSUS REGION

A procedure was developed to allocate coal production from PIES coal supply regions by Census Regions. The allocation procedure, which is approximate, is based upon previous years' production by Bureau of Mines' mining districts, by State and by county where necessary.[2] The allocation scheme is defined in Table I-2. For reference, a map showing the PIES coal supply regions is presented in Figure I-8.

METHODOLOGY TO DISTRIBUTE PIES COAL TRANSPORTATION VOLUMES AND UNIT COSTS BY CENSUS REGION

In the PIES Model, coal is divided into three product classes-metallurgical, low-sulfur and high-sulfur coal. The combined coal product classes of low-sulfur and high-sulfur coal are known as steam coal. Metallurgical coal is defined as

---

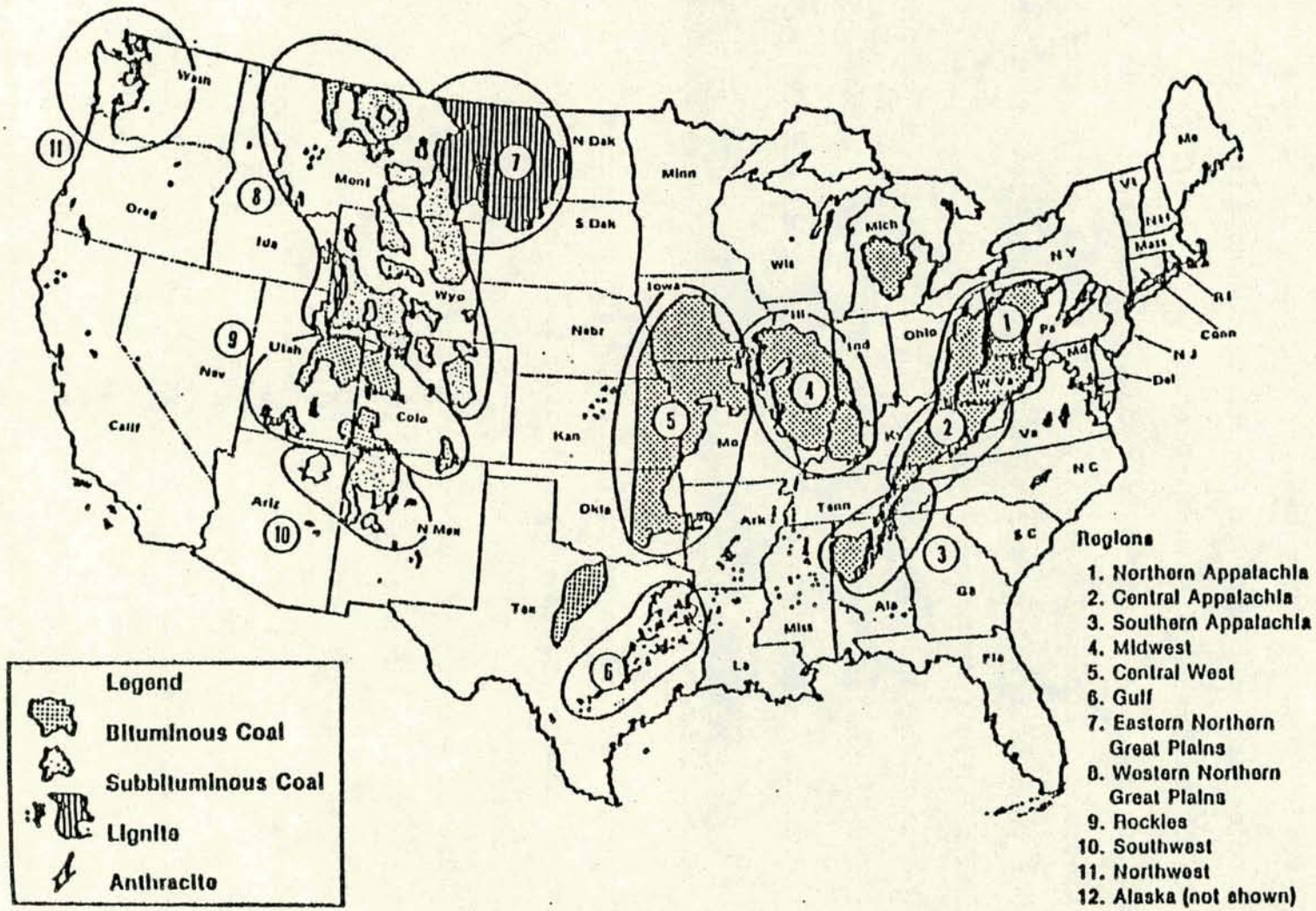
[2] Mineral Industry Survey, "Bituminous Coal and Lignite Distribution - Calendar Year 1975", Bureau of Mines, U.S. Department of the Interior, Washington, D.C., April 12, 1976 for production data by mining district; Coal Mine Expansion Study by ICF Inc., Washington, D.C., for Office of Coal, Federal Energy Administration, May 1976 for production data by State; and Bureau of Mines Mineral Yearbook, "Coal-Bituminous and Lignite", U.S. Department of Interior, Washington, D.C., 1975 for production data by county.

TABLE I-2 METHOD TO ALLOCATE COAL PRODUCTION FROM PIES COAL

SUPPLY REGIONS BY CENSUS REGIONS

	PIES Coal Supply Regions	Bureau of Mines' Mining Districts	Census Region Allocation Scheme
1.	Northern Appalachia	1 - 6	1/2 from C.R. #2 Middle Atlantic 1/4 from C.R. #3 South Atlantic 1/4 from C.R. #4 East North Central
2.	Central Appalachia	7,8	1/2 from C.R. #3 South Atlantic 1/2 from C.R. #5 East South Central
3.	Southern Appalachia	13	All from C.R. #5 East South Central
4.	Midwest	9 - 11	3/5 from C.R. #4 East North Central 2/5 from C.R. #5 East South Central
5.	Central West	12,14,15 (except Texas)	2/3 from C.R. #6 West North Central 1/3 from C.R. #7 West South Central
6.	Gulf	Texas	All from C.R. #7 West South Central
7.	Eastern Northern Great Plains	21,22 (lignite only)	All from C.R. #6 West North Central
8.	Western Northern Great Plains	16,19,22 (except lignite)	All from C.R. #8 Mountain
9.	Rockies	17,20	All from C.R. #8 Mountain
10.	Southwest	18	All from C.R. #8 Mountain
11.	Northwest	23 (except Alaska)	All from C.R. #9 Pacific
12.	Alaska	Alaska	All from Alaska

FIGURE I-8 PIES COAL SUPPLY REGIONS



Source:

U. S. Geological Survey Bulletin 1412
Coal Resources of the United States, January 1, 1974

premium quality coking coal with less than 1.3 percent sulfur, less than 0.8 percent ash, and more than 26 million BTU per ton. Since the level of demand for metallurgical coal is set outside of the PIES Model and restricted to domestic coking and export markets, no single estimate of BTU content is required by the model for metallurgical coal. Low-sulfur coal is defined to meet the Environmental Protection Agency's new source performance standard of 0.6 pounds of sulfur per million BTU. The remaining coal is called high-sulfur.

Both high- and low-sulfur steam coal from each region is assigned to one of four BTU categories:

Category	10^6BTU/Ton
High	24
Medium	22
Low	19
Very Low	14

These four categories represent (1) eastern bituminous coals, (2) other bituminous coals, (3) sub-bituminous coals, and (4) lignites, respectively.

The nine types of coal used in the PIES Model are identified in Table I-3, along with their PIES code and level of production in thousand tons per calendar day (MT/CD), which will serve as the basis for an arithmetic check of the distribution of coal volumes by Census Region.

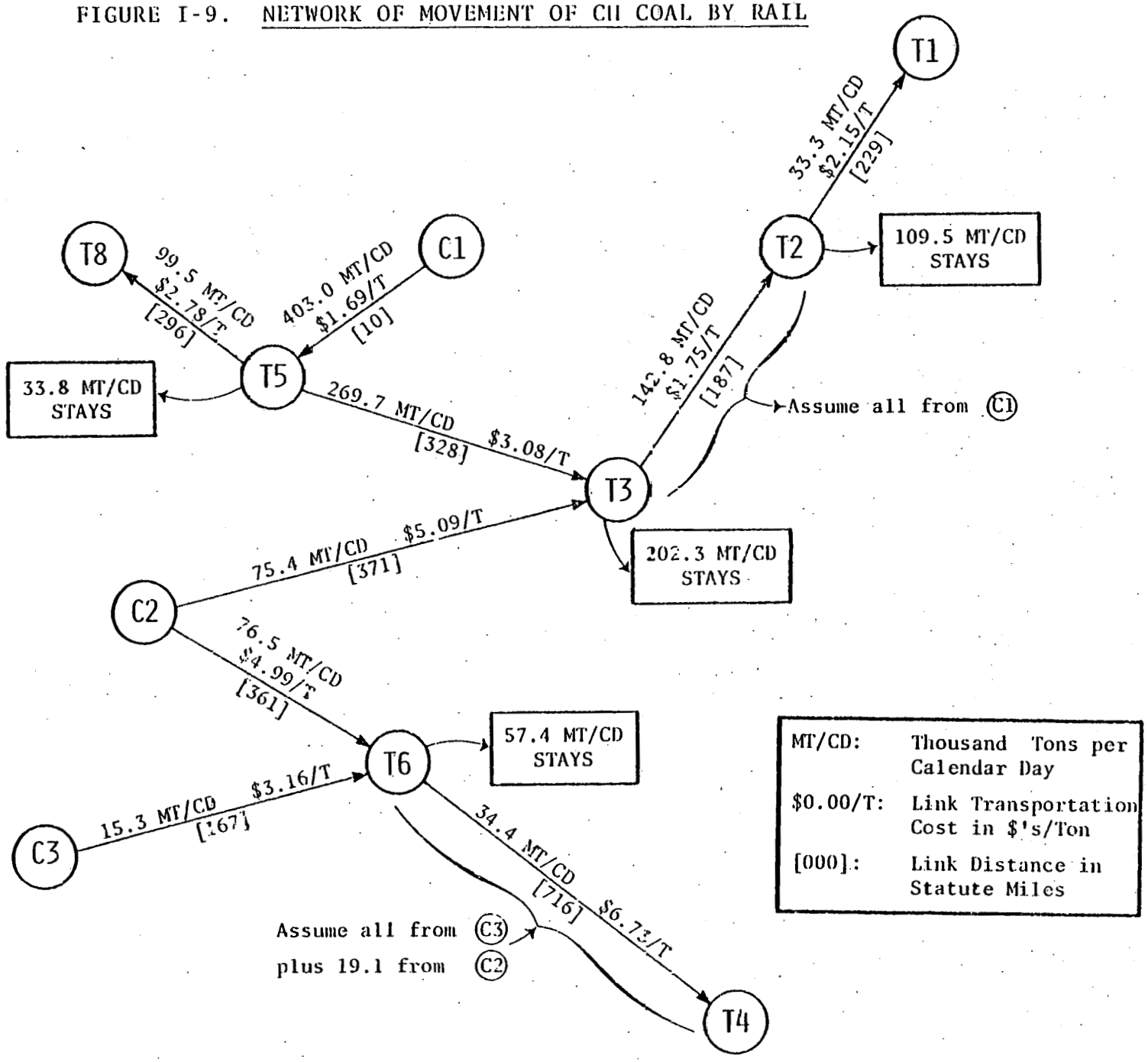
For each type of coal, the procedure outlined below was followed:

- The transportation network was sketched from coal supply region to transshipment node for movement by rail and/or barge for final distribution to Census Regions. As an example a network is shown for one type of coal in Figure I-9;

TABLE I-3 SUMMARY OF COAL PRODUCTION IN MT/CD BY TYPE OF COAL

Code	Type of Coal	Production Volume (in MT/CD)
CH:	High BTU (24×10^6 BTU/T), high sulfur	570.2
CI:	High BTU (24×10^6 BTU/T), low sulfur	451.4
CM:	Metallurgical	378.8
CU:	Very low BTU (14×10^6 BTU/T), high sulfur	73.1
CV:	Low BTU (19×10^6 BTU/T), high sulfur	70.5
CW:	Medium BTU (22×10^6 BTU/T), high sulfur	413.4
CX:	Low BTU (19×10^6 BTU/T), low sulfur	709.6
CY:	Very low BTU (14×10^6 BTU/T), low sulfur	69.0
CZ:	Medium BTU (22×10^6 BTU/T), low sulfur	73.6
	TOTAL	2809.6

FIGURE I-9. NETWORK OF MOVEMENT OF CII COAL BY RAIL



- Each shipment of coal was traced from coal supply region through the rail and/or barge transshipment network to a destination node and its corresponding Census Region(s). Figure I-10 traces the movement of the daily production of high BTU, high-sulfur coal from coal supply region 1. A simplifying assumption was made for the case in which one type of coal was shipped from two coal supply regions to a common transshipment node for further transshipment. The transshipment of the less costly coal arriving from the (generally) closer coal supply region is exhausted before transshipping the more costly coal from the farther coal supply region.
- For each shipment, the volume moved in thousand tons per calendar day (MT/CD), distance moved in miles, total transportation costs and units costs terms of dollar per ton ($/T) and dollar per ton-mile ($/Tm) were found:
- The data for each type of coal was collected and summarized by Census Region:
- Data on daily volumes and unit costs are displayed in a 10 x 10 matrix (including Alaska). The results for each type of coal are included in the matrices (Tables I-4 through I-12). The summary of coal production by type of coal, shown in Table I-3, served as the basis for an arithmetic check of

FIGURE 1-10 SAMPLE WORKSHEET TRACING MOVEMENT OF HIGH BTU, HIGH SULFUR COAL (TYPE CH)

Coal Sup Reg		Cens Reg		Originating Node			Next Node					Destin Node		Cens Reg		Total Dist	Total Cost	Deriv Cost/T	Deriv Cost/Tm
No	Vol	No	Vol	Code	Dist to	Unit Cost to	Code	Transf Cost	Vol	Dest to	Unit Cost to	Code	Vol	No	Vol				
C1	403.0	(1/2)#2	201.4	T5	10 mi	$1.69/T						T5	16.9	#2	16.9	10 mi	$ 28,561	$1.69/T	$0.169/Tm
		(1/4)#3	100.8									T5	8.45	#2	8.45		$ 14,281		
		(1/4)#4	100.8									T5	8.45	#2	8.45		$ 14,281		
							T8	0	49.74	296 mi	$2.78/T	T8	49.74	#4	49.74	306 mi	$222,338	$4.47/T	$0.01461/Tm
							T8	0	24.88			T8	24.88	#4	24.88	306 mi	$111,214		
							T8	0	24.88			T8	24.88	#4	24.88	306 mi	$111,214		
							T3	0	134.84	328 mi	$3.08/T	T3	63.45	(1/4)#2 (3/4)#3	15.86 47.59	338 mi	$ 75,652 $227,004	$4.77/T	$0.01411/Tm
							T3	0	67.43	328 mi	$3.08/T	T3	31.725	(1/4)#2 (3/4)#3	7.93 23.79		$ 37,826 $113,478		
							T3	0	67.43	328 mi	$3.08/T	T3	31.725	(1/4)#2 (3/4)#3	7.93 23.79		$ 37,826 $113,478		
							T2	0	71.4	187 mi	$1.75/T	T2	54.75	#2	54.75	525 mi	$356,970	$6.52/T	$0.01242/Tm
							T2	0	35.7			T2	27.375	#2	27.38		$178,485		
							T2	0	35.7			T2	27.375	#2	27.38		$178,485		
							T1	0	16.65	229 mi	$2.15/T	T1	16.65	#1	16.65	754 mi	$144,356	$8.67	$0.001150/Tm
							T1	0	8.33			T1	8.325	#1	8.33		$ 72,178		
							T1	0	8.33			T1	8.325	#1	8.33		$ 72,178		

TABLE I-4. TRANSPORTATION OF CH COAL (HIGH BTU 24 x 10^6 BTU/T, HIGH-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC	MT/CD 16.65 $/T 8.67 $/Tm 0.01150	MT/CD 87.51 $/T 5.27 $/Tm 0.01316	MT/CD 47.59 $/T 4.77 $/Tm 0.01411	MT/CD 49.74 $/T 4.47 $/Tm 0.01461						
NO. 3 SOUTH ATLANTIC	MT/CD 8.33 $/T 8.67 $/Tm 0.01150	MT/CD 53.19 $/T 5.24 $/Tm 0.01350	MT/CD 90.31 $/T 5.68 $/Tm 0.01309	MT/CD 24.88 $/T 4.47 $/Tm 0.01461						
NO. 4 EAST NORTH CENTRAL	MT/CD 8.33 $/T 8.67 $/Tm 0.01150	MT/CD 43.76 $/T 5.27 $/Tm 0.01345	MT/CD 23.79 $/T 4.77 $/Tm 0.01411	MT/CD 24.88 $/T 4.47 $/Tm 0.01461						
NO. 5 EAST SOUTH CENTRAL		MT/CD 9.43 $/T 5.09 $/Tm 0.01372	MT/CD 81.82 $/T 6.73 $/Tm 0.01233							
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN										
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-5. TRANSPORTATION OF CI COAL (HIGH BTU 24 x 10^6 BTU/T , LOW-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC		MT/CD 8.90 $/T 1.69 $/Tm 0.169		MT/CD 11.90 $/T 4.47 $/Tm 0.01461						
NO. 3 SOUTH ATLANTIC	MT/CD 3.85 $/T 8.99 $/Tm 0.01142	MT/CD 82.06 $/T 6.24 $/Tm 0.01297	MT/CD 93.49 $/T 6.23 $/Tm 0.01265	MT/CD 8.56 $/T 4.33 $/Tm 0.01494	MT/CD 15.69 $/T 4.00 $/Tm 0.01563					
NO. 4 EAST NORTH CENTRAL		MT/CD 4.45 $/T 1.69 $/Tm 0.169		MT/CD 5.95 $/T 4.47 $/Tm 0.01461						
NO. 5 EAST SOUTH CENTRAL	MT/CD 3.85 $/T 8.99 $/Tm 0.01142	MT/CD 77.61 $/T 6.38 $/Tm 0.01252	MT/CD 116.79 $/T 5.61 $/Tm 0.01314	MT/CD 2.61 $/T 4.00 $/Tm 0.01563	MT/CD 15.69 $/T 4.00 $/Tm 0.01563					
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN										
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-6. TRANSPORTATION OF CM COAL (METALLURGICAL) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC		MT/CD 4.24 $/T 1.69 $/Tm 0.169		MT/CD 13.02 $/T 4.33 $/Tm 0.01314	MT/CD 10.54 $/T 3.44 $/Tm 0.00715					
NO. 3 SOUTH ATLANTIC	MT/CD 0.20 $/T 8.99 $/Tm 0.01142	MT/CD 46.54 $/T 5.63 $/Tm 0.01313	MT/CD 78.04 $/T 5.09 $/Tm 0.01372	MT/CD 21.54 $/T 5.33 $/Tm 0.00762	MT/CD 5.48 $/T 3.46 $/Tm 0.00733					
NO. 4 EAST NORTH CENTRAL		MT/CD 2.13 $/T 1.69 $/Tm 0.169		MT/CD 6.50 $/T 4.33 $/Tm 0.01313	MT/CD 5.27 $/T 3.44 $/Tm 0.00715					
NO. 5 EAST SOUTH CENTRAL	MT/CD 0.20 $/T 8.99 $/Tm 0.01142	MT/CD 44.41 $/T 5.82 $/Tm 0.01300	MT/CD 85.24 $/T 5.14 $/Tm 0.01365	MT/CD 19.76 $/T 5.92 $/Tm 0.00690	MT/CD 12.01 $/T 3.36 $/Tm 0.00681	MT/CD 6.38 $/T 5.39 $/Tm 0.00852	MT/CD 0.50 $/T 6.76 $/Tm 0.00785			
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN				MT/CD 4.60 $/T 14.38 $/Tm 0.01056		MT/CD 1.30 $/T 11.60 $/Tm 0.01089	MT/CD 1.30 $/T 12.02 $/Tm 0.01083	MT/CD 5.90 $/T 4.18 $/Tm 0.01520	MT/CD 3.70 $/T 12.13 $/Tm 0.01082	
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-7. TRANSPORTATION OF CU COAL (VERY LOW BTU 14 x 10^6 BTU/T , HIGH-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL										
NO. 5 EAST SOUTH CENTRAL										
NO. 6 WEST NORTH CENTRAL						MT/CD 16.70 $/T 5.64 $/Tm 0.01312				
NO. 7 WEST SOUTH CENTRAL							MT/CD 56.40 $/T 2.97 $/Tm 0.02032			
NO. 8 MOUNTAIN										
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-8. TRANSPORTATION OF CV COAL (LOW BTU 19 x 10^6 BTU/T , HIGH-SULFUR FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL										
NO. 5 EAST SOUTH CENTRAL										
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN								MT/CD 43.10 $/T 4.67 $/Tm 0.01428	MT/CD 16.40 $/T 11.83 $/Tm 0.01086	
NO. 9 PACIFIC									MT/CD 11.00 $/T 8.08 $/Tm 0.01186	
ALASKA										

LEGEND

MT/CD	Volume in Thousand Tons per Calendar Day
$/T	Cost in Dollars per Ton
$/Tm	Cost in Dollars per Ton Mile

TABLE I-9. TRANSPORTATION OF CW COAL (MEDIUM BTU 22 x 10^6 BTU/T, HIGH-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL				MT/CD 103.02 $/T 3.50 $/Tm 0.00529	MTCD 81.81 $/T 2.84 $/Tm 0.00504	MT/CD 47.97 $/T 3.64 $/Tm 0.00588				
NO. 5 EAST SOUTH CENTRAL				MT/CD 68.68 $/T 3.50 $/Tm 0.00529	MT/CD 54.54 $/T 2.84 $/Tm 0.00504	MT/CD 31.98 $/T 3.64 $/Tm 0.00588				
NO. 6 WEST NORTH CENTRAL						MT/CD 16.93 $/T 1.69 $/Tm 0.169				
NO. 7 WEST SOUTH CENTRAL						MT/CD 8.47 $/T 1.69 $/Tm 0.169				
NO. 8 MOUNTAIN										
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE 1-10. TRANSPORTATION OF CX COAL (LOW BTU 19 x 10^6 BTU/T , LOW-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL										
NO. 5 EAST SOUTH CENTRAL										
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN				MT/CD 304.03 $/T 15.15 $/Tm 0.01049	MT/CD 116.50 $/T 15.81 $/Tm 0.00765	MT/CD 113.17 $/T 12.44 $/Tm 0.01077	MT/CD 58.70 $/T 12.15 $/Tm 0.01081	MT/CD 96.90 $/T 4.67 $/Tm 0.01428		
NO. 9 PACIFIC										
ALASKA									MT/CD 0.30 $/T 9.89 $/Tm 0.00521	

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-11. TRANSPORTATION OF CY COAL (VERY LOW BTU 14 x 10^6 BTU/T , LOW-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL										
NO. 5 EAST SOUTH CENTRAL										
NO. 6 WEST NORTH CENTRAL						MT/CD 69.00 $/T 5.64 $/Tm 0.01312				
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN										
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD	Volume in Thousand Tons per Calendar Day
$/T	Cost in Dollars per Ton
$/Tm	Cost in Dollars per Ton Mile

TABLE I-12. TRANSPORTATION OF CZ COAL (MEDIUM BTU 22 x 10^6 BTU/T, LOW-SULFUR) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC										
NO. 3 SOUTH ATLANTIC										
NO. 4 EAST NORTH CENTRAL				MT/CD 3.34 $/T 3.02 $/Tm 0.00938	MT/CD 20.06 $/T 3.02 $/Tm 0.00938					
NO. 5 EAST SOUTH CENTRAL				MT/CD 2.23 $/T 3.02 $/Tm 0.00938	MT/CD 13.37 $/T 3.02 $/Tm 0.00938					
NO. 6 WEST NORTH CENTRAL										
NO. 7 WEST SOUTH CENTRAL										
NO. 8 MOUNTAIN				MT/CD 32.10 $/T 16.03 $/Tm 0.01036					MT/CD 2.50 $/T 11.85 $/Tm 0.01861	
NO. 9 PACIFIC										
ALASKA										

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

the distribution of coal volumes by Census Region.

The same data: volume in MT/CD and unit costs in $/T and $/Tm. are aggregated for all types of coal and displayed in a single 10 x 10 matrix (Table I-13). A summary of coal volumes moving from and to Census Regions (and Alaska) is shown in Table I-14 as the basis for an arithmetric check of the distribution shown in Table I-13.

TABLE I-13. TRANSPORTATION OF ALL COAL (AGGREGATED) FROM CENSUS REGION TO CENSUS REGION

FROM \ TO	NO. 1 NEW ENGLAND	NO. 2 MIDDLE ATLANTIC	NO. 3 SOUTH ATLANTIC	NO. 4 EAST NORTH CENTRAL	NO. 5 EAST SOUTH CENTRAL	NO. 6 WEST NORTH CENTRAL	NO. 7 WEST SOUTH CENTRAL	NO. 8 MOUNTAIN	NO. 9 PACIFIC	ALASKA
NO. 1 NEW ENGLAND										
NO. 2 MIDDLE ATLANTIC	MT/CD 16.65 $/T 8.67 $/Tm 0.01150	MT/CD 100.65 $/T 5.00 $/Tm 0.01433	MT/CD 47.59 $/T 4.77 $/Tm 0.01411	MT/CD 74.66 $/T 4.45 $/Tm 0.01433	MT/CD 10.54 $/T 3.44 $/Tm 0.00715					
NO. 3 SOUTH ATLANTIC	MT/CD 12.38 $/T 8.77 $/Tm 0.01147	MT/CD 181.79 $/T 5.79 $/Tm 0.01315	MT/CD 261.84 $/T 5.70 $/Tm 0.01307	MT/CD 54.98 $/T 4.78 $/Tm 0.01045	MT/CD 21.17 $/T 3.86 $/Tm 0.01238					
NO. 4 EAST NORTH CENTRAL	MT/CD 8.33 $/T 6.87 $/Tm 0.01150	MT/CD 50.34 $/T 5.00 $Tm 0.01462	MT/CD 23.79 $/T 4.77 $/Tm 0.01411	MT/CD 143.69 $/T 3.73 $/Tm 0.00664	MT/CD 107.14 $/T 2.90 $/Tm 0.00564	MT/CD 47.97 $/T 3.64 $/Tm 0.00588				
NO. 5 EAST SOUTH CENTRAL	MT/CD 4.05 $/T 8.99 $/Tm 0.01142	MT/CD 131.45 $/T 6.09 $/Tm 0.01272	MT/CD 283.85 $/T 5.79 $/Tm 0.01298	MT/CD 93.28 $/T 4.01 $/Tm 0.00587	MT/CD 95.61 $/T 3.12 $/Tm 0.00663	MT/CD 38.36 $/T 3.93 $/TM 0.00633	MT/CD 0.50 $/T 6.76 $/Tm 0.00785			
NO. 6 WEST NORTH CENTRAL						MT/CD 102.63 $/T 4.99 $/Tm 0.01383				
NO. 7 WEST SOUTH CENTRAL						MT/CD 8.47 $/T 1.69 $/Tm 0.169	MT/CD 56.40 $/T 2.97 $/Tm 0.02032			
NO. 8 MOUNTAIN				MT/CD 340.73 $/T 15.31 $/Tm 0.01048	MT/CD 116.50 $/T 15.81 $/Tm 0.00765	MT/CD 134.47 $/T 12.43 $/Tm 0.01077	MT/CD 60.00 $/T 12.85 $/Tm 0.01081	MT/CD 145.90 $/T 4.65 $/Tm 0.01431	MT/CD 22.60 $/T 11.88 $/Tm 0.01138	
NO. 9 PACIFIC									MT/CD 11.00 $/T 8.08 $/Tm 0.01186	
ALASKA									MT/CD 0.30 $/T 9.09 $/Tm 0.00521	

LEGEND

MT/CD Volume in Thousand Tons per Calendar Day

$/T Cost in Dollars per Ton

$/Tm Cost in Dollars per Ton Mile

TABLE I-14 SUMMARY OF COAL VOLUMES IN MT/CD MOVING FROM AND TO CENSUS REGIONS AND ALASKA

From Census Region No.		To Census Region No.	
1	—	1	41.41
2	250.09	2	464.23
3	532.16	3	617.07
4	381.26	4	707.34
5	647.10	5	350.96
6	102.63	6	331.90
7	64.87	7	116.90
8	820.20	8	145.90
9	11.00	9	33.90
Alaska	0.30	Alaska	—
TOTAL	2809.61 MT/CD	TOTAL	2809.61 MT/CD

References

I-1. The Integrating Model of the Project Independence Evaluation System, Logistics Management Institute, Washington, D.C., for the Federal Energy Administration, August 1976.

I-2. Mineral Industry Survey, "Bituminous Coal and Lignite Distribution - Calendar Year 1975", Bureau of Mines, U.S. Department of the Interior, Washington, D.C., April 12, 1976.

I-3. Coal Mine Expansion Study, ICF Inc., Washington, D.C., for the Office of Coal, Federal Energy Administration, May 1976.

I-4. Bureau of Mines Mineral Yearbook, "Coal-Bituminous and Lignite", U.S. D partment of Interior, Washington, D.C., 1975

II. CRUDE OIL TRANSPORTATION COSTS

INTRODUCTION

In the PIES Model crude oil is produced in one of 14 oil regions (which correspond to the NPC oil and gas regions shown in Figure II-1, and is transported to one of 7 refinery regions where it it converted into the gasoline, residual oil, distillate oil and other petroleum products which are required by the PIES Equilibrating Mechanism. Neither the oil regions nor the refinery regions (which correspond to Petroleum Administration for Defense Districts - PADDs) shown in Figure II-2 correspond directly to Census Regions (see Figure II-3). Indeed, the boundaries of a number of the oil and gas regions do not even coincide with State borders.

PIES raw data contains crude oil transportation costs between oil producing regions and refinery regions. The costs are given for two separate modes of transportation; pipelines and barges. The pipeline mode also includes road transportation where relevant and the barge mode includes tanker transportation where that is permitted. With the exception of the Trans Alaskan Pipeline, no constraints are placed on any of the transportation links, i.e. unlimited quantities of fuel may flow between any oil producing region and refinery region providing that a link does in fact exist.

The two PIES Standard Tables which contain the transportation costs are named TROPLPRC (pipeline costs) and TROBLPRC (barge costs) respectively (Tables II-1 and II-2). Costs are only provided where links are possible; i.e. where pipelines already exist or are planned or where barge or tanker transportation is feasible.

FIGURE II-1 NPC OIL AND GAS REGIONS

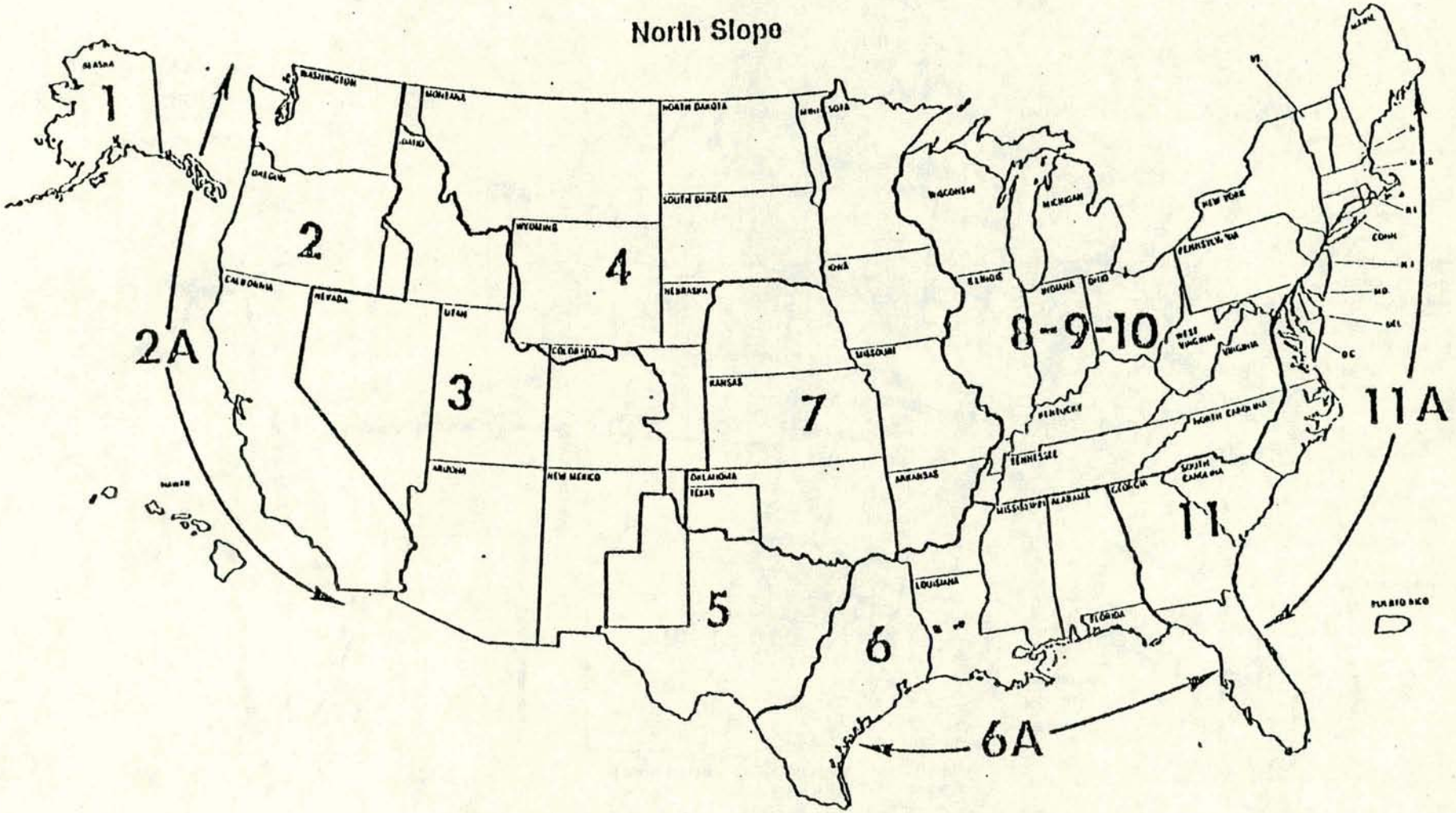


FIGURE II-2

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS

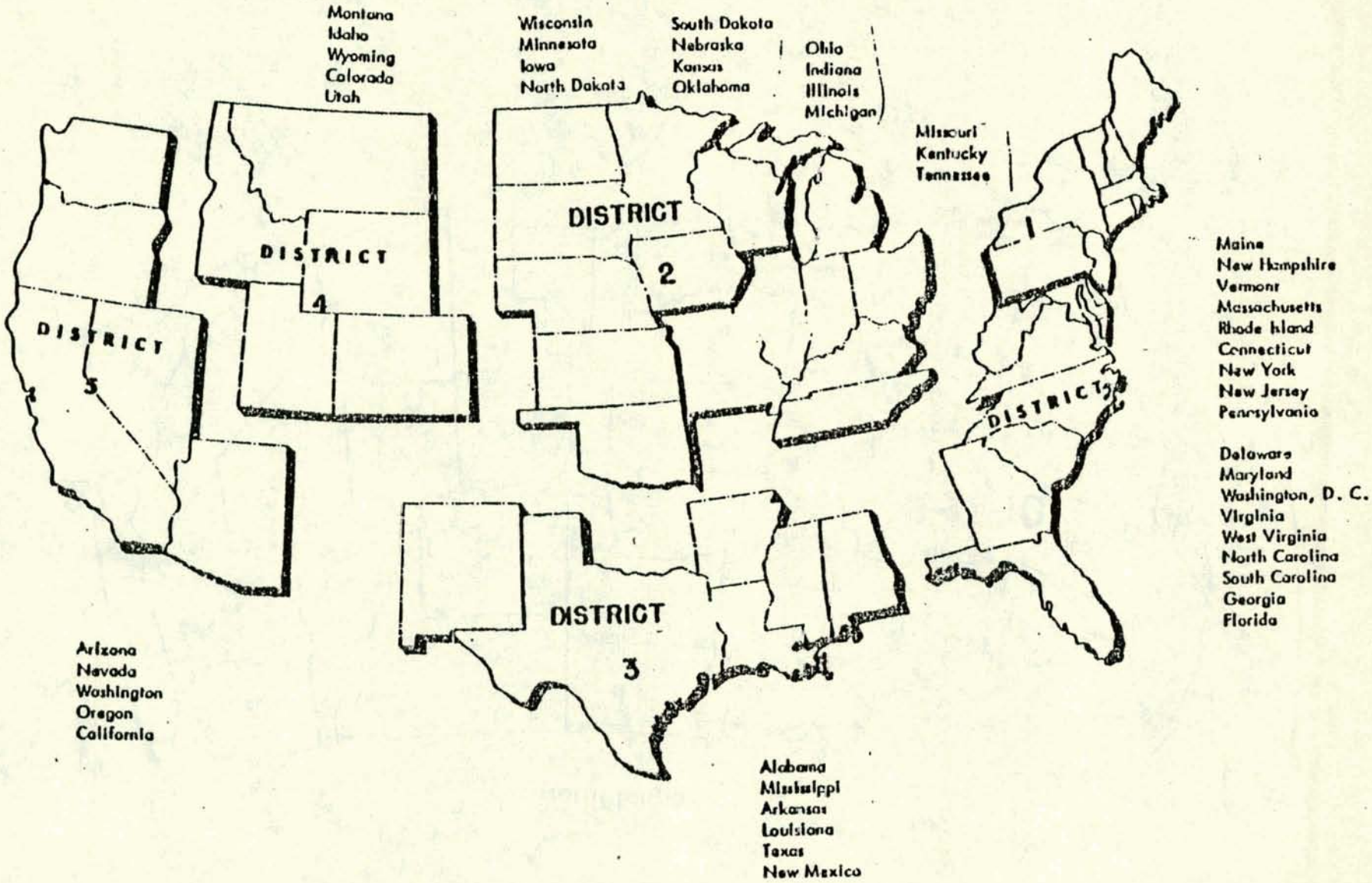
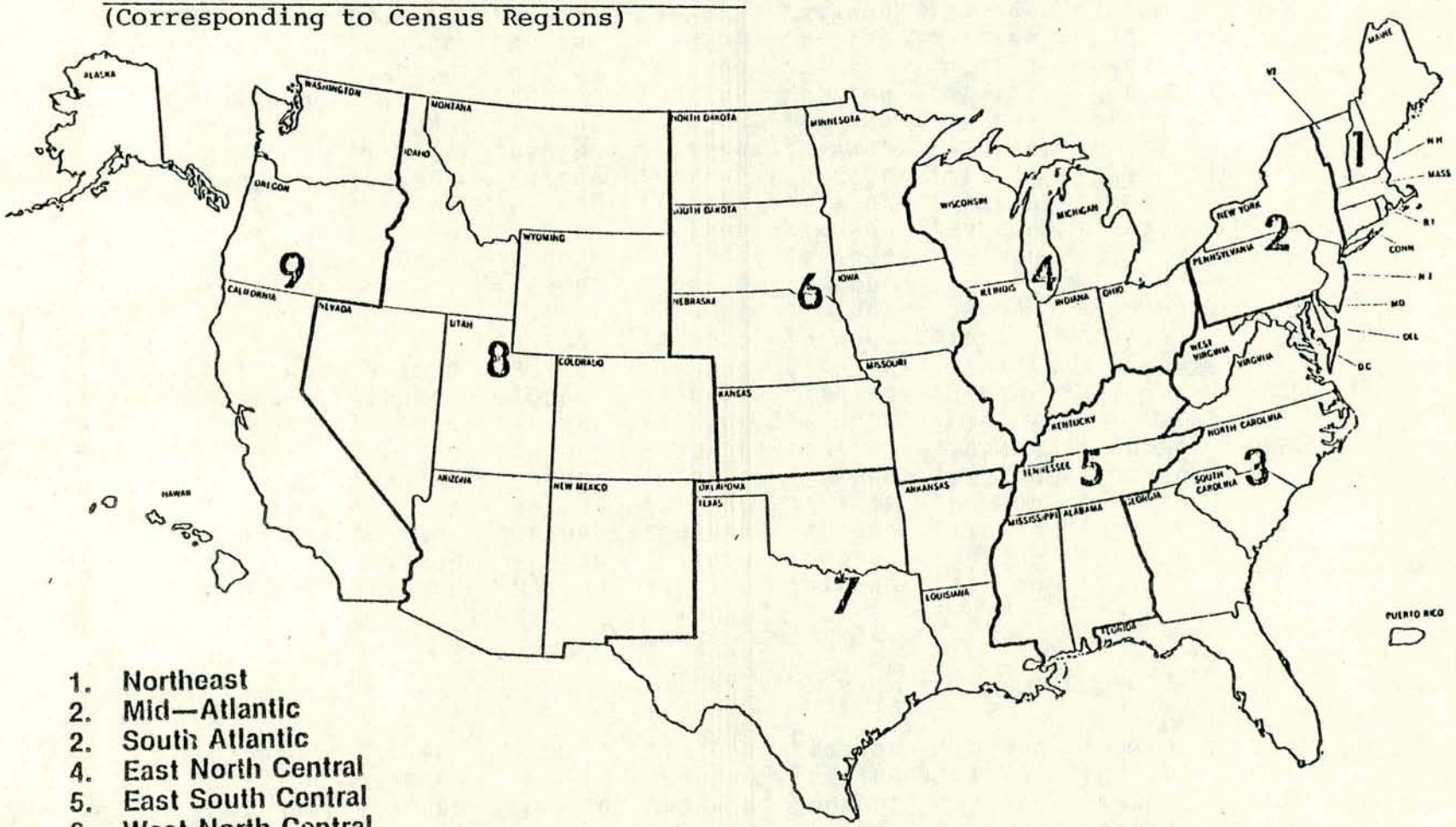


FIGURE II-3

PIES ELECTRIC UTILITY AND DEMAND REGIONS
(Corresponding to Census Regions)



1. Northeast
2. Mid—Atlantic
2. South Atlantic
4. East North Central
5. East South Central
6. West North Central
7. West South Central
8. Mountain
9. Pacific

TABLE II-1 - INTER-REGIONAL CRUDE OIL PIPELINE TRANSPORTATION COSTS

TABLE TROPLPRC

	R1	R6	R2	R7	R3	R4	R5	RN
D2	1.11980	1.09080	.992600	.856800	.652000	.596300	.012100	
D3	1.11980	1.09080	.992600	.856800	.652000	.596300	.012100	
D4	.853200	.795000	.372000	.305400	.305400	.353900	.266600	
D5	.853200	.795000	.430200	.254500	.515100	.012100	.596300	
D6	.426600	.426600	.233900	.183000	.183000	.333300	.469000	
D7	.409600	.470200	.287200	.221700	.012100	.515100	.797400	
D8	.374500	.239900	.250800	.328400	.063000	.621700	.879900	
D9	.306600	.256900	.169600	.044800	.181800	.190200	.813200	
DA	.172100	.172100	.060600	.111500	.279900	.406000	1.00110	
DB	.368400	.162400	.306600	.375700	.252000	.670200	1.01080	
DC	.146600	.167200	.244800	.313900	.327200	.608400	1.08590	.200000
R1	0.00000	.185400	.250800	.250800	.410800			
R2	.250800	.163600	0.00000	.060600	.272700	.430200		
R3	.410800	.227800	.272700	.163600	0.00000	.574400	.797400	
R4			.430200	.596300	.574400	0.00000	.596300	
R5					.797400	.596300	0.00000	
R6	.185400	0.00000	.163600	.168400	.227800			
R7	.250800	.168400	.060600		.163600	.596300		
C1	.172100	.172100	.060600	.111500	.279900	.406000	1.00110	
C2	.172100	.172100	.060600	.111500	.279900	.406000	1.00110	
C3	.409600	.470200	.287200	.221700	.012100	.515100	.797400	
C4	.172100	.172100	.060600	.111500	.279900	.406000	1.00110	
C5	.306600	.256900	.169600	.044800	.181800	.190200	.813200	
C6	.409600	.470200	.287200	.221700	.012100	.515100	.797400	
C7	.853200	.795000	.430200	.254500	.515100	.012100	.596300	
C8	.853200	.795000	.430200	.254500	.515100	.012100	.596300	
C9	.853200	.795000	.372000	.305400	.305400	.353900	.266600	
CA	.853200	.795000	.372000	.305400	.305400	.353900	.266600	
CB	1.11980	1.09080	.992600	.856800	.652000	.596300	.012100	
CC	1.42280	1.45440	1.29560	1.15980	1.01560	.899300	.333300	
S1	.853200	.795000	.372000	.305400	.305400	.353900	.266600	
DN	.200000							0.00000
DO							1.31000	

TABLE II- 2 - INTER-REGIONAL CRUDE OIL BARGE/TANKER TRANSPORTATION COSTS

TABLE TROBLPRC

	R1	R2	R3	R5	R6	R7	R4	RN
D1	2.43000	2.30000	1.96000	1.31000	2.40000	2.16000	1.91000	2.47000
D2	1.76950	1.89070	1.54530	.012100	1.70890	2.07250		1.80950
D3	1.76950	1.89070	1.54530	.012100	1.70890	2.07250		1.80950
D4								
D5								
D6	.727200	.727200			.666600	.909000		.767200
D7	.545400	.545400	.012100	1.39380	.484800	.727200		.524800
D8	.484800	.484800	.072700	1.39380	.424200	.666600		
D9								
DA			.606000		.727200			
DB	.424200	.666600	.181800	1.39380	.363600	.848400		.464200
DC	.060600	1.03020	.606000	1.70890	.012100	1.21200		.100600
DD	4.48000	4.35000	4.01000	3.36000	4.45000	4.21000	3.96000	
F1	.580000	.490000	.800000	.420000	.580000	.490000	.650000	
F2	.310000	.560000	.370000	1.26000	.310000	.560000	.940000	
F3	.380000	.630000	.400000	1.25000	.380000	.630000	.970000	
F4	1.03000	1.20000	.930000	.560000	1.03000	1.20000	1.50000	
F5	.680000	.930000	.900000	2.13000	.680000	.930000	1.36000	
F6	.590000	.840000	.810000	2.00000	.590000	.840000	1.27000	
F7	.830000	1.05000	.980000	2.16000	.830000	1.05000	1.51000	
F8	1.76000	2.01000	1.86000	1.70000	1.76000	2.01000	2.30000	
F9	1.26000		1.26000	1.11000	1.26000			
FA	.680000	.930000	.900000	1.11000	.680000	.930000	1.36000	
FB	1.75000	2.00000	1.85000	1.69000	1.75000	2.00000	2.29000	
FC	1.74000	1.99000	1.84000	1.68000	1.74000	1.99000	2.28000	
FD	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.500000	0.00000
C1			.606000		.727200			
C2			.606000		.727200			
C3								
C4	.545400	.545400	.012100	1.39380	.484800	.727200		
C5								
C6								
C7	1.76950	1.89070	1.54530	.012100	1.70890	2.07250		

Links where both pipeline and barge transportation are possible will have costs for both transportation modes. Because no capacity constraints are used, the model however will choose to send all the crude via the cheaper of the two modes. In general this will be the pipeline mode with the exception of crude from Alaska to refinery regions other than California (refinery region 5). In order to convert crude oil costs to an inter-census region basis it is necessary to allocate oil production in the PIES model to Census Regions and also to allocate refinery capacity from PADDs to Census Regions.

ALLOCATION OF OIL PRODUCTION TO CENSUS REGION

In the reference case, the PIES model permits the production of 20 different types of crude oil in the U.S. Each crude is characterized by having a different assay which is used to define the crude oil attributes needed by the PIES refinery model. The supply curves (i.e. the quantity versus price relationships) for each of these crude types are contained in the Oil Standard Tables. In general, each crude type is produced in only one or two oil regions; for example oil type AS (Alaskan South Brooks Range) is produced in PIES oil regions 1 and 4. In this case, the oil produced in region 4 is not true Alaskan crude but is crude with an assay similar to that of Alaskan crude. PIES domestic crude oils are listed in Table II-3.

Table II-4 shows the regions in which each of the crude types is produced. The allocation of production to specific States has been done using maps of the Nation's oil fields (Ref. II-1). The allocation of specific oil fields to states is largely unambiguous. The right-most column in Table II-4 shows the refinery regions that

TABLE II-3 DOMESTIC CRUDE OIL TYPES

Code	Description		Constituent Crudes For Which Attributes Exist		
AS	Alaskan S. Brooks Range		AS		
WC	West Coast Blend		WC		
WO	Pacific Offshore		WO		
WM	Wyoming Mix	Oil Region 4	WM-80%	AS-3%	WT-17%
		Oil Region 5	WM-86%	H3-14%	
WT	West Texas Mix		WT		
LC	Louisiana Onshore		LC-48% WT-2%	GT-40%	TE-1%
LO	Louisiana Offshore		LO		
OK	Oklahoma Mix		OK-93%	H3-7%	
I2	Indigenous I2		I2-91%	I1-9%	
I1	Indigenous I1		I1		
AN	Alaskan North Slope Proven		AN		
AP	Alaskan Prudhoe Bay		AN		
AB	Alaskan Beaufort Sea		AN		
N1	Naval Petrol Reserve 1		WC		
H5	Heavy Crude, PADD 5		H5		
H3	Heavy Crude, PADD 3		H3		
H2	Heavy Crude, PADD 2		H2		
TS	Tar Sands Synthetic Crude		OL		
GT	Texas Gulf		Treated as Constituents of Other Crudes		
TE	East Texas Mix		Treated as Constituents of Other Crudes		
SO	Shale Oil		SO		
L1	Synthoil		OL		

TABLE II-4 ALLOCATION OF PIES CRUDE OIL PRODUCTION TO CENSUS REGIONS

Oil Type Code	Produced in PIES Region	Corresponding NPC Region	State	Census Region	Permitted to travel to Refinery Region
AS	O1	1	AK	9	4,5
WC	O2	2	CA	9	4,5
WO	O3	2A	CA	9	4,5
AN	OD	1	AK	9	1,2,3,4,5,6,7
AP	OD	1	AK	9	1,2,3,4,5,6,7
AB	OD	1	AK	9	1,2,3,4,5,6,7
N1	O2	2	CA	9	4,5
H5	O2	2	CA	9	5
SO	S1			8	2,4,7
WM	O4	3	WY	8	2,4,7
WM	O5	4	WY	8	2,4,7
H3	O5	4	WY	8	3
TS	O4	3	WY	8	1,2,4,5,6
AS	O4	3	WY	8	4,5
WT	O6	5	TX	7	1,2,3,4,6,7
LC	O7	6	LO	7	1,2,3,4,6,7
GT	O7	6	TX	7	1,2,3,4,6,7
TE	O7	6	TX	7	1,2,3,4,6,7
LO	O8	6A	LO	7	1,2,3,4,6,7
OK	O9	7	OK	7	1,2,3,4,6,7
H2	O7	6	LO	7	2,7
H2	O9	7	OK	7	2,7
I1	OB	11	NJ	3	1,2,3,6,7
I1	OC	11A	NJ	3	1,2,3,6,7
I1	OA	8,9,10	PA	2	1,2,3,6,7
I2	OA	8,9,10	PA	2	1,2,3,4,6,7

the crude is permitted to flow to. This column merely shows the links that are considered feasible. As we shall see later, the Model uses only a fraction of all the links that are available to it. Using Table II-4 it is possible to allocate all PIES oil production to Census Regions.

In addition to normal crude production, PIES permits the production of oil from tar sands (TS), oil from shale oil (SO) and synthetic oil from coal (OL). In the PIES 1985 $13 reference case synthetic oil is too expensive to be brought into production ($17/bbl) and need be given no further consideration. Oil from tar sands is treated like any other crude within the model but produces the pooled crude (OL) within the model. With a production cost of $15/barrel it too is too expensive to come into production in the $13 reference case and in any case is not permitted to be considered for production by 1985 except in the accelerated scenario.

At $12/bbl,oil from shale oil does come into production. It is produced in a single separate shale region (S1) which we have located in the Rocky Mountains (Census Region 8).

TRANSPORTATION BETWEEN CENSUS REGIONS AND REFINERY REGIONS

In order to determine the way in which the Model chooses the links by which crude is actually transported, it is necessary to look at the PIES Report (known familiarly as Wonderbread). Pages 79 through 83 of the Report detail the oil flows between Oil and Refinery Regions. These pages are included as Appendix A to this chapter.

The flows described on these pages are summarized in Table II-5 which shows the origin of oil on the basis of Census Region

TABLE II-5 OIL FLOWS FROM CENSUS REGIONS TO REFINERY REGIONS

	Oil Type	Refinery Region 1 Volume	Refinery Region 1 Cost	Refinery Region 1 Product	Refinery Region 2 Volume	Refinery Region 2 Cost	Refinery Region 2 Product	Refinery Region 6 Volume	Refinery Region 6 Cost	Refinery Region 6 Product
Census Region 2	I1				27.1	.0606				
	I2				274.5	.0606				
	Totals or Means				301.6	.0606				
Census Region 3	I1	138.4	.1466					120.5	.1624	
	Totals or Means	138.4	.1466					120.5	.1624	19.57

TABLE II-5 OIL FLOWS FROM CENSUS REGION TO REFINERY REGION

Oil Type	Refinery Region 3 Volume	Refinery Region 3 Cost	Refinery Region 3 Product	Refinery Region 7 Volume	Refinery Region 7 Cost	Refinery Region 7 Product
WT(04)	23.2	.3054	7.0853			
WT(06)	1587.4	.1830	290.4942			
WT(07)	56.8	.0121	.6873			
WT(09)				33.2	.0448	
TE	284.2	.0121	3.4388			
LC	1364.1	.0121	16.5056			
GT	1136.8	.0121	13.7553			
LO	1418.7	.0630	89.3781			
OK				440.9	.0448	
H2	78.0	.2872	22.4016	9.0	.0448	
Totals or Means	5949.2	.075	443.7462	483.1	.0448	

Census Region 7

TABLE II-5 : OIL FLOWS FROM CENSUS REGION TO REFINERY REGION

	Oil Type	Refinery Region 2			Refinery Region 3			Refinery Region 4			Refinery Region 7		
		Volume	Cost	Product	Volume	Cost	Product	Volume	Cost	Product	Volume	Cost	Product
Census Region 8	AS							4.1	.3539				
	SO	300	.372										
	WM(04)	59.6	.372								49.3	.3054	
	WM(05)										470.2.	.2545	
	H5				82.5	.5151							
	Totals or Means	359.6	.372		82.5	.5151		4.1	.3539		519.5	.2593	134.72

TABLE II-5 OIL FLOWS FROM CENSUS REGION TO REFINERY REGION

	Oil Type	Refinery Region 3 Volume	Refinery Region 3 Cost	Refinery Region 3 Product	Refinery Region 4 Volume	Refinery Region 4 Cost	Refinery Region 4 Product	Refinery Region 5 Volume	Refinery Region 5 Cost	Refinery Region 5 Product
Census Region 9	AS							328.4	1.31	
	WC							1176.5	.0121	
	WO				603.9	.5963		37.1	.0121	
	AN	48.0	4.01					2000	1.31	
	H5							129	.0121	
Totals or Means		48.0	4.01		603.9	.5963		NOT APPLICABLE		

and the destination of the oil in terms of Refinery Region.

ALLOCATION OF REFINERY CAPACITY TO CENSUS REGION

This has been done on the basis of refinery capacity in use on January 1st, 1976, using data in Reference II-1 which describes each refinery in terms of location, ownership, capacity, etc. The geographical data is detailed in Table II-6 and summarized in Table II-7.

These same data correspond to similar data published by the FEA and the Bureau of Mines. (Reference II-2)

Tables II-5 and II-7 may now be used to determine the costs of transporting crude from one Census Region to another.

The procedure is to determine from Table II-5 to which Refinery Regions crude is transported from each Census Region. The correspondence between Refinery Regions and Census Regions is given by Table II-7. Tables II-8 and II-9 show the costs per barrel and flows between Census Regions. The costs are the costs from Table II-5. except when crude from a census region travels to two (or more) refinery regions, both of which have areas which fall into one Census Region. In those instances we have computed the weighted averages of the costs of the crude oil flowing into the region.

For example, oil produced in Census Region 7 flows to PIES Refinery Regions 3 and 7. 92% of Refinery Regions 3's capacity is in Census Region 7 and 41.3% of Refinery Region 7's capacity.

Thus 5473 (= 0.92 x 5949.2) thousand barrels/day of oil is transported to the region at a cost of 7.5¢/barrel and a further 199.5(= 0.413 x 483.1) thousand barrels/day at a cost of .448¢/barrel. The weighted average cost is 7.39¢/barrel ($= \frac{5473 \times 7.5 + 199.5 \times 4.48}{5672.5}$)

TABLE II-6 ALLOCATION OF REFINERY CAPACITY TO CENSUS REGIONS

Census Region 1	Refinery Capacity bbls/CD	PADD	
Maine	-	1A	0% of PADD 1A Capacity (PIES Refinery Region 1)
New Hamshire	-	1A	
Vermont	-	1A	
Massachusetts	-	1A	
Rhode Island	-	1A	
Connecticut	-	1A	
Census Region 2			
New York	111,385	1A	100% of PADD 1A Capacity (PIES Refinery Region 1)
New Jersey	539,000	1A	
Pennsylvania	757,020	1A	
Census Region 3			
W. Virginia	19,450	1B	100% of PADD 1B Capacity (PIES Refinery Region 6)
Maryland	28,500	1B	
Delaware	140,000	1B	
Virginia	53,000	1B	
Wash., D.C.	-		
N. Carolina	-		
S. Carolina	-		
Georgia	18,000	1B	
Florida	5,700	1B	

Census Region 4	Refinery Capacity	PADD	
Wisconsin	45,400	2B	3% of PADD 2B Capacity (PIES Refinery Region 7
Illinois	1,176,050	2A	89% of PADD 2A Capacity (PIES Refinery Region 2)
Indiana	561,160	2A	
Michigan	147,200	2A	
Ohio	589,770	2A	
Census Region 5			
Kentucky	164,000	2A	8% of PADD 2A Capacity (PIES Refinery Region 2)
Tennessee	48,500	2A	
Mississippi	329,500	3	6% of PADD 3 Capacity (PIES Refinery Region 3)
Alabama	49,875	3	
Census Region 6			
N. Dakota	58,658	2B	55% of PADD 2B Capacity (PIES Refinery Region 7)
S. Dakota	-		
Nebraska	5,000	2B	
Kansas	451,180	2B	
Minnesota	216,800	2B	
Iowa	-		
Missouri	107,000	2A	4% of PADD 2A Capacity (PIES Refinery Region 2)
Census Region 7			
Oklahoma	545,775	2B	41% of PADD 2B Capacity (PIES Refinery Region 7)
Texas	3,966,330	3	87% of PADD 3 Capacity (PIES Refinery Region 3)
Arkansas	60,786	3	
Louisiana	1,753,095	3	

ensus Region 8	Refinery Capacity	PADD	
Idaho	-		
Nevada	-		
Utah	152,000	4	100% of PADD 4 Capacity (PIES Refinery Region 4) <1% of PADD 5 Capacity (PIES Refinery Region 5) 2% of PADD 3 Capacity (PIES Refinery Region 3)
Arizona	4,000	5	
Montana	156,181	4	
Wyoming	187,340	4	
Colorado	62,125	4	
New Mexico	104,230	3	
Census Region 9			
Washington	366,900	5	>99% of PADD 5 Capacity (PIES Refinery Region 5)
Oregon	14,000	5	
California	1,903,935	5	
Alaska	74,250	(5)	
Hawaii	101,750	(5)	

TABLE II-7 PERCENTAGE OF PIES REFINERY CAPACITY ATTRIBUTABLE TO CENSUS REGIONS

Census Region \ PIES Refinery Region	1	2	3	4	5	6	7
1							
2	100						
3						100	
4		89.5					3.4
5		7.5	6				
6		4					55.3
7			92				41.3
8			2	100			
9					100		

TABLE II-8 COSTS OF OIL TRANSPORTATION BETWEEN CENSUS REGION (In $/barrel)

From Census Region	To Census Regions 1	2	3	4	5	6	7	8	9
1									
2				.0606	.0606	.0606			
3		.1466	.1624						
4									
5									
6									
7				.0448	.075	.0448	.0739	.075	
8				.366	.3942	.2647	.3261	.4002	
9					4.01		4.01	.6017	.01 or 1.31

TABLE II-9 CRUDE OIL FLOWS BETWEEN CENSUS REGIONS

(in thousand of barrels/day)

From Census Region	To Census Region 1	2	3	4	5	6	7	8	9
1									
2				266.92	22.62	12.06			
3		138.4	120.5						
4									
5									
6									
7				16.43	356.95	267.15	5672.78	118.98	
8				335.91	31.92	301.67	290.45	5.75	
9								603.9	1,34(
Alaska					2.88		44.16	0.96	2,30(

The high costs of transportation from Census Region 9 reflect the costs of transportation from Alaska.

Within Census Region 9 itself, Californian oil is transported at a cost of $0.0121/barrel and Alaskan Oil is transported to California at a cost of $1.31/barrel. PIES reference case has 2.3 million barrels/day moving from Alaska to Californian Refineries and 1.34 million barrels/day of West Coast oil moving to refineries also in California.

References

II-1. The International Petroleum Encyclopedia - Vol. 9. 1976., p. 142 et seq.

II-2. "Trends in Refinery Capacity and Utilization" E. Peers and V. Marsick, Federal Energy Administration, Washington, D.C., June 1976.

Appendix II-A

Pages 79 through 83 of the PIES $13 Reference Case Report for 1985

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 85BAU6A
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
.3448		09 0 7	MIDCONTINENT		M7 R	PA028	9.3
						TOTAL	87.3
M3 HEAVY CRUDE,PA003(MB/CD)							
.5151		05 0 6	EASTERN ROCKY MOUNTAINS	PIPELINE OR LOCAL	R3 R	PA03	92.5
						TOTAL	92.5
M4 HEAVY CRUDE,PA004(MB/CD)							
				PIPELINE OR LOCAL			
M5 HEAVY CRUDE,PA005(MB/CD)							
.0121		02 0 2	PACIFIC COAST STATES	PIPELINE OR LOCAL	R5 R	PA05	129.0
						TOTAL	129.0
TS TAR SANDS SYNTHETIC CRUDE(MB/CD)							
				PIPELINE OR LOCAL			
LO LOUISIANA OFFSHORE(MB/CD)							
.3630		08 0 6A	GULF OF MEXICO	PIPELINE OR LOCAL	M3 R	PA03	1318.7
						TOTAL	1413.7
TE EAST TEXAS MIX(MB/CD)							
.0121		07 0 6	WESTERN GULF BASIN	PIPELINE OR LOCAL	R3 R	PA03	284.2
						TOTAL	284.2
MT WEST TEXAS MIX(MB/CD)							
				PIPELINE OR LOCAL			

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 85BAU6A
DEMAND SCENARIO..... D851215
DATE & REVISION..... DEC15-1
IMPORTS..... 813

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
.3956		04 0 3	WESTERN ROCKY MOUNTAINS		R3 R	PA03	23.2
.1830		06 0 5	N.TEXAS & E. NEW MEXICO		R3 R	PA03	1587.4
.0121		07 0 6	WESTERN GULF BASIN		R3 R	PA03	56.3
.3448		09 0 7	MIDCONTINENT		M7 R	PA028	33.2
						TOTAL	1700.0
OK OKLAHOMA MIX(MB/CD)							
.3448		09 0 7	MIDCONTINENT	PIPELINE OR LOCAL	M7 R	PA028	440.9
						TOTAL	440.9
AS ALASKAN SO. BROOKS RANGE(MB/CD)							
1.3100		01 0 1	ALASKA(EX NORTH SLOPE)	BARGE/SHIP OR LOCAL	R5 R	PA05	328.4
						TOTAL	328.4
.3539		04 0 3	WESTERN ROCKY MOUNTAINS	PIPELINE OR LOCAL	R6 R	PA06	4.1
						TOTAL	4.1
MO PACIFIC OFFSHORE(MB/CD)							
.5963		03 0 2A	PACIFIC OCEAN (EX ALASKA)	PIPELINE OR LOCAL	R6 R	PA06	603.9
.0121		03 0 2A	PACIFIC OCEAN (EX ALASKA)		R5 R	PA05	37.1
						TOTAL	641.0
AN ALASKAN NORTH SLOPE PROVEN(MB/CD)							
6.0100		00 0	NORTH SLOPE (ON & OFF)	BARGE/SHIP OR LOCAL	R3 R	PA03	48.0
						TOTAL	48.0

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 858AU6A
DEMAND SCENARIO..... 0851215
DATE & REVISION..... DEC15-1
IMPORTS..... 513

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
				PIPELINE OR LOCAL			
1.3130		00 0	NORTH SLOPE (ON _ OFF)		R5 R	PA05	2000.0
						TOTAL	2000.0
GT TEXAS GULF(MB/CD)							
				PIPELINE OR LOCAL			
.3121		07 0	6 WESTERN GULF BASIN		R3 R	PA03	1136.3
						TOTAL	1136.3
AP ALASKAN PRUDHOE BAY(MB/CD)							
				BARGE/SHIP OR LOCAL			
				PIPELINE OR LOCAL			
II INDIGENOUS I1(MB/CD)							
				PIPELINE OR LOCAL			
.0606		0A 0	8-4-10 MICH.BAS.E.INT_ APP.		R2 R	PA02A	27.1
.1624		0B 0	11 ATLANTIC COAST		R6 R	PA01B	120.5
.1466		0C 0	11A ATLANTIC OCEAN		R1 R	PA01A	138.4
						TOTAL	286.0
I2 INDIGENOUS I2(MB/CD)							
				PIPELINE OR LOCAL			
.3606		0A 0	8-4-10 MICH.BAS.E.INT_ APP.		R2 R	PA02A	274.5
						TOTAL	274.5
OL OIL.AGGREGATE FOREIGN (MB/CD)							
				BARGE/SHIP OR LOCAL			
		FO F	OTHER FOREIGN LOCATIONS		R1 R	PA01A	867.6
		FO F	OTHER FOREIGN LOCATIONS		R2 R	PA02A	3271.2
		FO F	OTHER FOREIGN LOCATIONS		R3 R	PA03	198.5
		FO F	OTHER FOREIGN LOCATIONS		R6 R	PA01B	329.5

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 858AU6A
DEMAND SCENARIO..... 0851215
DATE & REVISION..... DEC15-1
IMPORTS..... 513

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
						TOTAL	4000.8
				PIPELINE OR LOCAL			
WM WYOMING MIX(MB/CD)							
				PIPELINE OR LOCAL			
.3720		04 0	3 WESTERN ROCKY MOUNTAINS		R2 R	PA02A	59.6
.3054		04 0	3 WESTERN ROCKY MOUNTAINS		R7 R	PA02B	49.3
.2585		05 0	4 EASTERN ROCKY MOUNTAINS		R7 R	PA02B	470.2
						TOTAL	579.1
LC LOUISIANA ONSHORE(MB/CD)							
				PIPELINE OR LOCAL			
.0121		07 0	6 WESTERN GULF BASIN		R3 R	PA03	1384.1
						TOTAL	1384.1

III NATURAL GAS TRANSPORTATION COST

INTRODUCTION

Within PIES, natural gas is modeled as being produced primarily from gas wells but also is produced in association with crude oil. Primary production of natural gas occurs in one of 15 gas regions. These gas regions correspond to the 14 NPC oil and gas regions except that Alaska is divided into two regions; North and South. Production of associated natural gas occurs in the oil regions in which the crude production takes place. Some production of synthetic natural gas also takes place in PIES coal regions.

Natural gas is also imported from Canada and from Algeria as LNG (liquefied natural gas). Consumption of natural gas takes place both in utility and demand regions both of which coincide with Census Regions. In addition, natural gas is used as a refinery feedstock and consequently provision must be made in the model for transporting natural gas to refinery regions.

In all cases, natural gas is assumed to be transported by pipeline from the point of production to the point of consumption. No constraints are placed on volumes that may move between regions.

Natural gas transportation costs are contained in the PIES Standard Table TRNPLPRC (Table III-1) which gives costs between gas, import and coal regions to utility, demand and refinery regions.

The PIES Model structure provides links so that associated natural gas produced in oil regions is transported from the oil regions to the coincident gas regions. There are no costs associated with these links.

TABLE III-1 PIES STANDARD TABLE TRNPLPRC

TABLE TRNPLPRC

	D1	D2	D4	D6	D3	D5	D7	D8	D9	U1	U2
G2	1.66740	1.63950	1.43710	1.33650	1.51830	1.47860	1.37990	1.18600	.921100	1.66740	1.63950
G1	1.89290	1.86500	1.66260	1.56200	1.74380	1.70400	1.60540	1.41140	1.14650	1.89290	1.86500
G3	.727200	.688100	.493500	.385100	.545400	.506300	.389500	.229300	.099600	.727200	.688100
G4	.727200	.688100	.493500	.385100	.545400	.506300	.389500	.229300	.099600	.727200	.688100
G5	.698100	.649300	.400200	.092100	.470800	.427500	.308400	.092100	.281400	.698100	.649300
G6	.606000	.562600	.313900	.194800	.429600	.389600	.335400	.037800	.340800	.606000	.562600
G7	.515100	.467500	.294200	.181800	.285700	.251100	.116800	.161900	.346300	.515100	.467500
G8	.428500	.378300	.251100	.173000	.177400	.138400	.021500	.255400	.476000	.428500	.378300
G9	.398200	.346300	.268300	.216400	.142700	.112400	.112400	.324500	.562600	.398200	.346300
GA	.402600	.359200	.168700	.056900	.219100	.186100	.160200	.121200	.385100	.402600	.359200
GB	.259600	.212100	.056200	.103900	.116800	.108100	.216400	.259600	.523800	.259600	.212100
GC	.147100	.099600	.108100	.207700	.138400	.160200	.311700	.363600	.627500	.147100	.099600
GD	.333300	.281400	.285700	.289900	.121200	.138400	.251100	.441400	.692500	.333300	.281400
GE	.129900	.077800	.194800	.277000	.142700	.177400	.337600	.437200	.701000	.129900	.077800
FU	0.00000	0.00000			0.00000	0.00000	0.00000		0.00000	0.00000	0.00000
F1			0.00000	0.00000				0.00000	0.00000		
C1	.147100	.099600	.108100	.207700	.138400	.160200	.311700	.363600	.627500	.147100	.099600
C2	.147100	.099600	.108100	.207700	.138400	.160200	.311700	.363600	.627500	.147100	.099600
C3	.428500	.378300	.251100	.173000	.177400	.138400	.021500	.255400	.476000	.428500	.378300
C4	.259600	.212100	.056200	.103900	.116800	.108100	.216400	.259600	.523800	.259600	.212100
C5	.402600	.359200	.168700	.056900	.219100	.186100	.160200	.121200	.385100	.402600	.359200
C6	.428500	.378300	.251100	.173000	.177400	.138400	.021500	.255400	.476000	.428500	.378300
C7	.606000	.562600	.313900	.194800	.429600	.389600	.335400	.037800	.340800	.606000	.562600
C8	.606000	.562600	.313900	.194800	.429600	.389600	.335400	.037800	.340800	.606000	.562600
C9	.698100	.649300	.400200	.092100	.470800	.427500	.308400	.092100	.281400	.698100	.649300
CA	.698100	.649300	.400200	.092100	.470800	.427500	.308400	.092100	.281400	.698100	.649300
CB	.727200	.688100	.493500	.385100	.545400	.506300	.389500	.229300	.099600	.727200	.688100
CC	1.66740	1.63950	1.43710	1.33650	1.51830	1.47860	1.37990	1.18600	.921100	1.66740	1.63950
GN	0.00000	.050000									
0.0											.050000
D1											
D2											
D3											

TABLE TRNPLPRC-CONTINUED

	U4	U6	U3	U5	U7	U8	U9	R1	R2	R3	R4
G2	1.43710	1.33650	1.51830	1.47860	1.37990	1.18600	.921100				
G1	1.66260	1.56200	1.74380	1.70400	1.60540	1.41140	1.14650				
G3	.493500	.385100	.545400	.506300	.389500	.229300	.099600				
G4	.493500	.385100	.545400	.506300	.389500	.229300	.099600				
G5	.400200	.092100	.470800	.427500	.308400	.092100	.281400				
G6	.313900	.194800	.429600	.389600	.335400	.037800	.340800				0.00000
G7	.294200	.181800	.285700	.251100	.116800	.161900	.346300				
G8	.251100	.173000	.177400	.138400	.021500	.255400	.476000			0.00000	
G9	.268300	.216400	.142700	.112400	.112400	.324500	.562600			0.00000	
GA	.168700	.056900	.219100	.186100	.160200	.121200	.385100				0.00000
GB	.056200	.103900	.116800	.108100	.216400	.259600	.523800				
GC	.108100	.207700	.138400	.160200	.311700	.363600	.627500	0.00000	0.00000		
GD	.285700	.289900	.121200	.138400	.251100	.441400	.692500				
GE	.194800	.277000	.142700	.177400	.337600	.437200	.701000	0.00000			
FD			0.00000	0.00000	0.00000		0.00000				
F1	0.00000	0.00000				0.00000	0.00000				
C1	.108100	.207700	.138400	.160200	.311700	.363600	.627500				
C2	.108100	.207700	.138400	.160200	.311700	.363600	.627500				
C3	.251100	.173000	.177400	.138400	.021500	.255400	.476000				
C4	.056200	.103900	.116800	.108100	.216400	.259600	.523800				
C5	.168700	.056900	.219100	.186100	.160200	.121200	.385100				
C6	.251100	.173000	.177400	.138400	.021500	.255400	.476000				
C7	.313900	.194800	.429600	.389600	.335400	.037800	.340800				
C8	.313900	.194800	.429600	.389600	.335400	.037800	.340800				
C9	.400200	.092100	.470800	.427500	.308400	.092100	.281400				
CA	.400200	.092100	.470800	.427500	.308400	.092100	.281400				
CB	.493500	.385100	.545400	.506300	.389500	.229300	.099600				
CC	1.43710	1.33650	1.51830	1.47860	1.37990	1.18600	.921100				
GN											
0.0											
D1											
D2											
D3											
D4											
D5											
D6											
D7											
D8											

TABLE TRNPLPRC-CONTINUED

	R5	R6	R7	RN	G2	G3	G4	G5	G6	G7	G8
G2											
G1											
G3	0.00000										
G4	0.00000										
G5											
G6											
G7											
G8											
G9											
GA											
GB			0.00000								
GC											
GD		0.00000									
GE											
FD											
F1											
C1											
C2											
C3											
C4											
C5											
C6											
C7											
C8											
C9											
CA											
CB											
CC											
G9				0.00000							
0.0											
D1					0.00000						
D2						0.00000					
D3							0.00000				
D4								0.00000			
D5									0.00000		
D6										0.00000	
D7											0.00000
D8											

TABLE: TRNPLPRC-CONTINUED

	G9	GA	GB	GC	GD	GE	G1	GN
G2								
G1								
G3								
G4								
G5								
G6								
G7								
G8								
G9								
GA								
GB								
GC								
GD								
GE								
F0								
F1								
C1								
C2								
C3								
C4								
C5								
C6								
C7								
C8								
C9								
CA								
CB								
CC								
GN								
0.0								
D1								
D2								
D3								
D4								
D5								
D6								
D7								
D8	0.00000							
D9		0.00000						
DA			0.00000	0.00000				
DB					0.00000			
DC						0.00000		
DD							0.00000	
DN								0.00000

The costs of transportation of imported natural gas are included in the purchase price. Imports are moved directly from PIES import regions to PIES utility or demand region.

Links are provided to transport natural gas from gas region to the co-located PIES refinery regions. No costs are associated with these links.

ALLOCATION OF GAS PRODUCTION TO CENSUS REGION

Table III-2 shows the correspondence of natural gas production in PIES gas regions to States and thus to Census Regions. The Nation's major gas producing fields do not in general coincide geographically with the oil producing fields although they are generally located in close proximity. As with oil production, we have allocated gas production to States on the basis of maps in the International Petroleum Encyclopedia Vol. 6. There were only two instances where gas fields appeared to overlap two Census Regions. These were in PIES gas region OA which includes Kansas, Texas and Oklahoma and PIES gas region OC which includes Pennsylvania and West Virginia. In region OA Kansas is in Census Region 6 whilst Texas and Oklahoma are in Census Region 7. In region OC Pennsylvania is in Census Region 2 and West Virginia in Census Region 3.

We allocated production in these regions to Census Region according to the 1974 relative production levels of non-associated natural gas in each of these states as given on p.25 of 1974 Gas Facts published by the AGA. These allocations are shown in Table III-2.

Table III-3 lists the crude oils types which have associated gas production in the PIES Model. Also listed are the oil and Census Region in which this production takes place.

TABLE III-2 RELATIONSHIP OF PIES GAS REGIONS TO CENSUS REGIONS

PIES Region	NPC Region	State	Proportion of Production By State	Census Region
2	1S	AK		9
3	2	CA		9
4	2A	CA		9
5	3	WY UT CO		8
6	4	WY MN		8
7	5	TX		7
8	6	LO		7
9	6A	LO		7
A	7	KS TX OK	8% 92%	6
B	8,9	OH		4
C	10	PA WV	29% 71%	2
D	11			2
E	11A			2

TABLE III-3 CRUDE OIL TYPES HAVING ASSOCIATED NATURAL GAS PRODUCTION

Oil Types	PIES Oil Region	Census Region
AS	O1	9(AK)
WC	O2	9(CA)
WO	O3	9(CA)
WM	O4	8
WT	O5	7
LC	O7	7
LO	O8	7
OK	O9	7
I2	OA	2
I1	OC	3
AN	OD	9(AK)
AP	OD	9(AK)
AB	OD	9(AK)

Production of synthetic natural gas takes place in PIES Coal Region 08 (The Western Northern Great Plains) and PIES coal region OA (The South-West) both regions being in Census Region 8.

TRANSPORTATION BETWEEN PRODUCTION REGIONS AND CONSUMPTION REGIONS

Although the model provides for a great number of possible transportation links, in practice only a few are used. In order to determine which links are actually used it is necessary to use the PIES Report. Pages 85 and 86 of the Report detail the flows between production and consumption regions.

The inter-census region transportation costs that we derive are given in Table III-4. Table III-5 shows the quantities of natural gas transported that are associated with these costs.

TABLE III-4 NATURAL GAS INTER-CENSUS REGION TRANSPORTATION COST
($/thousand standard cubic feet)

Census Region From	To 1	2	3	4	5	6	7	8	9
1									
2		0.0467*							
3		0.0996							
4				0.0562					
5									
6				0.1687		0.0569			
7		0.3463	0.1427	0.0469*	0.1124	0.1797*	0.0357*	0.1619	
8						0.0921		0.0378	
9									0.0996
Alaska									1.083*

*Denotes cost is a weighted average.

TABLE III-5 INTER-CENSUS REGION FLOWS OF NATURAL GAS
(in thousands of standard cubic feet/calendar day)

Census Region From	To 1	2	3	4	5	6	7	8	9
1									
2		1095.2							
3		928.7							
4				127.0					
5									
6				782.9		4.0			
7		4190.0	4842.9	11859.9	3351.4	2699.4	23503.6	755.0	
8						3914.0		2690.6	
9									1235.8
Alaska									3184.7

APPENDIX III-A

Pages 85 and 86 of the PIES $13 Reference Case Report for 1985

.1504-	G3 G	2	PACIFIC COAST STATES	
.1504-	G4 G	2A	PACIFIC OCEAN	
.1579-	G5 G	3	WESTERN ROCKY MOUNTAINS	
.1579-	G5 G	3	WESTERN ROCKY MOUNTAINS	
.2122-	G6 G	4	EASTERN ROCKY MOUNTAINS	
.2122-	G6 G	4	EASTERN ROCKY MOUNTAINS	
.0082-	G7 G	5	WEST TEXAS _ E. NEW MEXICO	
.1332-	G7 G	5	WEST TEXAS _ E. NEW MEXICO	
.0081-	G7 G	5	WEST TEXAS _ E. NEW MEXICO	
.2285-	G8 G	6	WESTERN GULF BASIN	
.2285-	G8 G	6	WESTERN GULF BASIN	
.1073-	G9 G	6A	GULF OF MEXICO	
.1376-	G9 G	6A	GULF OF MEXICO	
.0963	G9 G	6A	GULF OF MEXICO	
.1073-	G9 G	6A	GULF OF MEXICO	
.0183	G9 G	6A	GULF OF MEXICO	
.1376-	G9 G	6A	GULF OF MEXICO	
.1931-	G4 G	7	MIDCONTINENT	
.0813-	G4 G	7	MIDCONTINENT	
.1938-	G8 G	8-9	MICH. BASIN _ E.INTERIOR	
.1504-	GC G	10	APPALACHIANS	
.1504-	GC G	10	APPALACHIANS	
.6711	G2 G	18	SOUTH ALASKA	
.6711	G2 G	18	SOUTH ALASKA	
	01 0	1	ALASKA(EX NORTH SLOPE)	
	02 0	2	PACIFIC COAST STATES	
	03 0	2A	PACIFIC OCEAN (EX ALASKA)	
	04 0	3	WESTERN ROCKY MOUNTAINS	
	05 0	4	EASTERN ROCKY MOUNTAINS	
	06 0	5	W.TEXAS _ E. NEW MEXICO	
	U7 U	6	WESTERN GULF BASIN	
	08 0	6A	GULF OF MEXICO	
	09 0	7	MIDCONTINENT	

D9 D	PACIFIC		609.7
D9 D	PACIFIC		566.1
U6 U	WEST NORTH CENTRAL		11.9
D6 D	WEST NORTH CENTRAL		1677.3
U8 U	MOUNTAIN		603.9
D8 D	MOUNTAIN		1861.9
D6 D	WEST NORTH CENTRAL		2653.1
D7 D	WEST SOUTH CENTRAL		3507.9
D8 D	MOUNTAIN		755.0
U7 U	WEST SOUTH CENTRAL		5201.0
D7 D	WEST SOUTH CENTRAL		14794.7
U3 U	SOUTH ATLANTIC		336.2
U5 U	EAST SOUTH CENTRAL		297.6
D2 D	MID ATLANTIC		8190.0
D3 D	SOUTH ATLANTIC		4506.7
D6 D	EAST NORTH CENTRAL		2073.2
D5 D	EAST SOUTH CENTRAL		3059.5
U6 U	WEST NORTH CENTRAL		50.3
D6 D	EAST NORTH CENTRAL		9786.7
D6 D	EAST NORTH CENTRAL		127.0
U2 U	MID ATLANTIC		520.7
D2 D	MID ATLANTIC		408.0
U9 U	PACIFIC		26.5
D9 D	PACIFIC		870.6
G2 G	18	SOUTH ALASKA	102.0
G3 G	2	PACIFIC COAST STATES	475.1
G4 G	2A	PACIFIC OCEAN	428.2
G5 G	3	WESTERN ROCKY MOUNTAINS	121.1
G6 G	4	EASTERN ROCKY MOUNTAINS	453.1
G7 G	5	WEST TEXAS _ E. NEW MEXICO	1864.9
G8 G	6	WESTERN GULF BASIN	4349.8
G9 G	6A	GULF OF MEXICO	2159.1
G4 G	7	MIDCONTINENT	839.8

TABLE OF PRIMARY PRODUCTS THRU SYSTEM

1985 REFERENCE CASE

MODEL..... 658AU6A
DEMAND SCENARIO..... 0851215
DATE & REVISION..... DEC15-1
IMPORTS..... 313

MATERIAL CODE	MATERIAL NAME	LOCATION CODE	LOCATION NAME	TRANSPORT MODE	DESTINATION CODE	DESTINATION NAME	QUANTITY
		0A 0	8-9-10 MICH.BAS.E.INT_ APP.		GC G	10 APPALACHIANS	237.6
		0B 0	11 ATLANTIC COAST		GD G	11 ATLANTIC COAST	55.7
		0C 0	11A ATLANTIC OCEAN		GE G	11A ATLANTIC OCEAN	110.8
		0D 0	NORTH SLOPE (ON _ OFF)		G1 G	1N ALASKAN NORTH SLOPE	2287.6
.0378		CB C	WESTERN NORTHERN GREAT PLAINS		U8 U	MOUNTAIN	224.8
.0921		CA C	SOUTHWEST		U6 U	WEST NORTH CENTRAL	224.8
.0965		G1 G	1N ALASKAN NORTH SLOPE		D9 D	PACIFIC	2267.6
.0314		GD G	11 ATLANTIC COAST		D2 D	MID ATLANTIC	55.7
.1722-		GE G	11A ATLANTIC OCEAN		D2 D	MID ATLANTIC	110.8
						TOTAL	78809.6

APPENDIX A. COAL SUPPLY CURVES

The following introductory discussion of coal supply curves is taken from LMI's report on the PIES Model.[1] Coal supply curves as functions of price and quantity were developed as raw data input into the PIES Model. Excellent references are available which describe the development of these supply curves.[2,3]

Twelve coal supply regions are used, based upon combinations of Bureau of Mines' (BOM) mining districts. Figure A-1 shows the boundaries of the coal regions and identifies them by name. Coal is divided into three product classes-metallurgical, low-sulfur and high-sulfur for several heat values. The combined coal product classes of low-sulfur and high-sulfur coal are known as steam coal. Metallurgical coal is defined as premium quality coking coal with less than 1.3 percent sulfur, less than 0.8 percent ash, and more than 26 million BTU per ton. Since the level of demand for metallurgical coal is set outside of the PIES model and restricted to domestic coking and export markets, no single estimate of BTU content is required by the modelfor metallurgical coal. Low-sulfur coal is defined to meet the Environmental Protection Agency's new source performance standard of 0.6 pounds of sulfur per million BTU. The remaining

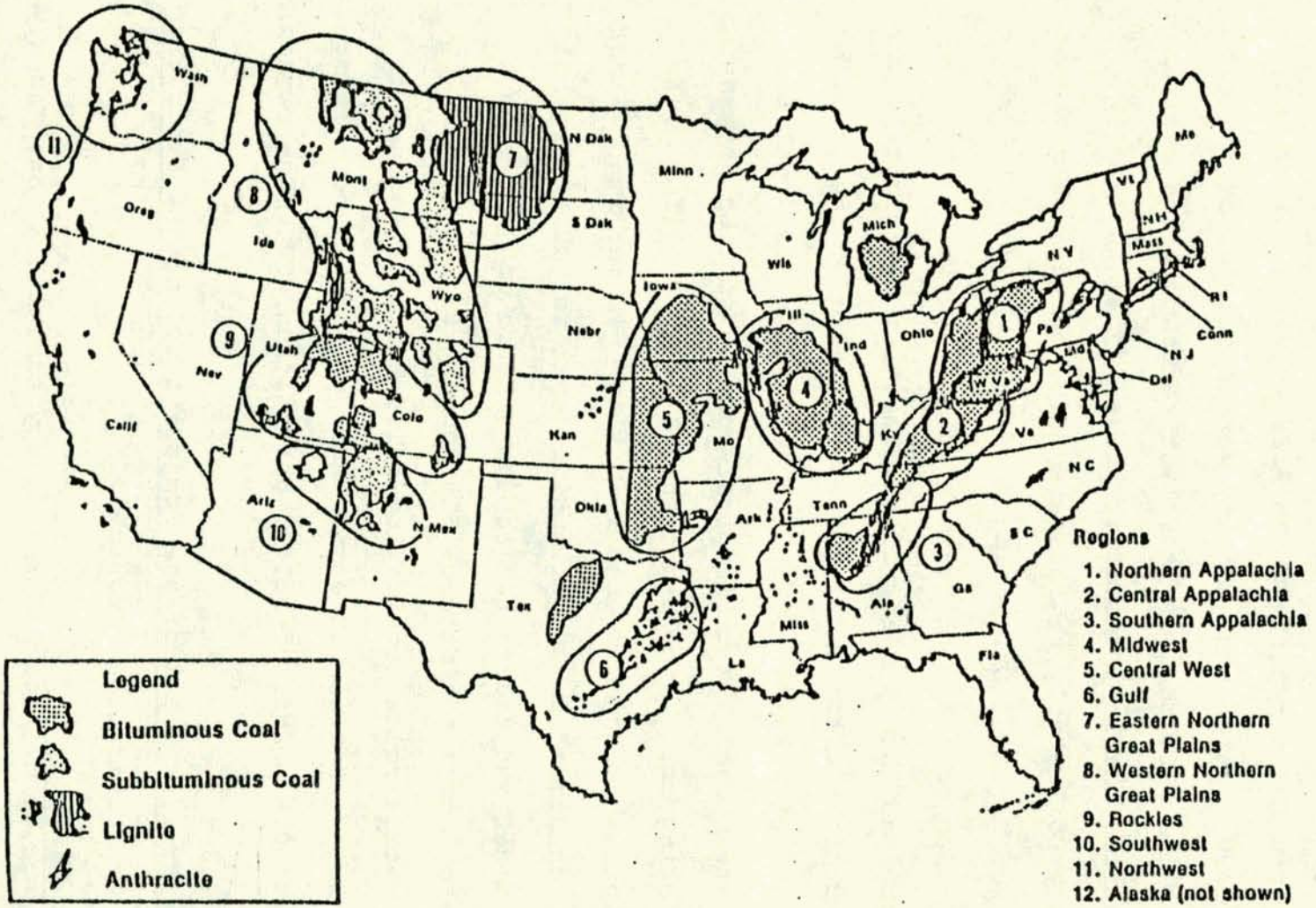
---

1 The Integrating Model of the Project Independence Evaluation System, by Logistics Management Institute, Washington, D.C., for Federal Energy Administration, August 1976.

2 PIES Coal Supply Curve Methodology, Final Report, by ICF Inc., Washington, D.C., for Federal Energy Administration, January 1976.

3 1976 National Energy Outlook, Appendix D "Coal, Oil and Gas Supply," Federal Energy Administration, Washington,D.C., 1976.

FIGURE A-1 PIES COAL SUPPLY REGIONS



Source:

U. S. Geological Survey Bulletin 1412
Coal Resources of the United States, January 1, 1974

coal is called high-sulfur. Table A-1 defines the regional break-out by BOM mining district and lists the region/product class/heat value combinations for which supply curves were developed.

Both high- and low-sulfur steam coal from each region is assigned to one of four BTU categories:

Category	10^6BTU/Ton
High	24
Medium	22
Low	19
Very Low	14

These four categories represent (1) eastern bituminous coals, (2) other bituminious coals, (3) sub-bituminous coals, and (4) lignites, respectively. The BTU heat value assignments for steam coal by region are as follows:

Region	10^6BTU/Ton
Northern Appalachia	24
Central Appalachia	24
Southern Appalachia	24
Midwest	22
Central West	22
Gulf	14
Eastern Northern Great Plains	14
Western Northern Great Plains	19
Rockies	22
Southwest	19
Northwest	19
Alaska	19

Each step of the coal supply curves represents the development of a different mine type. There are surface mines defined by mine size (annual production level) and overburden ratio, which is defined as cubic yards of overburden per ton of coal. There are also deep mines defined by mine size, seam thickness and seam depth. A total of 102 mine types were developed consisting of 36 surface mine types, which represent various combinations

TABLE A-1. COAL SUPPLY REGIONS AND PRODUCT CLASSES FOR PIES MODEL

	Region	BOM Mining Districts	Product Classes	Heat Value (10^6 Btu/Ton)
1.	Northern Appalachia	1-6	Metallurgical	26
			Low Sulfur	24
			High Sulfur	24
2.	Central Appalachia	7&8	Metallurgical	26
			Low Sulfur	24
			High Sulfur	24
3.	Southern Appalachia	13	Metallurgical	26
			Low Sulfur	24
			High Sulfur	24
4.	Midwest	9-11	Low Sulfur	22
			High Sulfur	22
5.	Central West	12,14&15 (except Texas)	Metallurgical	26
			High Sulfur	22
6.	Gulf	Texas	High Sulfur	14
7.	Eastern Northern Great Plains	21&22 (only lignite reserves)	Low Sulfur	14
			High Sulfur	14
8.	Western Northern Great Plains	16,19&22 (excluding lignite reserves)	Low Sulfur	19
			High Sulfur	19
9.	Rockies	17&20	Metallurgical	26
			Low Sulfur	22
10.	Southwest	18	Low Sulfur	19
			High Sulfur	19
11.	Northwest	23 (except Alaska)	High Sulfur	19
12.	Alaska	Alaska	Low Sulfur	19

Source: PIES Coal Supply Curve Methodology, ICF Inc.

of six mine sizes, five seam thicknesses, and four seam depths.

The price attached to each step is the minimum acceptable selling price (in constant dollars) for coal from that particular mine type. The minimum acceptable selling price is the price at which a coal company would recover all of its costs plus earn an eight percent return on its investment in the mine being costed. The minimum acceptable price for each mine type and the projected market clearing price are two different concepts. The minimum acceptable prices trace out a supply curve with some mines cheaper to develop than others. It is assumed that the mines will be developed in order of increasing cost. The market clearing price is the minimum acceptable price for only the last mine to be developed (i.e., the marginal mine). The production level associated with each step is the maximum annual production that the BOM-demonstrated reserve base could sustain from mines of that particular mine type in that region for 20 years. Table A-2 provides a summary of the estimated minimum acceptable selling price for each of the 102 mine types for which costs were estimated.

The following 24 exhibits present the long-term coal supply curves used in the PIES Model.[4] Although the figures present only the supply curves for 1985, the tables have estimates for 1980, 1985 and 1990. The prices shown in the exhibits are greater than the corresponding prices shown in Table A-2 since the prices shown in the exhibits reflect the following adjustments:

---

4 PIES Coal Supply Curve Methodology, op.cit.

TABLE A-2. ESTIMATED MINIMUM ACCEPTABLE SELLING PRICE FOR RAW COAL BY MINE TYPE (1975 $/Ton - FOB Mine)

SURFACE MINES

Mine Size (10^6 Tons/Year)	Overburden Ratio* 5:1	10:1	15:1	20:1	25:1	30:1	45:1
0.1	X	X	27.97	34.13	40.42	46.93	69.90
0.5	X	9.21	11.14	13.15	15.27	17.54	26.02
1.0	5.90	7.16	8.46	9.84	11.34	12.95	19.59
2.0	5.16	6.30	7.50	8.70	10.10	11.51	16.90
3.0	4.75	5.82	6.95	8.13	9.35	10.63	15.34
4.0	4.48	5.48	6.54	7.65	X	X	X

DEEP MINES

Mine Size (10^6 Tons/Year)	Seam Thickness 72"	60-71"	48-59"	36-47"	28-35"	Seam Thickness 72"	60-71"	48-59"	36-47"	28-35"
	Drift					Shaft - 400 Foot Depth				
0.1	X	14.48	15.44	16.52	17.76	17.97	18.96	20.05	21.28	22.69
0.5	X	13.55	14.35	15.21	16.17	14.87	15.71	16.62	17.61	18.71
1.0	X	12.71	13.38	14.09	X	13.77	14.50	15.28	16.10	X
2.0	X	X	10.88	X	X	11.10	11.62	12.16	X	X
3.0	X	X	X	X	X	9.09	X	X	X	X
	Shaft - 700 Foot Depth					Shaft - 1,000 Foot Depth				
0.1	20.12	21.09	22.16	23.40	24.83	22.49	23.47	24.54	25.74	27.10
0.5	15.28	16.14	17.07	18.07	19.18	15.70	16.57	17.51	18.52	19.64
1.0	13.98	14.73	15.51	16.34	X	14.19	14.95	15.75	16.59	X
2.0	11.24	11.76	12.31	X	X	11.37	11.91	12.46	X	X
3.0	10.00	X	X	X	X	10.11	X	X	X	X

* Cubic yards of overburden per ton of coal.

X indicates that no mine was costed out with the indicated specifications.

Source: PIES Coal Supply Curve Methodology, ICF Inc.

- a cleaning charge of $2.00 per ton was added to all high and medium BTU coal;
- a cleaning charge of $4.00 per ton was added to all metallurgical coal;
- Alaska prices were inflated by 50 percent to reflect high regional labor and capital costs.

The prices do not include a boiler charge for burning low BTU and very low BTU coal or reclamation costs or severance taxes.

The labels in the first column of the exhibits identify the type of mine being operated. SX and SY symbolize existing surface mines. SX represents mines in operation as of December 31, 1974. SY represents those mines scheduled to be in at least partial production as of December 31, 1976. Production from the SY mines may not reach full capacity until as late as 1979 in some cases. DX and DY signify existing deep mines. As with the surface mines, DX represents those mines in operation as of December 31, 1974 and DY presents those mines scheduled to be in at least partial production as of December 31, 1976.

The new surface mine labels begin with S and have two numbers trailing, e.g., S/10/1.0. The first number is the overburden ratio, i.e., cubic yards of overburden per ton in place. The second number is the size of the mine being developed in millions of tons per year. Thus, the label S/10/1.0 translates into surface mines with 10 to 1 overburden ratios, each capable of producing one million tons of coal annually.

The new deep mine labels begin with D and have three numbers trailing, e.g., D/48/04/0.5. The first number is the minimum

seam thickness being mined in inches. The second number is the depth of the seam in hundreds of feet. The third number is the size of the mine in millions of tons per year. Thus, the label D/48/04/0.5 stands for a deep mine with a 48 inch seam lying 400 feet below the surface and producing 500,000 tons annually. Two zeroes in the depth columns indicate a drift mine.

Note that the horizontal axes vary between five different scales: (1) 0-20 million tons, (2) 0-80 million tons, (3) 0-160 million tons, (4) 0-400 million tons and (5) 0-800 million tons. Since these scales are simply multiples of each other, supply curves drawn on different scales can be easily compared. Remember, however, that the BTU content of coal varies by region and product class. All the vertical axes are the same, going from 0 to $35 a ton. A dotted line is used to indicate that the supply curve extends beyond the limits of scale.

EXHIBIT A-Ia

Region: Northern Appalachia
Product Class: Metallurgical

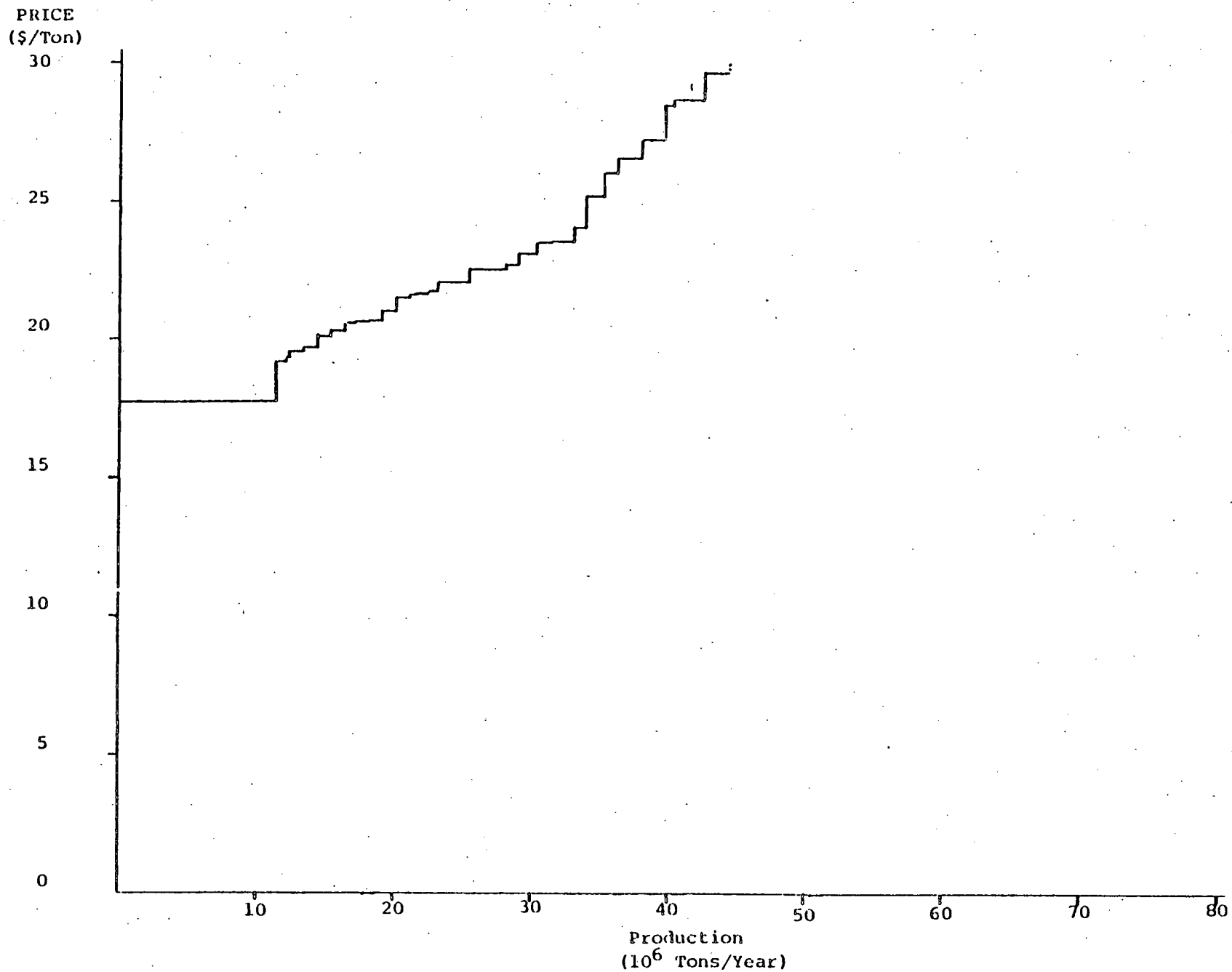


EXHIBIT A-Ib

Region: Northern Appalachia
Product Class: Metallurgical
BTU Content (10^6 BTU/TON): --

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	13.30	2.5	--	--	2.5	--	--
DX	15.95	1.7	--	--	4.2	--	--
DY	17.70	11.8	11.8	11.8	16.0	11.8	11.8
S/25/0.5	19.27	0.5	0.5	0.5	16.5	12.3	12.3
D/48/00/0.1	19.44	0.3	0.3	0.3	16.8	12.6	12.6
D/48/07/1.0	19.51	1.0	1.0	1.0	17.8	13.6	13.6
D/48/10/1.0	19.75	1.0	1.0	1.0	18.8	14.6	14.6
D/36/04/1.0	20.10	1.0	1.0	1.0	19.8	15.6	15.6
D/36/07/1.0	20.34	1.0	1.0	1.0	20.8	16.6	16.6
D/36/00/0.1	20.52	0.7	0.7	0.7	21.5	17.3	17.3
D/36/10/1.0	20.59	1.0	1.0	1.0	22.5	18.3	18.3
D/48/04/0.5	20.62	1.0	1.0	1.0	23.5	19.3	19.3
D/48/07/0.5	21.07	1.0	1.0	1.0	24.5	20.3	20.3
D/48/10/0.5	21.51	1.0	1.0	1.0	25.5	21.3	21.3
S/30/0.5	21.54	0.5	0.5	0.5	26.0	21.8	21.8
D/36/04/0.5	21.61	1.0	1.0	1.0	27.0	22.8	22.8
D/28/00/0.1	21.76	0.5	0.5	0.5	27.5	23.3	23.3
D/36/07/0.5	22.07	2.5	2.5	2.5	30.0	25.8	25.8
D/36/10/0.5	22.52	2.5	2.5	2.5	32.5	28.3	28.3
D/28/04/0.5	22.71	1.0	1.0	1.0	33.5	29.3	29.3
D/28/07/0.5	23.18	1.5	1.5	1.5	35.0	30.8	30.8
S/45/1.0	23.59	1.0	1.0	1.0	36.0	31.8	31.8
D/28/10/0.5	23.64	1.5	1.5	1.5	37.5	33.3	33.3
D/48/04/0.1	24.05	0.9	0.9	0.9	38.4	34.2	34.2
D/36/04/0.1	25.28	1.6	1.6	1.6	40.0	35.8	35.8
D/48/07/0.1	26.16	0.7	0.7	0.7	40.7	36.5	36.5
D/28/04/0.1	26.69	1.7	1.7	1.7	42.4	38.2	38.2
D/36/07/0.1	27.40	1.8	1.8	1.8	44.2	40.0	40.0
D/48/10/0.1	28.54	0.7	0.7	0.7	44.9	40.7	40.7
D/28/07/0.1	28.83	2.2	2.2	2.2	47.1	42.9	42.9
D/36/10/0.1	29.74	1.8	1.8	1.8	48.9	44.7	44.7
S/45/0.5	30.82	1.5	1.5	1.5	50.4	46.2	46.2
D/28/10/0.1	31.10	2.2	2.2	2.2	52.6	48.4	48.4
S/25/0.1	44.42	0.6	0.6	0.6	53.2	49.0	49.0
S/30/0.1	50.93	0.6	0.6	0.6	53.8	49.6	49.6
S/45/0.1	73.90	0.9	0.9	0.9	54.7	50.5	50.5

EXHIBIT A-IIa

Region: Northern Appalachia
Product Class: Low Sulfur

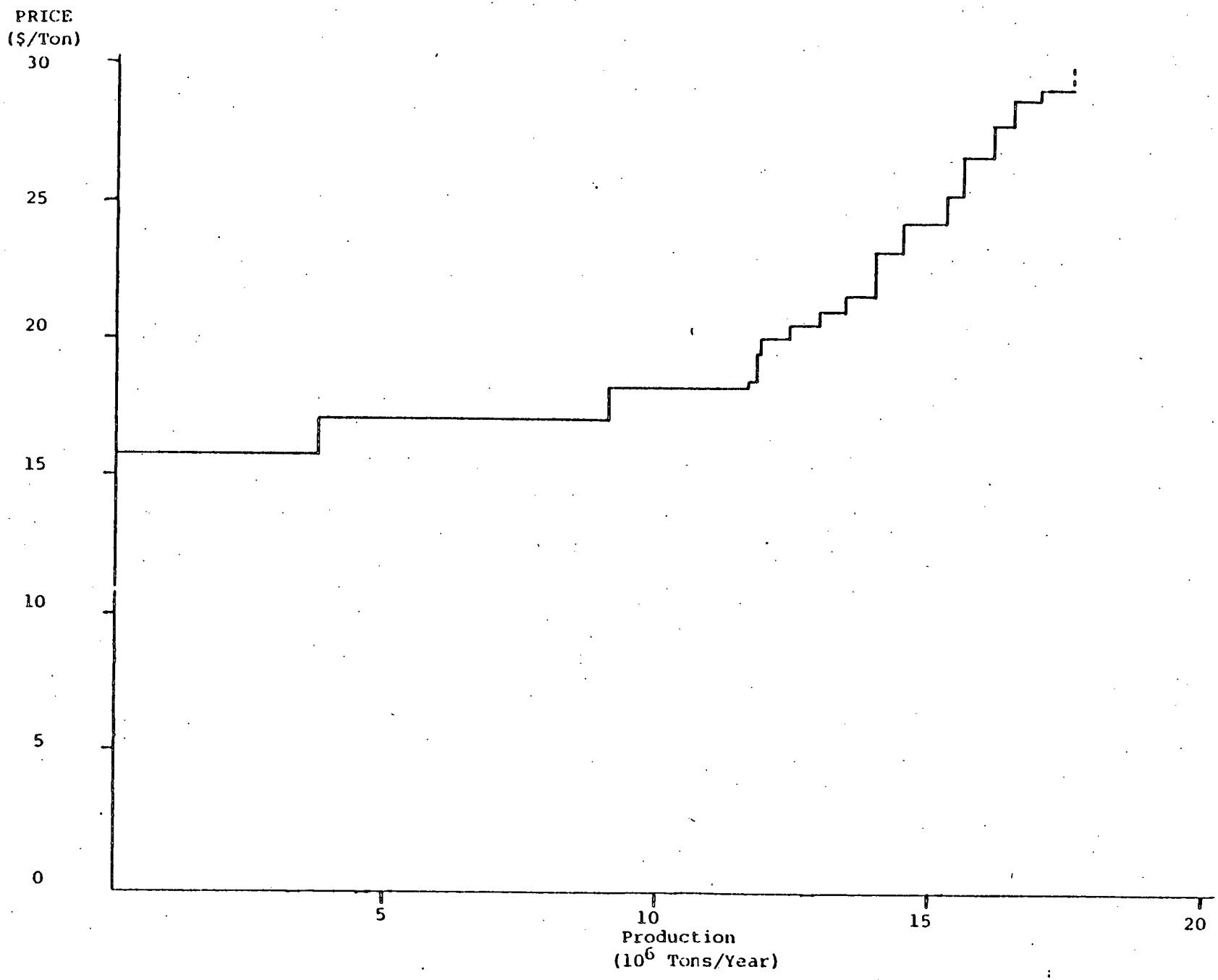


EXHIBIT A-IIb

Region: Northern Appalachia
Product Class: Low Sulfur
BTU Content (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
DX	15.94	3.7	3.7	3.7	3.7	3.7	3.7
DY	17.23	5.3	5.3	5.3	9.0	9.0	9.0
SX	18.42	2.6	2.6	2.6	11.6	11.6	11.6
D/36/00/0.1	18.52	0.1	0.1	0.1	11.7	11.7	11.7
D/28/00/0.1	19.76	0.1	0.1	0.1	11.8	11.8	11.8
D/36/07/0.5	20.07	0.5	0.5	0.5	12.3	12.3	12.3
D/36/10/0.5	20.52	0.5	0.5	0.5	12.8	12.8	12.8
D/28/07/0.5	21.18	0.5	0.5	0.5	13.3	13.3	13.3
D/28/10/0.5	21.64	0.5	0.5	0.5	13.8	13.8	13.8
D/36/04/0.1	23.28	0.6	0.6	0.6	14.4	14.4	14.4
D/28/04/0.1	24.69	0.8	0.8	0.8	15.2	15.2	15.2
D/36/07/0.1	25.40	0.3	0.3	0.3	15.5	15.5	15.5
D/28/07/0.1	26.83	0.6	0.6	0.6	16.1	16.1	16.1
D/36/10/0.1	27.74	0.3	0.3	0.3	16.4	16.4	16.4
S/45/0.5	28.82	0.5	0.5	0.5	16.9	16.9	16.9
D/28/10/0.1	29.10	0.6	0.6	0.6	17.5	17.5	17.5
S/20/0.1	36.13	0.3	0.3	0.3	17.8	17.8	17.8
S/25/0.1	42.42	0.3	0.3	0.3	18.1	18.1	18.1
S/30/0.1	48.93	0.3	0.3	0.3	18.4	18.4	18.4
S/45/0.1	71.90	1.2	1.2	1.2	19.6	19.6	19.6

EXHIBIT A-IIIa

Region: Northern Appalachia
Product Class: High Sulfur

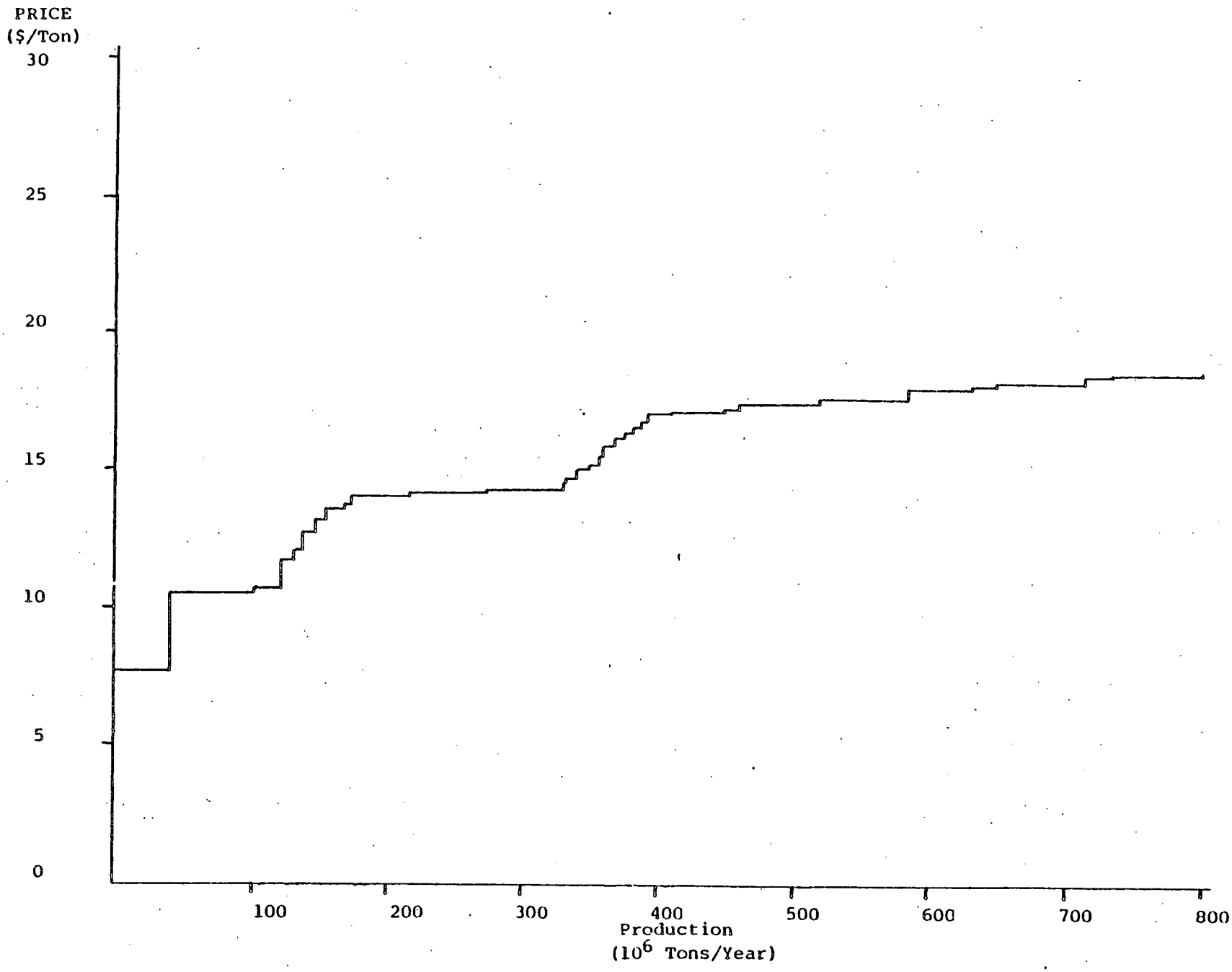


EXHIBIT A-IIIb

Region: Northern Appalachia
Product Class: High Sulfur
BTU Content (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons		
		1980	1985	1990	1980	1985	1990
SX	7.76	52.0	42.0	32.0	52.0	42.0	32.0
DX	10.68	74.5	59.5	44.5	126.5	101.5	76.5
DY	10.73	16.6	16.6	16.6	143.10	118.1	93.1
S/20/2.0	10.78	6.0	6.0	6.0	149.1	124.1	99.1
S/20/1.0	11.84	7.0	7.0	7.0	156.1	131.1	106.1
S/25/2.0	12.10	8.0	8.0	8.0	164.1	139.1	114.1
D/48/00/2.0	12.88	8.0	8.0	8.0	172.1	147.1	122.1
S/25/1.0	13.34	9.0	9.0	9.0	181.1	156.1	131.1
S/30/2.0	13.51	8.0	8.0	8.0	189.1	164.1	139.1
D/60/04/2.0	13.62	2.0	2.0	2.0	191.1	166.1	141.1
D/60/07/2.0	13.76	4.0	4.0	4.0	195.1	170.1	145.1
D/60/10/2.0	13.91	4.0	4.0	4.0	199.1	174.1	169.1
D/48/04/2.0	14.16	42.0	42.0	42.0	241.1	216.1	191.1
D/48/07/2.0	14.31	58.0	58.0	58.0	299.1	274.1	249.1
D/48/10/2.0	14.46	58.0	58.0	58.0	357.1	332.1	307.1
D/60/00/1.0	14.71	1.0	1.0	1.0	358.1	333.1	308.1
S/30/1.0	14.95	9.0	9.0	9.0	367.1	342.1	317.1
S/20/0.5	15.15	7.5	7.5	7.5	374.6	349.6	324.6
D/48/00/1.0	15.38	9.0	9.0	9.0	383.6	358.6	333.6
D/60/00/0.5	15.55	1.0	1.0	1.0	384.6	359.6	334.6
D/36/00/1.0	16.09	9.0	9.0	9.0	393.6	368.6	343.6
D/48/00/0.5	16.35	8.0	8.0	8.0	401.6	376.6	351.6
D/60/00/0.1	16.48	0.8	0.8	0.8	402.4	377.4	352.4
D/60/04/1.0	16.50	5.0	5.0	5.0	407.4	382.4	357.4
D/60/07/1.0	16.73	5.0	5.0	5.0	412.4	387.4	362.4
D/60/10/1.0	16.95	5.0	5.0	5.0	417.4	392.4	367.4
D/36/00/0.5	17.21	10.0	10.0	10.0	427.4	402.4	377.4
S/25/0.5	17.27	8.5	8.5	8.5	435.9	410.9	385.9
D/48/04/1.0	17.28	42.0	42.0	42.0	477.9	452.9	427.9
D/48/00/0.1	17.44	9.0	9.0	9.0	486.9	461.9	436.9
D/48/07/1.0	17.51	60.0	60.0	60.0	546.9	521.9	496.9
D/60/04/0.5	17.71	3.5	3.5	3.5	550.4	525.4	500.4
D/48/10/1.0	17.75	60.0	60.0	60.0	610.4	585.4	560.4
D/36/04/1.0	18.10	49.0	49.0	49.0	659.4	634.4	609.4
D/60/07/0.5	18.14	5.5	5.5	5.5	664.9	639.9	614.9
D/28/00/0.5	18.17	8.0	8.0	8.0	672.9	647.9	622.9
D/36/07/1.0	18.34	68.0	68.0	68.0	740.9	715.9	690.9
D/36/00/0.1	18.52	10.6	10.6	10.6	751.5	726.5	701.5
D/60/10/0.5	18.57	5.5	5.5	5.5	757.0	732.0	707.0
D/36/10/1.0	18.59	68.0	68.0	58.0	825.0	800.0	775.0
D/48/04/0.5	18.62	43.0	43.0	43.0	868.0	843.0	818.0
S/45/2.0	18.90	24.0	24.0	24.0	892.0	867.0	842.0
D/48/07/0.5	19.07	60.0	60.0	60.0	952.0	927.0	902.0
D/48/10/0.5	19.51	60.0	60.0	60.0	1,012.0	987.0	962.0

EXHIBIT A-IIIb (Continued)

Region: Northern Appalachia
Product Class: High Sulfur
BTU Content (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
S/30/0.5	19.54	8.5	8.5	8.5	1,020.5	995.5	970.5
D/36/04/0.5	19.61	49.0	49.0	49.0	1,069.5	1,044.5	1,019.5
D/28/00/0.1	19.76	8.7	8.7	8.7	1,078.2	1,053.2	1,028.2
D/36/07/0.5	20.07	68.0	68.0	68.0	1,146.2	1,121.2	1,096.2
D/36/10/0.5	20.52	68.0	68.0	68.0	1,214.2	1,189.2	1,164.2
D/28/04/0.5	20.71	41.5	41.5	41.5	1,255.7	1,230.7	1,205.7
D/60/04/0.1	20.96	3.5	3.5	3.5	1,259.2	1,234.2	1,209.2
D/28/07/0.5	21.18	58.0	58.0	58.0	1,317.2	1,292.2	1,267.2
S/45/1.0	21.59	27.0	27.0	27.0	1,344.2	1,319.2	1,294.2
D/28/10/0.5	21.64	58.0	58.0	58.0	1,402.2	1,377.2	1,352.2
D/48/04/0.1	22.05	43.1	43.1	43.1	1,445.3	1,420.3	1,395.3
D/60/07/0.1	23.09	5.1	5.1	5.1	1,450.4	1,425.4	1,400.4
D/36/04/0.1	23.28	49.8	49.8	49.8	1,500.2	1,475.2	1,450.2
D/48/07/0.1	24.16	60.2	60.2	60.2	1,560.4	1,535.4	1,510.4
D/28/04/0.1	24.69	42.1	42.1	42.1	1,602.5	1,577.5	1,552.5
D/36/07/0.1	25.40	71.1	71.1	71.1	1,673.6	1,648.6	1,623.6
D/60/10/0.1	25.47	5.1	5.1	5.1	1,678.7	1,653.7	1,628.7
D/48/10/0.1	26.54	60.2	60.2	60.2	1,738.9	1,713.9	1,688.9
D/28/07/0.1	26.83	59.1	59.1	59.1	1,798.0	1,773.0	1,748.0
D/36/10/0.1	27.74	71.1	71.1	71.1	1,869.1	1,844.1	1,819.1
S/45/0.5	28.82	26.0	26.0	26.0	1,895.1	1,870.1	1,845.1
D/28/10/0.1	29.10	59.1	59.1	59.1	1,954.2	1,929.2	1,904.2
S/20/0.1	36.13	7.1	7.1	7.1	1,961.3	1,936.3	1,911.3
S/25/0.1	42.42	8.7	8.7	8.7	1,970.0	1,945.0	1,920.0
S/30/0.1	48.93	8.7	8.7	8.7	1,978.7	1,953.7	1,928.7
S/45/0.1	71.90	25.8	25.8	25.8	2,004.5	1,979.5	1,954.5

EXHIBIT A-IVa

Region: Central Appalachia

Product Class: Metallurgical

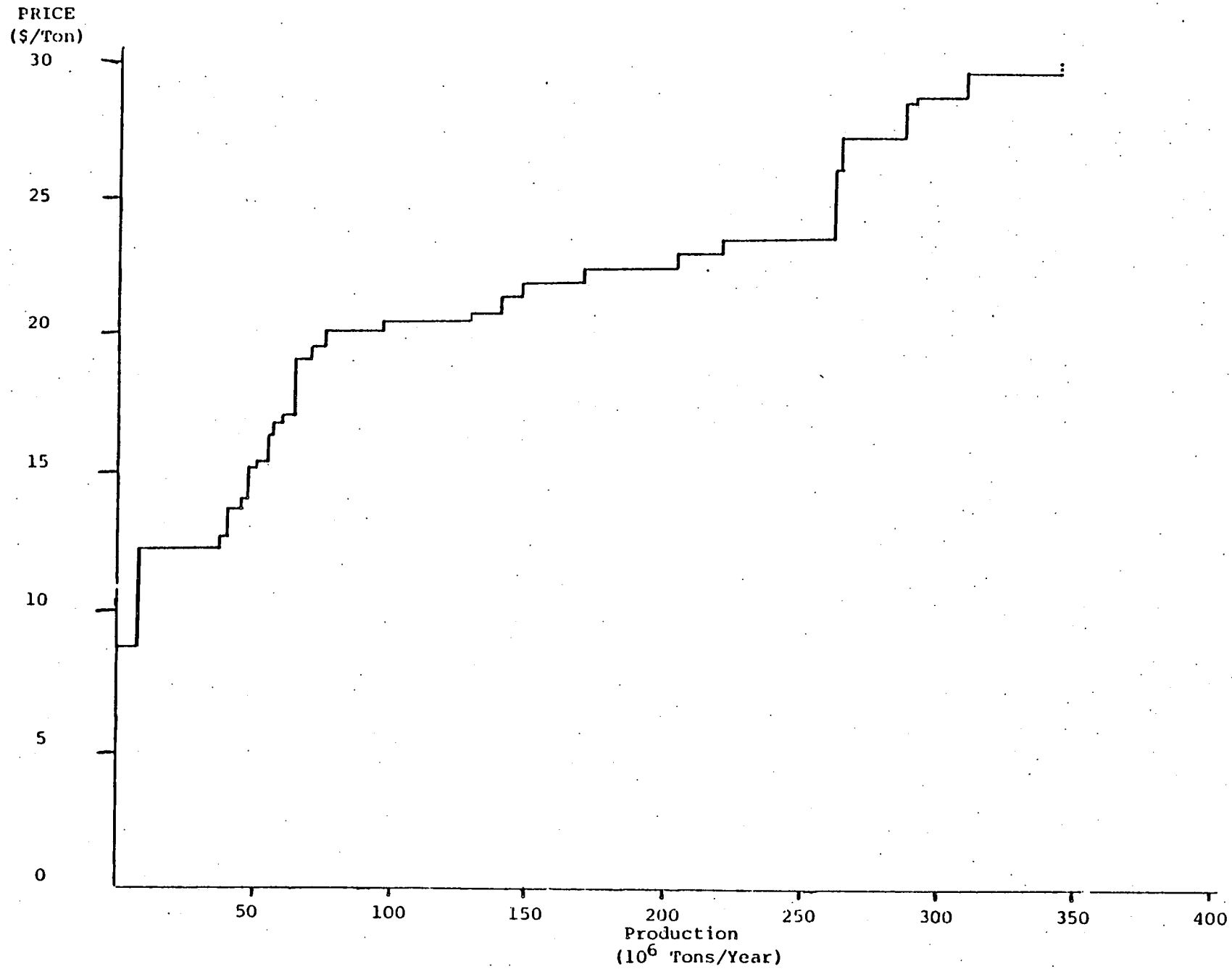


EXHIBIT A-IVb

Region: Central Appalachia
Product Class: Metallurgical
BTU CONTENT (10^6 BTU/TON): --

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	8.83	17.6	8.6	--	17.6	8.6	--
DX	12.36	40.0	22.0	4.0	57.6	30.6	4.0
DY	12.41	7.2	7.2	7.2	64.8	37.8	11.2
S/15/1.0	12.46	1.0	1.0	1.0	65.8	38.8	12.2
S/20/2.0	12.78	2.0	2.0	2.0	67.8	40.8	14.2
S/20/1.0	13.84	5.0	5.0	5.0	72.8	45.8	19.2
S/25/2.0	14.10	2.0	2.0	2.0	74.8	47.8	21.2
S/15/0.5	15.14	1.0	1.0	1.0	75.8	48.8	22.2
S/25/1.0	15.34	5.0	5.0	5.0	80.8	53.8	27.2
S/30/2.0	15.51	2.0	2.0	2.0	82.8	55.8	29.2
D/48/10/2.0	16.46	2.0	2.0	2.0	84.8	57.8	31.2
S/30/1.0	16.95	5.0	5.0	5.0	89.8	62.8	36.2
S/20/0.5	17.15	4.0	4.0	4.0	94.8	66.8	40.2
S/25/0.5	19.27	4.0	4.0	4.0	98.8	70.8	44.2
D/48/07/1.0	19.51	3.0	3.0	3.0	101.8	73.8	47.2
D/48/10/1.0	19.75	2.0	2.0	2.0	103.8	75.8	49.2
D/36/07/1.0	20.34	22.0	22.0	22.0	125.8	97.8	71.2
D/36/10/1.0	20.59	33.0	33.0	33.0	158.8	130.8	104.2
S/45/2.0	20.90	10.0	10.0	10.0	168.8	140.8	114.2
D/48/07/0.5	21.07	1.5	1.5	1.5	170.3	142.3	115.7
D/48/10/0.5	21.51	3.0	3.0	3.0	173.3	145.3	118.7
S/30/0.5	21.54	4.0	4.0	4.0	177.3	149.3	122.7
D/36/07/0.5	22.07	22.5	22.5	22.5	199.8	171.8	145.2
D/36/10/0.5	22.52	33.5	33.5	33.5	233.3	205.3	178.7
D/28/07/0.5	23.18	18.5	18.5	18.5	251.8	223.8	197.2
S/45/1.0	23.59	12.0	12.0	12.0	263.8	235.8	209.2
D/28/10/0.5	23.64	28.0	28.0	28.0	291.8	263.8	237.2
D/48/07/0.1	26.16	2.0	2.0	2.0	293.8	265.8	239.2
D/36/07/0.1	27.40	22.9	22.9	22.9	316.7	288.7	262.1
D/48/10/0.1	28.54	2.8	2.8	2.8	319.5	291.5	264.9
D/28/07/0.1	28.83	18.8	18.8	18.8	338.3	310.3	283.7
D/36/10/0.1	29.74	34.6	34.6	34.6	372.9	344.9	318.3
S/45/0.5	30.82	11.5	11.5	11.5	384.4	356.4	329.8
D/28/10/0.1	31.10	28.0	28.0	28.0	412.4	384.4	357.8
S/15/0.1	31.97	1.0	1.0	1.0	413.4	385.4	358.8
S/20/0.1	38.13	3.8	3.8	3.8	417.2	389.2	362.6
S/25/0.1	44.42	3.8	3.8	3.8	421.0	393.0	366.4
S/30/0.1	50.93	3.8	3.8	3.8	424.8	396.8	370.2
S/45/0.1	73.90	11.2	11.2	11.2	436.0	408.0	381.4

EXHIBIT A-Va

Region: Central Appalachia
Product Class: Low Sulfur

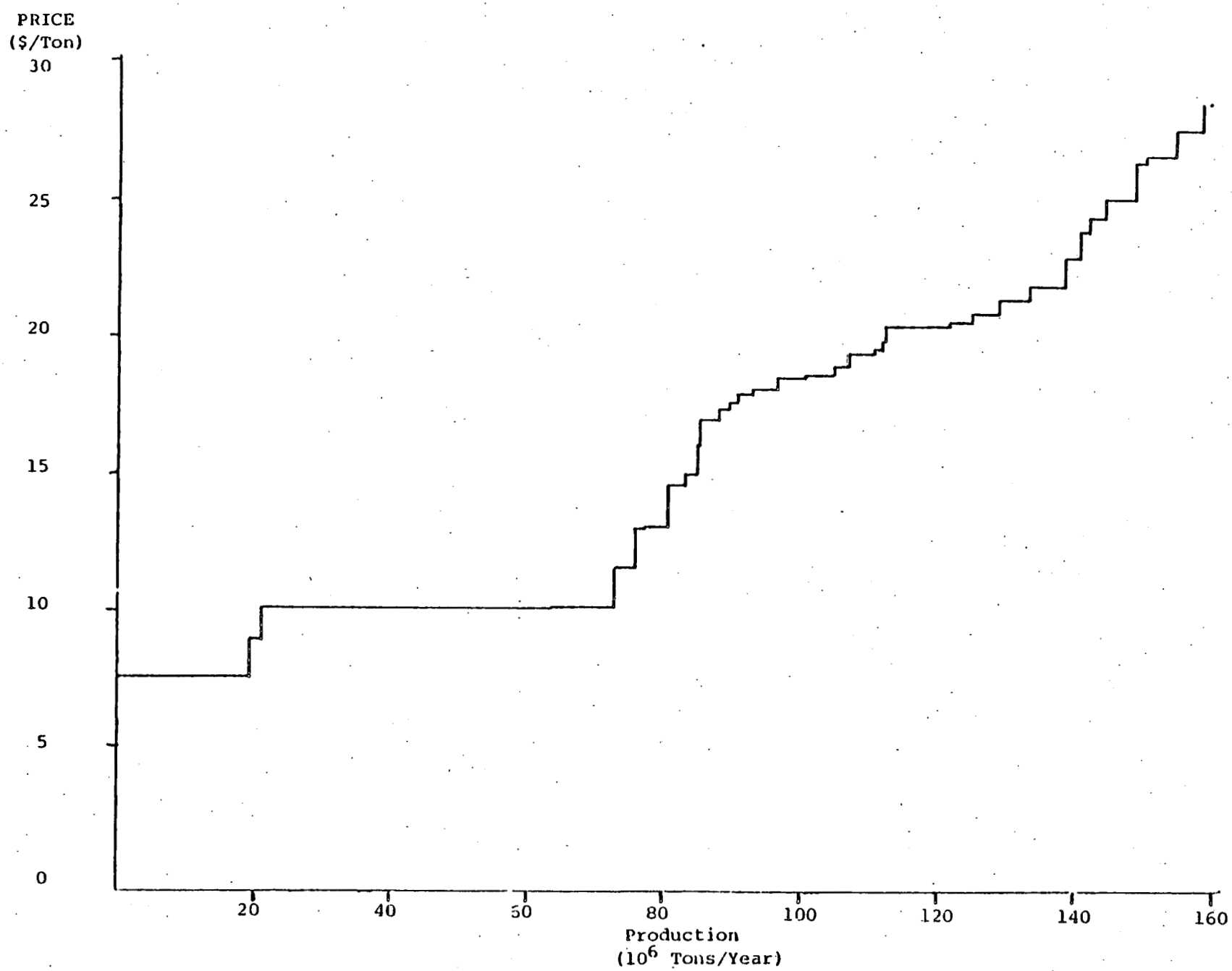


EXHIBIT A-Vb

Region: Central Appalachia
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	7.83	19.4	19.4	19.4	19.4	19.4	19.4
SY	9.14	2.2	2.2	2.2	21.6	21.6	21.6
DX	10.36	42.1	42.1	42.1	63.7	63.7	63.7
DY	10.41	7.1	7.1	7.1	70.8	70.8	70.8
S/15/1.0	10.46	2.0	2.0	2.0	72.8	72.8	72.8
S/20/1.0	11.84	3.0	3.0	3.0	75.8	75.8	75.8
S/15/0.5	13.14	1.5	1.5	1.5	77.3	77.3	77.3
S/25/1.0	13.34	3.0	3.0	3.0	80.3	80.3	80.3
S/30/1.0	14.95	3.0	3.0	3.0	83.3	83.3	83.3
S/20/0.5	15.15	1.5	1.5	1.5	84.8	84.8	84.8
D/48/00/0.5	16.35	0.5	0.5	0.5	85.3	85.3	85.3
D/36/00/0.5	17.21	1.0	1.0	1.0	86.3	86.3	86.3
S/25/0.5	17.27	1.5	1.5	1.5	87.8	87.8	87.8
D/48/04/1.0	17.28	1.0	1.0	1.0	88.8	88.8	88.8
D/48/00/0.1	17.44	0.1	0.1	0.1	88.9	88.9	88.9
D/48/07/1.0	17.51	1.0	1.0	1.0	89.9	89.9	89.9
D/48/10/1.0	17.75	1.0	1.0	1.0	90.9	90.9	90.9
D/36/04/1.0	18.10	2.0	2.0	2.0	92.9	92.9	92.9
D/28/00/0.5	18.17	0.5	0.5	0.5	93.4	93.4	93.4
D/36/07/1.0	18.34	3.0	3.0	3.0	96.4	96.4	96.4
D/36/00/0.1	18.52	0.5	0.5	0.5	96.9	96.9	96.9
D/36/10/1.0	18.59	3.0	3.0	3.0	99.9	99.9	99.9
D/48/04/0.5	18.62	1.5	1.5	1.5	101.4	101.4	101.4
S/45/2.0	18.90	4.0	4.0	4.0	105.4	105.4	105.4
D/48/07/0.5	19.07	1.5	1.5	1.5	106.9	106.9	106.9
D/48/10/0.5	19.51	1.5	1.5	1.5	108.4	108.4	108.4
S/30/0.5	19.54	1.5	1.5	1.5	109.9	109.9	109.9
D/36/04/0.5	19.61	3.0	3.0	3.0	112.9	112.9	112.9
D/28/00/0.1	19.76	0.7	0.7	0.7	113.6	113.6	113.6
D/36/07/0.5	20.07	4.0	4.0	4.0	117.6	117.6	117.6
D/36/10/0.5	20.52	4.0	4.0	4.0	121.6	121.6	121.6
D/28/04/0.5	20.71	3.0	3.0	3.0	124.6	124.6	124.6
D/28/07/0.5	21.18	4.0	4.0	4.0	128.6	128.6	128.6
S/45/1.0	21.59	5.0	5.0	5.0	133.6	133.6	133.6
D/28/10/0.5	21.64	4.0	4.0	4.0	137.6	137.6	137.6
D/48/04/0.1	22.05	0.9	0.9	0.9	138.5	138.5	138.5
D/36/04/0.1	23.28	2.6	2.6	2.6	141.1	141.1	141.1
D/48/07/0.1	24.16	1.3	1.3	1.3	142.4	142.4	142.4
D/28/04/0.1	24.69	3.2	3.2	3.2	145.6	145.6	145.6
D/36/07/0.1	25.40	3.7	3.7	3.7	149.3	149.3	149.3
D/48/10/0.1	26.54	1.3	1.3	1.3	150.6	150.6	150.6
D/28/07/0.1	26.83	4.7	4.7	4.7	155.3	155.3	155.3
D/36/10/0.1	27.74	3.7	3.7	3.7	159.0	159.0	159.0
S/45/0.5	28.82	4.5	4.5	4.5	163.5	163.5	163.5
D/28/10/0.1	29.10	4.7	4.7	4.7	168.2	168.2	168.2
S/15/0.1	29.97	1.4	1.4	1.4	169.6	169.6	169.6
S/20/0.1	36.13	1.7	1.7	1.7	171.3	171.3	171.3
S/25/0.1	42.42	1.7	1.7	1.7	173.0	173.0	173.0
S/30/0.1	48.93	1.7	1.7	1.7	174.7	174.4	174.7
S/45/0.1	71.90	5.1	5.1	5.1	179.8	179.8	179.8

EXHIBIT A-VIa

Region: Central Appalachia
Product Class: High Sulfur

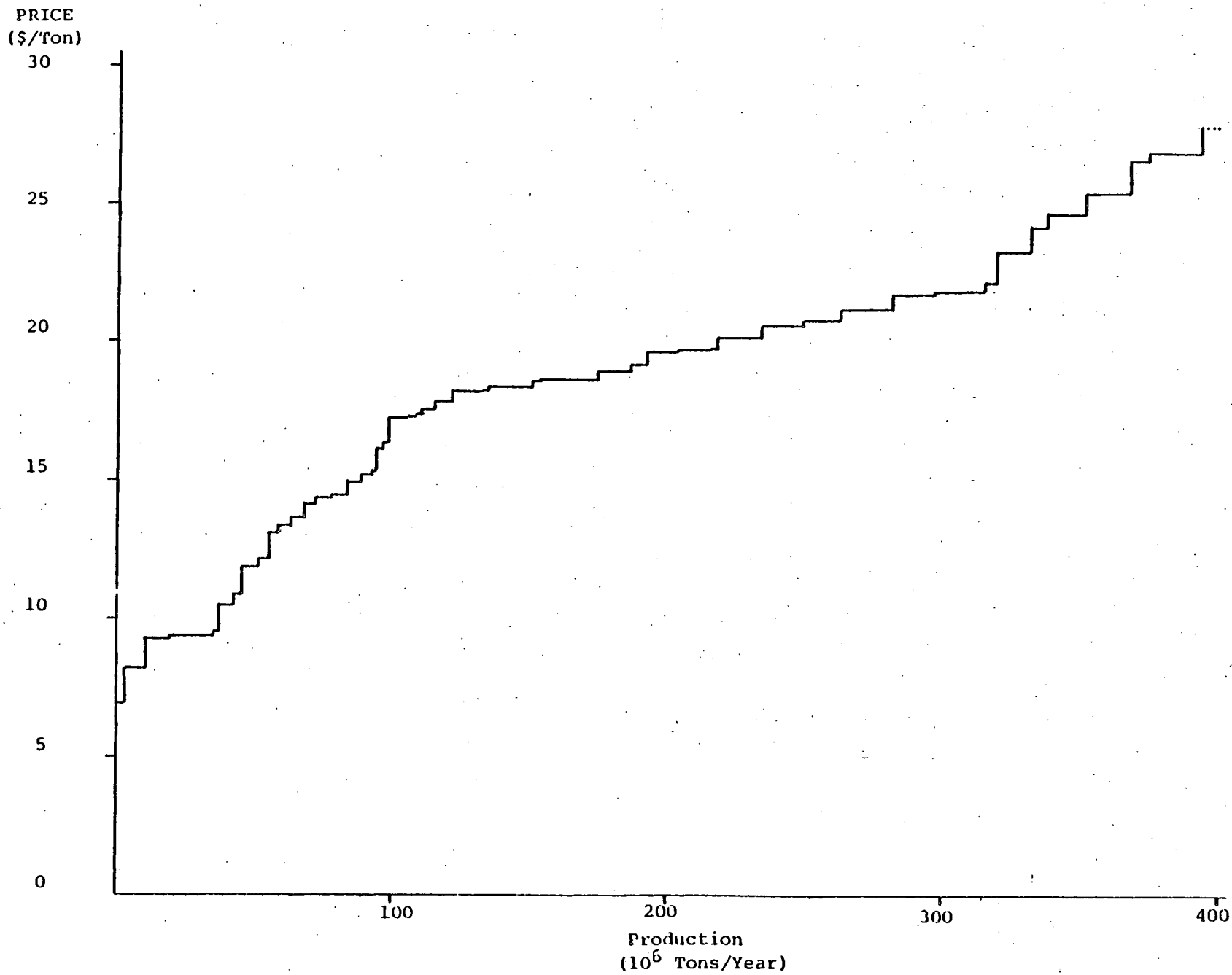


EXHIBIT A-VIb

Region: Central Appalachia
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	6.94	6.3	3.3	0.3	6.3	3.3	0.3
SY	8.22	7.0	7.0	7.0	13.3	10.3	7.3
DX	9.40	15.6	9.6	3.6	28.9	19.9	10.9
DY	9.45	15.5	15.5	15.5	44.4	35.4	26.4
S/15/2.0	9.50	2.0	2.0	2.0	46.4	37.4	28.4
S/15/1.0	10.46	5.0	5.0	5.0	51.4	42.4	33.4
S/20/2.0	10.78	4.0	4.0	4.0	55.4	46.4	37.4
S/20/1.0	11.84	5.0	5.0	5.0	60.4	51.4	42.4
S/25/2.0	12.10	4.0	4.0	4.0	64.4	55.4	46.4
S/15/0.5	13.14	4.0	4.0	4.0	68.4	59.4	50.4
S/25/1.0	13.34	5.0	5.0	5.0	73.4	64.4	55.4
S/30/2.0	13.51	4.0	4.0	4.0	77.4	68.4	59.4
D/48/04/2.0	14.16	4.0	4.0	4.0	81.4	72.4	63.4
D/48/07/2.0	14.31	6.0	6.0	6.0	87.4	78.4	69.4
D/48/10/2.0	14.46	6.0	6.0	6.0	93.4	84.4	75.4
S/30/1.0	14.95	5.0	5.0	5.0	98.4	89.4	80.4
S/20/0.5	15.15	4.5	4.5	4.5	102.9	93.9	84.9
D/48/00/1.0	15.38	1.0	1.0	1.0	103.9	94.9	85.9
D/36/00/1.0	16.09	2.0	2.0	2.0	105.9	96.9	87.9
D/48/00/0.5	16.35	1.5	1.5	1.5	107.4	98.4	89.4
D/36/00/0.5	17.21	2.5	2.5	2.5	109.9	100.9	91.9
S/25/0.5	17.27	4.5	4.5	4.5	114.4	105.4	96.4
D/48/04/1.0	17.28	4.0	4.0	4.0	118.4	109.4	100.4
D/48/00/0.1	17.44	0.9	0.9	0.9	119.3	110.3	101.3
D/48/07/1.0	17.51	6.0	6.0	6.0	125.3	116.3	107.3
D/48/10/1.0	17.75	6.0	6.0	6.0	131.3	122.3	113.3
D/36/04/1.0	18.10	11.0	11.0	11.0	142.3	133.3	124.3
D/28/00/0.5	18.17	2.5	2.5	2.5	144.8	135.8	126.8
D/36/07/1.0	18.34	16.0	16.0	16.0	160.8	151.8	142.8
D/36/00/0.1	18.52	2.5	2.5	2.5	163.3	154.3	145.3
D/36/10/1.0	18.59	16.0	16.0	16.0	179.3	170.3	161.3
D/48/04/0.5	18.62	5.0	5.0	5.0	184.3	175.3	166.3
S/45/2.0	18.90	12.0	12.0	12.0	196.3	187.3	178.3
D/48/07/0.5	19.07	6.0	6.0	6.0	202.3	193.3	184.3
D/48/10/0.5	19.51	6.0	6.0	6.0	208.3	199.3	190.3
S/30/0.5	19.54	4.5	4.5	4.5	212.8	203.8	194.8
D/36/04/0.5	19.61	12.0	12.0	12.0	224.8	215.8	206.8
D/28/00/0.1	19.76	2.8	2.8	2.8	227.6	218.6	209.6
D/36/07/0.5	20.07	16.0	16.0	16.0	243.6	234.6	225.6
D/36/10/0.5	20.52	16.0	16.0	16.0	259.6	250.6	241.6
D/28/04/0.5	20.71	13.0	13.0	13.0	272.6	263.6	254.6
D/28/07/0.5	21.18	18.5	18.5	18.5	291.1	282.1	273.1
S/45/1.0	21.59	15.0	15.0	15.0	306.1	297.1	288.1
D/28/10/0.5	21.64	18.5	18.5	18.5	324.6	315.6	306.6
D/48/04/0.1	22.05	4.4	4.4	4.4	329.0	320.0	311.0
D/36/04/0.1	23.28	12.0	12.0	12.0	341.0	332.0	323.0

EXHIBIT A-VIb (Continued)

Region: Central Appalachia
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
D/48/07/0.1	24.16	6.1	6.1	6.1	347.1	338.1	329.1
D/28/04/0.1	24.69	13.7	13.7	13.7	360.8	351.8	342.8
D/36/07/0.1	25.40	17.1	17.1	17.1	377.9	368.9	359.9
D/48/10/0.1	26.54	6.1	6.1	6.1	384.0	375.0	366.0
D/28/07/0.1	26.83	19.0	19.0	19.0	403.0	394.0	385.0
D/36/10/0.1	27.74	17.1	17.1	17.1	420.1	411.1	402.1
S/45/0.5	28.82	14.0	14.0	14.0	434.1	425.1	416.1
D/28/10/0.1	29.10	19.0	19.0	19.0	453.1	444.1	435.1
S/15/0.1	29.97	3.6	3.6	3.6	456.7	447.7	438.7
S/20/0.1	36.13	4.8	4.8	4.8	461.5	452.5	443.5
S/25/0.1	42.42	4.8	4.8	4.8	466.3	457.3	448.3
S/30/0.1	48.93	4.8	4.8	4.8	471.1	462.1	453.1
S/45/0.1	71.90	13.9	13.9	13.9	485.0	476.0	467.0

EXHIBIT A-VIIa

Region: Southern Appalachia
Product Class: Metallurgical

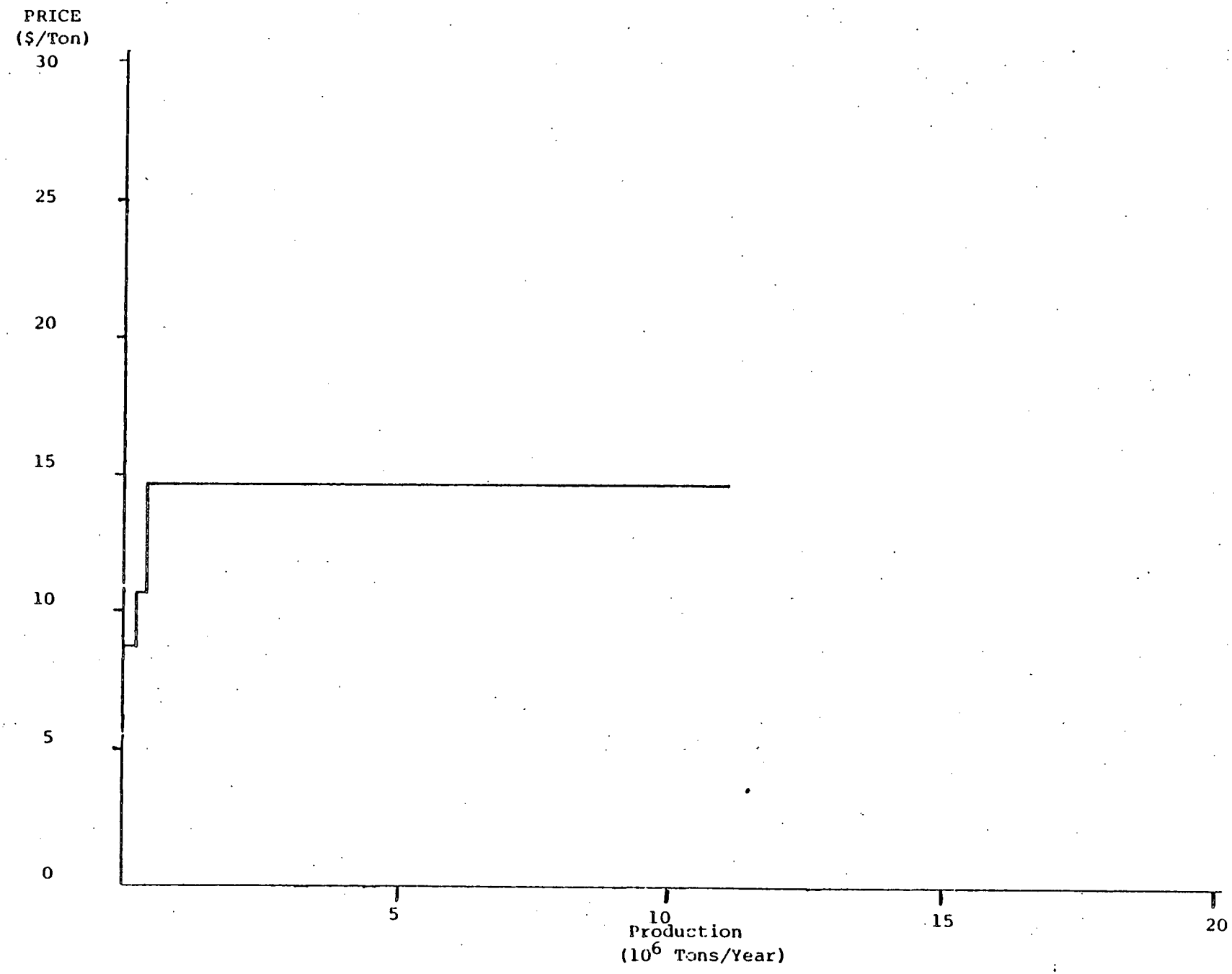


EXHIBIT A-VIIb

Region: Southern Appalachia
Product Class: Metallurgical
BTU CONTENT (10^6 BTU/TON): --

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	8.83	1.2	0.2	--	1.2	0.2	--
SY	10.64	0.2	0.2	0.2	1.4	0.4	0.2
DX	12.94	0.4	--	--	1.8	0.4	0.2
DY	14.70	10.8	10.8	10.8	12.6	11.2	11.0

EXHIBIT A-VIIIa

Region: Southern Appalachia
Product Class: Low Sulfur

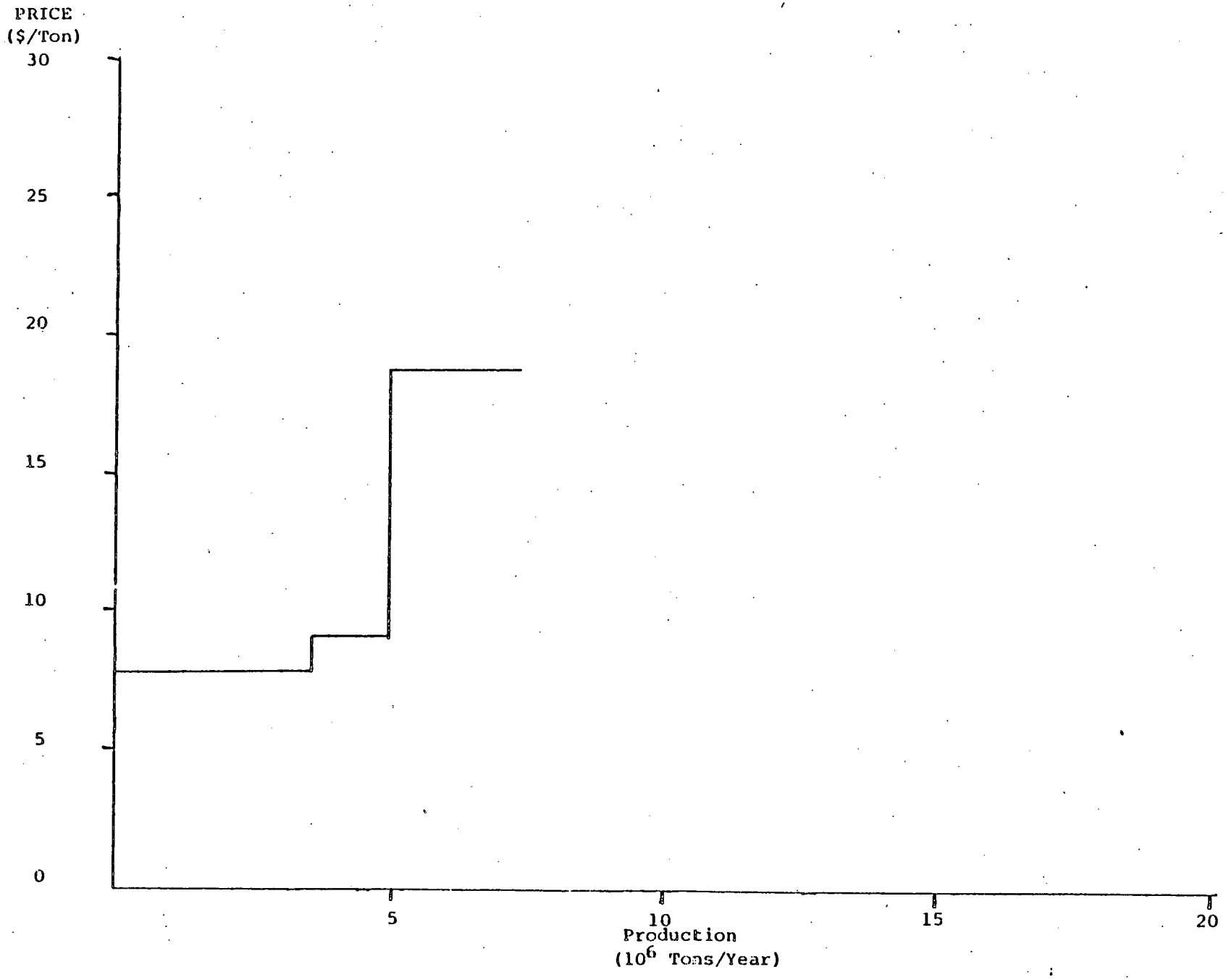


EXHIBIT A-VIIIb

Region: Southern Appalachia
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	7.83	3.6	3.6	3.6	3.6	3.6	3.6
SY	9.14	1.4	1.4	1.4	5.0	5.0	5.0
DX	18.81	2.4	2.4	2.4	7.4	7.4	7.4

EXHIBIT A-IXa

Region: Southern Appalachia
Product Class: High Sulfur

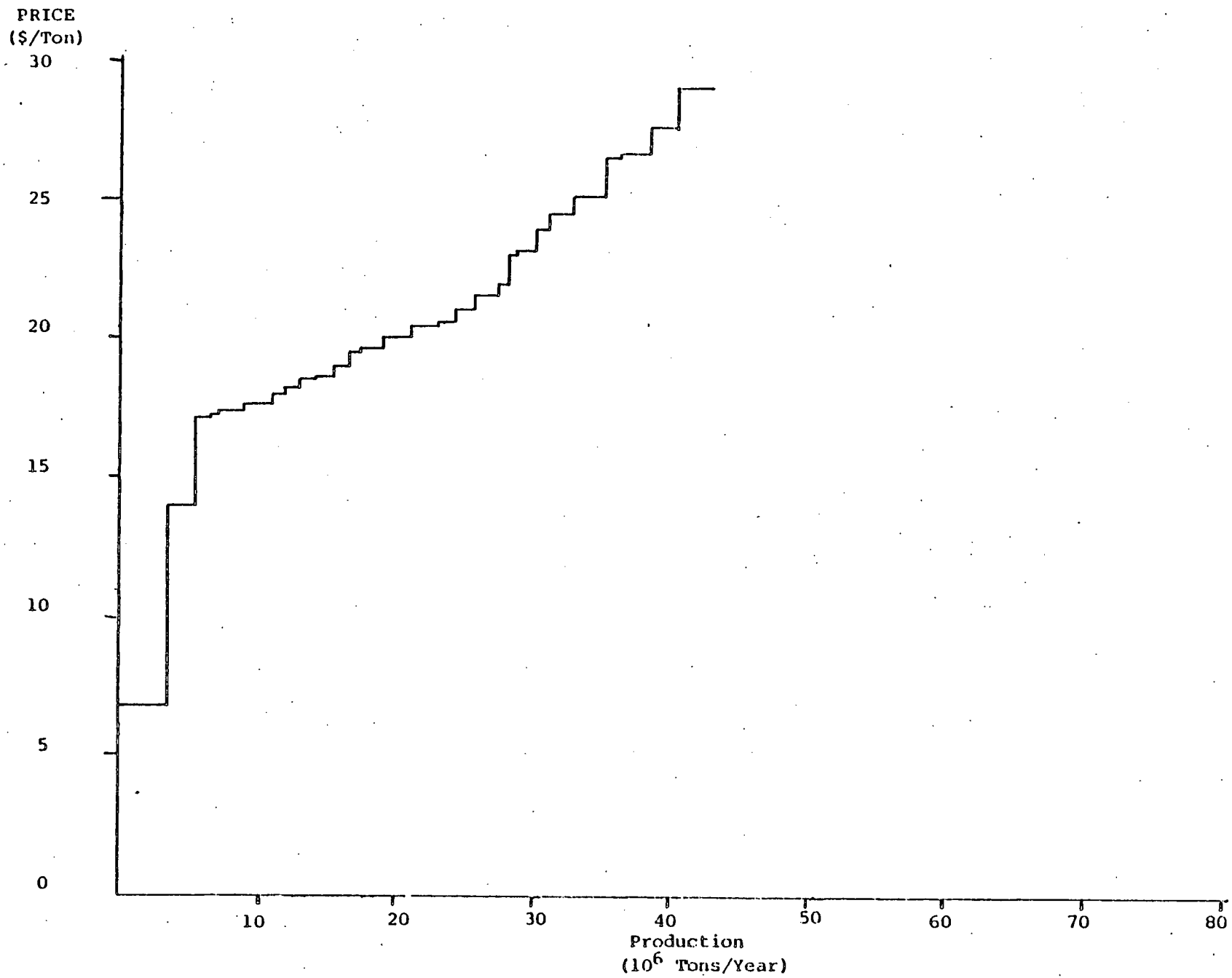


EXHIBIT A-IXb

Region: Southern Appalachia
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 24

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	6.94	4.7	3.7	2.7	4.7	3.7	2.7
DX	14.17	2.9	1.9	0.9	7.6	5.6	3.6
D/48/04/1.0	17.28	1.0	1.0	1.0	8.6	6.6	4.6
D/48/00/0.1	17.44	0.5	0.5	0.5	9.1	7.1	5.1
D/48/07/1.0	17.51	2.0	2.0	2.0	11.1	9.1	7.1
D/48/10/1.0	17.75	2.0	2.0	2.0	13.1	11.1	9.1
D/36/04/1.0	18.10	1.0	1.0	1.0	14.1	12.1	10.1
D/36/07/1.0	18.34	1.0	1.0	1.0	15.1	13.1	11.1
D/36/00/0.1	18.52	0.7	0.7	0.7	15.8	13.8	11.8
D/36/10/1.0	18.59	1.0	1.0	1.0	16.8	14.8	12.8
D/48/04/0.5	18.62	1.0	1.0	1.0	17.8	15.8	13.8
D/48/07/0.5	19.07	1.0	1.0	1.0	18.8	16.8	14.8
D/48/10/0.5	19.51	1.0	1.0	1.0	19.8	17.8	15.8
D/36/04/0.5	19.61	1.0	1.0	1.0	20.8	18.8	16.8
D/28/00/0.1	19.76	0.5	0.5	0.5	21.3	19.3	17.3
D/36/07/0.5	20.07	2.0	2.0	2.0	23.3	21.3	19.3
D/36/10/0.5	20.52	2.0	2.0	2.0	25.3	23.3	21.3
D/28/04/0.5	20.71	1.0	1.0	1.0	26.3	24.3	22.3
D/60/04/0.1	20.96	0.2	0.2	0.2	26.5	24.5	22.5
D/28/07/0.5	21.18	1.5	1.5	1.5	28.0	26.0	24.0
D/28/10/0.5	21.64	1.5	1.5	1.5	29.5	27.5	25.5
D/48/04/0.1	22.05	0.9	0.9	0.9	30.4	28.4	26.4
D/60/07/0.1	23.09	0.3	0.3	0.3	30.7	28.7	26.7
D/36/04/0.1	23.28	1.5	1.5	1.5	32.2	30.2	28.2
D/48/07/0.1	24.16	1.1	1.1	1.1	33.3	31.3	29.3
D/28/04/0.1	24.69	1.8	1.8	1.8	35.1	33.1	31.1
D/36/07/0.1	25.40	2.0	2.0	2.0	37.1	35.1	33.1
D/60/10/0.1	25.47	0.3	0.3	0.3	37.4	35.4	33.4
D/48/10/0.1	26.54	1.1	1.1	1.1	38.5	36.5	34.5
D/28/07/0.1	26.83	2.4	2.4	2.4	40.9	38.9	36.9
D/36/10/0.1	27.74	2.0	2.0	2.0	42.9	40.9	38.9
D/28/10/0.1	29.10	2.4	2.4	2.4	45.3	43.3	41.3

EXHIBIT A-Xa

Region: Midwest
Product Class: Low Sulfur

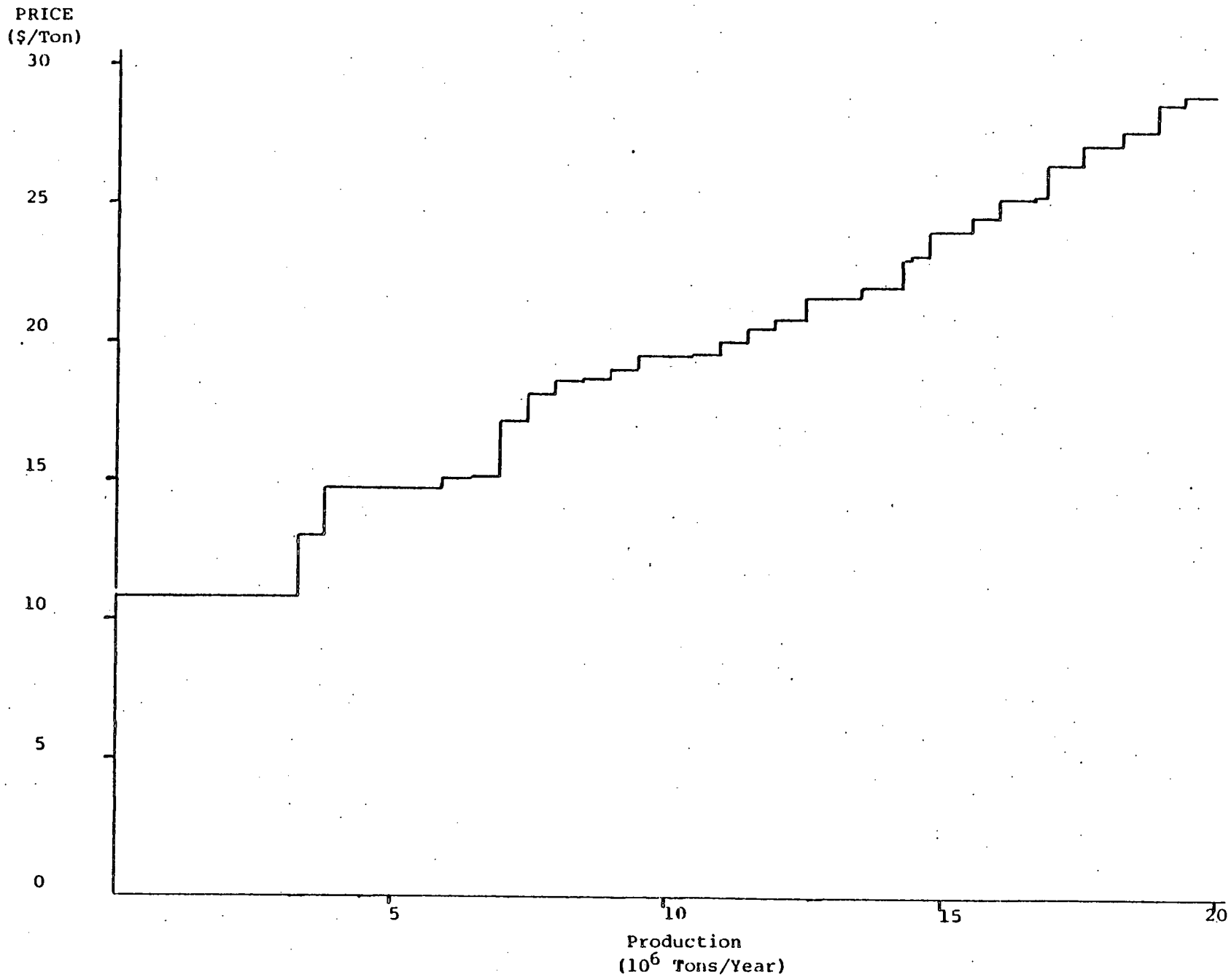


EXHIBIT A-Xb

Region: Midwest
Product Class: Low Sulfur
BTU Content (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	10.90	3.3	3.3	3.3	3.3	3.3	3.3
SY	13.02	0.4	0.4	0.4	3.7	3.7	3.7
DX	14.80	2.2	2.2	2.2	5.9	5.9	5.9
DY	15.08	0.6	0.6	0.6	6.5	6.5	6.5
S/20/0.5	15.15	0.5	0.5	0.5	7.0	7.0	7.0
S/25/0.5	17.27	0.5	0.5	0.5	7.5	7.5	7.5
D/60/07/0.5	18.14	0.5	0.5	0.5	8.0	8.0	8.0
D/60/10/0.5	18.57	0.5	0.5	0.5	8.5	8.5	8.5
D/48/04/0.5	18.62	0.5	0.5	0.5	9.0	9.0	9.0
D/48/07/0.5	19.07	0.5	0.5	0.5	9.5	9.5	9.5
D/48/10/0.5	19.51	0.5	0.5	0.5	10.0	10.0	10.0
S/30/0.5	19.54	0.5	0.5	0.5	10.5	10.5	10.5
D/36/04/0.5	19.61	0.5	0.5	0.5	11.0	11.0	11.0
D/36/07/0.5	20.07	0.5	0.5	0.5	11.5	11.5	11.5
D/36/10/0.5	20.52	0.5	0.5	0.5	12.0	12.0	12.0
D/60/04/0.1	20.96	0.6	0.6	0.6	12.6	12.6	12.6
S/45/1.0	21.59	1.0	1.0	1.0	13.6	13.6	13.6
D/48/04/0.1	22.05	0.6	0.6	0.6	14.2	14.2	14.2
D/60/07/0.1	23.09	0.2	0.2	0.2	14.4	14.4	14.4
D/36/04/0.1	23.28	0.4	0.4	0.4	14.8	14.8	14.8
D/48/07/0.1	24.16	0.8	0.8	0.8	15.6	15.6	15.6
D/20/04/0.1	24.69	0.5	0.5	0.5	16.1	16.1	16.1
D/36/07/0.1	25.40	0.6	0.6	0.6	16.7	16.7	16.7
D/60/10/0.1	25.47	0.2	0.2	0.2	16.9	16.9	16.9
D/48/10/0.1	26.54	0.8	0.8	0.8	17.7	17.7	17.7
D/28/07/0.1	26.83	0.6	0.6	0.6	18.3	18.3	18.3
D/36/10/0.1	27.74	0.6	0.6	0.6	18.9	18.9	18.9
S/45/0.5	28.82	0.5	0.5	0.5	19.4	19.4	19.4
D/28/10/0.1	29.10	0.6	0.6	0.6	20.0	20.0	20.0

EXHIBIT A-XIa

Region: Midwest
Product Class: High Sulfur

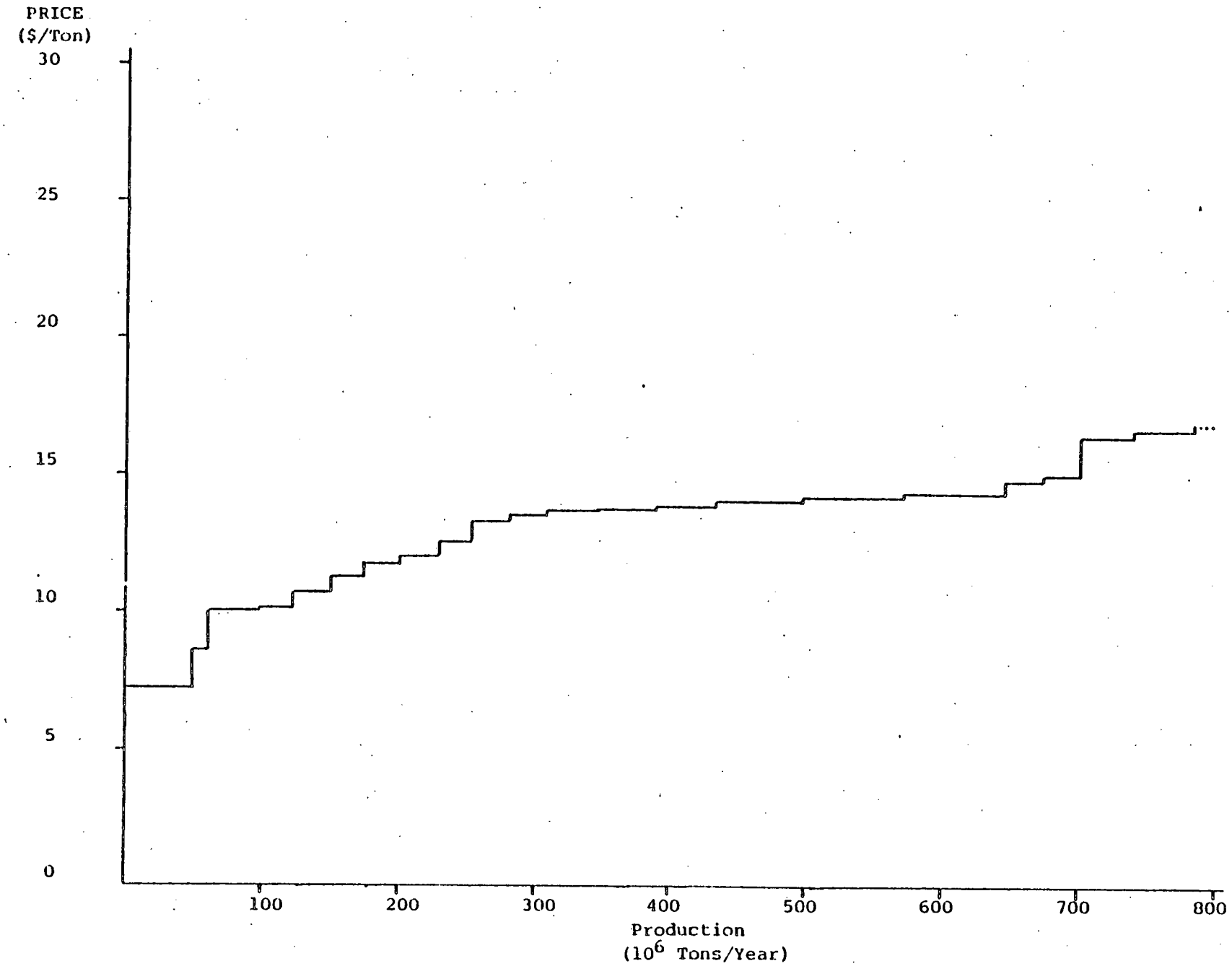


EXHIBIT A-XIb

Region: Midwest
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	7.20	63.5	49.5	35.5	63.5	49.5	35.5
SY	8.66	11.4	11.4	11.4	74.9	60.9	46.9
DX	10.03	41.3	31.8	22.3	116.2	83.2	69.2
DY	10.08	16.0	16.0	16.0	132.2	99.2	85.2
S/20/3.0	10.13	24.0	24.0	24.0	156.2	123.2	109.2
S/20/2.0	10.78	28.0	28.0	28.0	184.2	151.2	137.2
S/25/3.0	11.35	24.0	24.0	24.0	208.2	175.2	161.2
S/20/1.0	11.84	27.0	27.0	27.0	235.2	202.2	188.2
S/25/2.0	12.10	28.0	28.0	28.0	263.2	230.2	216.2
S/30/3.0	12.63	24.0	24.0	24.0	287.2	254.2	240.2
S/25/1.0	13.34	28.0	28.0	28.0	315.2	282.2	268.2
S/30/2.0	13.51	28.0	28.0	28.0	343.2	310.2	296.2
D/60/04/2.0	13.62	36.0	36.0	36.0	379.2	346.2	332.2
D/60/07/2.0	13.76	44.0	44.0	44.0	423.2	390.2	376.2
D/60/10/2.0	13.91	44.0	44.0	44.0	467.2	434.2	420.2
D/48/04/2.0	14.16	64.0	64.0	64.0	531.2	498.2	484.2
D/48/07/2.0	14.31	74.0	74.0	74.0	605.2	572.2	558.2
D/48/10/2.0	14.46	74.0	74.0	74.0	679.2	646.2	632.2
S/30/1.0	14.95	28.0	28.0	28.0	707.2	674.2	660.2
S/20/0.5	15.15	27.0	27.0	27.0	734.2	701.2	687.2
D/60/04/1.0	16.50	39.0	39.0	39.0	773.2	740.2	726.2
D/60/07/1.0	16.73	44.0	44.0	44.0	817.2	784.2	770.2
D/60/10/1.0	16.95	44.0	44.0	44.0	861.2	828.2	814.2
S/25/0.5	17.27	26.5	26.5	26.5	887.7	854.7	840.7
D/48/04/1.0	17.28	65.0	65.0	65.0	952.7	919.7	905.7
S/45/3.0	17.34	78.0	78.0	78.0	1,030.7	997.7	983.7
D/48/07/1.0	17.51	76.0	76.0	76.0	1,106.7	1,073.7	1,059.7
D/60/04/0.5	17.71	38.0	38.0	38.0	1,144.7	1,111.7	1,097.7
D/48/10/1.0	17.75	76.0	76.0	76.0	1,220.7	1,187.7	1,173.7
D/36/04/1.0	18.10	55.0	55.0	55.0	1,275.7	1,242.7	1,228.7
D/60/07/0.5	18.14	43.5	43.5	43.5	1,319.2	1,286.2	1,272.2
D/36/07/1.0	18.34	63.0	63.0	63.0	1,382.2	1,349.2	1,335.2
D/60/10/0.5	18.57	43.5	43.5	43.5	1,425.7	1,392.7	1,378.7
D/36/10/1.0	18.59	63.0	63.0	63.0	1,488.7	1,455.7	1,441.7
D/48/04/0.5	18.62	64.5	64.5	64.5	1,553.2	1,520.2	1,506.2
S/45/2.0	18.90	80.0	80.0	80.0	1,633.2	1,600.2	1,586.2
D/48/07/0.5	19.07	76.0	76.0	76.0	1,709.2	1,676.2	1,662.2
D/48/10/0.5	19.51	76.0	76.0	76.0	1,769.2	1,752.2	1,738.2
S/30/0.5	19.54	26.5	26.5	26.5	1,795.7	1,778.7	1,764.7

EXHIBIT A-XIb (Continued)

Region: Midwest
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
D/36/04/0.5	19.61	56.0	56.0	56.0	1,851.7	1,834.7	1,820.7
D/36/07/0.5	20.07	63.5	63.5	63.5	1,915.2	1,898.2	1,884.2
D/36/10/0.5	20.52	63.5	63.5	63.5	1,978.7	1,961.7	1,947.7
D/28/04/0.5	20.71	25.5	25.5	25.5	2,004.2	1,987.2	1,973.2
D/60/04/0.1	20.96	38.2	38.2	38.2	2,042.4	2,025.4	2,011.4
D/28/07/0.5	21.18	27.0	27.0	27.0	2,069.4	2,052.4	2,038.4
S/45/1.0	21.59	81.0	81.0	81.0	2,150.4	2,133.4	2,119.4
D/28/10/0.5	21.64	27.0	27.0	27.0	2,177.4	2,160.4	2,146.4
D/48/04/0.1	22.05	65.6	65.6	65.6	2,243.0	2,226.0	2,212.0
D/60/07/0.1	23.09	44.8	44.8	44.8	2,287.8	2,270.8	2,256.8
D/36/04/0.1	23.28	57.8	57.8	57.8	2,345.6	2,328.6	2,314.6
D/48/07/0.1	24.16	76.4	76.4	76.4	2,422.0	2,405.0	2,391.0
D/28/04/0.1	24.69	26.6	26.6	26.6	2,448.6	2,431.6	2,417.6
D/36/07/0.1	25.40	65.9	65.9	65.9	2,514.5	2,497.5	2,483.5
D/60/10/0.1	25.47	44.8	44.8	44.8	2,559.3	2,542.3	2,528.3
D/48/10/0.1	26.54	76.4	76.4	76.4	2,635.7	2,618.7	2,604.7
D/28/07/0.1	26.83	27.7	27.7	27.7	2,663.4	2,646.4	2,632.4
D/36/10/0.1	27.74	65.9	65.9	65.9	2,729.3	2,712.3	2,698.3
S/45/0.5	28.82	80.5	80.5	80.5	2,809.8	2,792.8	2,778.8
D/28/10/0.1	29.10	27.7	27.7	27.7	2,837.5	2,820.5	2,806.5

EXHIBIT A-XIIa

Region: Central West

Product Class: Metallurgical

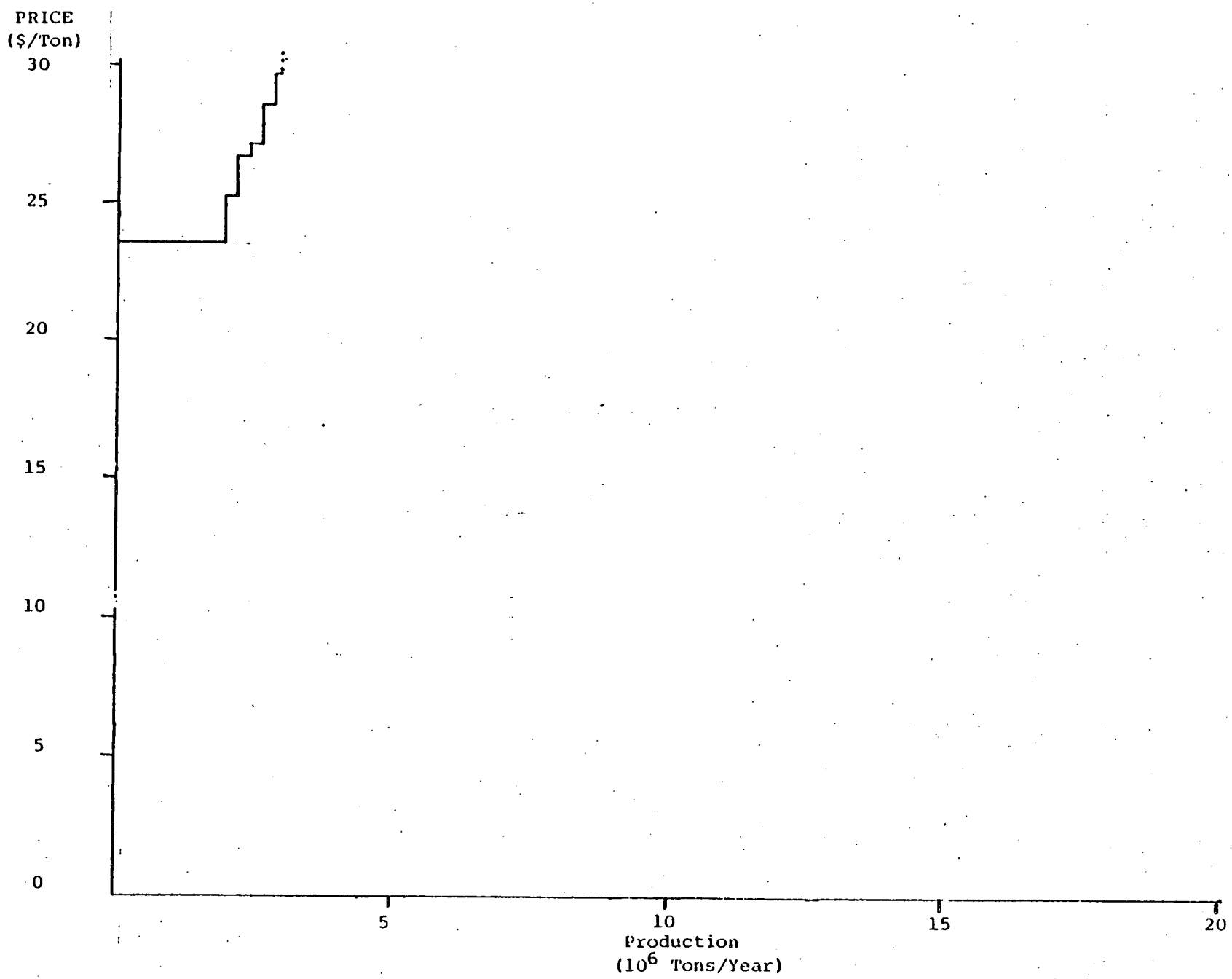


EXHIBIT A-XIIb

Region: Central West
Product Class: Metallurgical
BTU CONTENT (10^6 BTU/TON): --

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
S/45/1.0	23.59	2.0	2.0	2.0	2.0	2.0	2.0
D/36/04/0.1	25.28	0.2	0.2	0.2	2.2	2.2	2.2
D/28/04/0.1	26.69	0.2	0.2	0.2	2.4	2.4	2.4
D/36/07/0.1	27.40	0.2	0.2	0.2	2.6	2.6	2.6
D/28/07/0.1	28.83	0.2	0.2	0.2	2.8	2.8	2.8
D/36/10/0.1	29.74	0.2	0.2	0.2	3.0	3.0	3.0
S/45/0.5	30.82	1.5	1.5	1.5	4.5	4.5	4.5
D/28/10/0.1	31.10	0.2	0.2	0.2	4.7	4.7	4.7

EXHIBIT A-XIIIa

Region: Central West
Product Class: High Sulfur

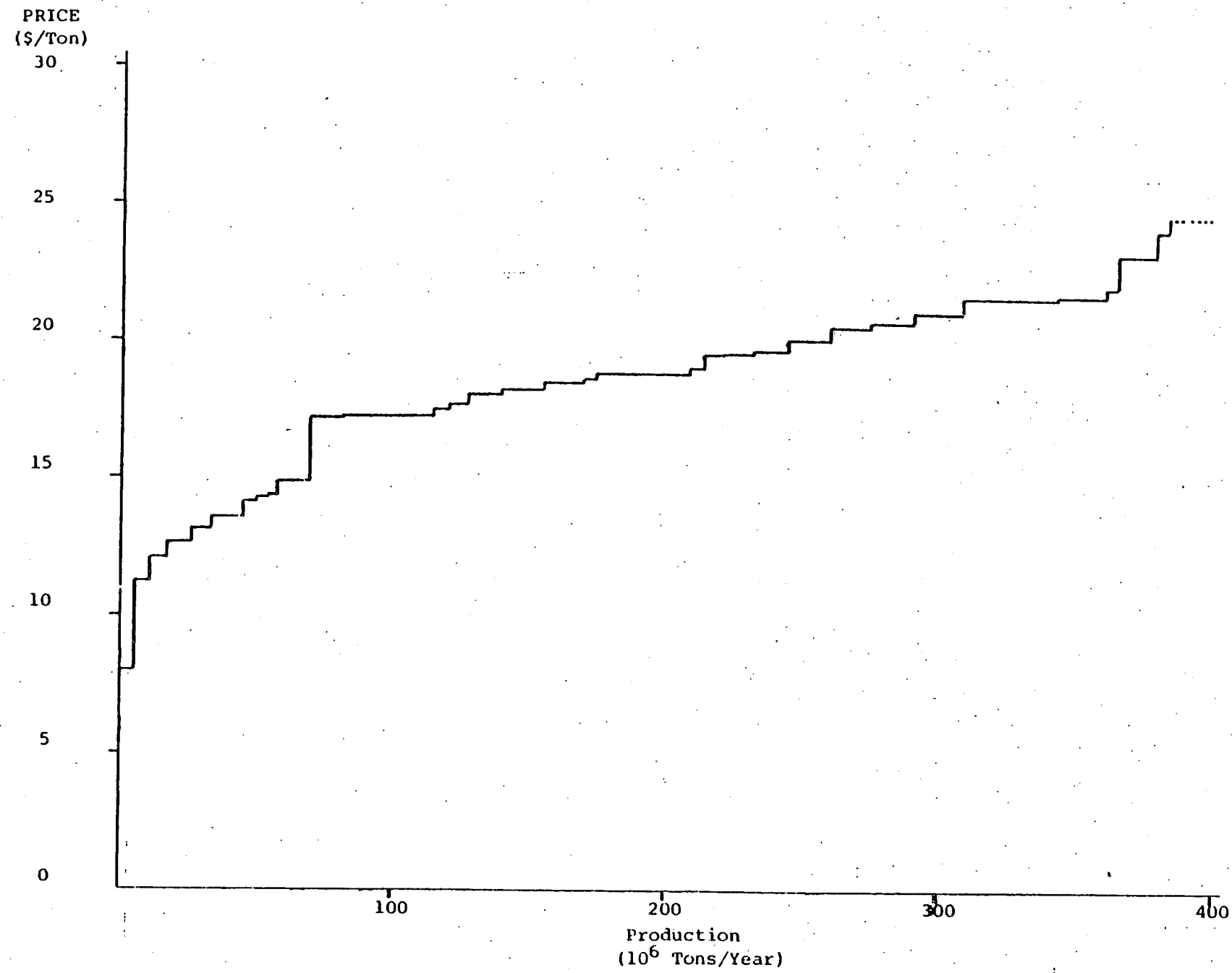


EXHIBIT A-XIIIb

Region: Central West
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	7.99	7.3	5.8	4.3	7.3	5.8	4.3
S/25/3.0	11.35	6.0	6.0	6.0	13.3	11.8	10.3
S/25/2.0	12.10	6.0	6.0	6.0	19.3	17.8	16.3
S/30/3.0	12.63	9.0	9.0	9.0	28.3	26.8	25.3
S/25/1.0	13.34	7.0	7.0	7.0	35.3	33.8	32.3
S/30/2.0	13.51	12.0	12.0	12.0	47.3	45.8	44.3
D/48/04/2.0	14.16	4.0	4.0	4.0	51.3	49.8	48.3
D/48/07/2.0	14.31	4.0	4.0	4.0	55.3	53.8	52.8
D/48/10/2.0	14.46	4.0	4.0	4.0	59.3	57.8	56.3
S/30/1.0	14.95	12.0	12.0	12.0	71.3	69.8	68.3
S/25/0.5	17.27	7.0	7.0	7.0	78.3	76.8	75.3
D/48/04/1.0	17.28	5.0	5.0	5.0	83.3	81.8	80.3
S/45/3.0	17.34	33.0	33.0	33.0	116.3	114.8	113.3
D/48/07/1.0	17.51	6.0	6.0	6.0	122.3	120.8	119.3
D/48/10/1.0	17.75	6.0	6.0	6.0	128.3	126.8	125.3
D/36/04/1.0	18.10	13.0	13.0	13.0	141.3	139.8	138.3
D/36/07/1.0	18.34	15.0	15.0	15.0	156.3	154.8	153.3
D/36/10/1.0	18.59	15.0	15.0	15.0	171.3	169.8	168.3
D/48/04/0.5	18.62	4.5	4.5	4.5	175.8	174.3	172.8
S/45/2.0	18.90	34.0	34.0	34.0	209.8	208.3	206.8
D/48/07/0.5	19.07	6.0	6.0	6.0	215.8	214.3	212.8
D/48/10/0.5	19.51	6.0	6.0	6.0	221.8	220.3	218.8
S/30/0.5	19.54	11.5	11.5	11.5	233.3	231.8	230.3
D/36/04/0.5	19.61	13.0	13.0	13.0	246.3	244.8	243.3
D/36/07/0.5	20.07	15.0	15.0	15.0	261.3	259.8	258.3
D/36/10/0.5	20.52	15.0	15.0	15.0	276.3	274.8	273.3
D/28/04/0.5	20.71	15.5	15.5	15.5	291.8	290.3	288.8
D/28/07/0.5	21.18	18.0	18.0	18.0	309.8	308.3	306.8
S/45/1.0	21.59	34.0	34.0	34.0	343.8	342.3	340.8
D/28/10/0.5	21.64	18.0	18.0	18.0	361.8	360.3	358.8
D/48/04/0.1	22.05	4.7	4.7	4.7	366.5	365.0	363.5
D/36/04/0.1	23.28	13.6	13.6	13.6	380.1	378.6	377.1
D/48/07/0.1	24.16	5.5	5.5	5.5	385.6	384.1	382.6
D/28/04/0.1	24.69	16.1	16.1	16.1	401.7	400.2	398.7
D/36/07/0.1	25.40	16.2	16.2	16.2	417.9	416.4	414.9
D/48/10/0.1	26.54	5.5	5.5	5.5	423.4	421.9	420.4
D/28/07/0.1	26.83	18.9	18.9	18.9	442.3	440.8	439.3
D/36/10/0.1	27.74	16.2	16.2	16.2	458.4	457.0	455.5
S/45/0.5	28.82	34.0	34.0	34.0	492.5	491.0	489.5
D/28/10/0.1	29.10	18.9	18.9	18.9	511.4	509.9	508.4

EXHIBIT A-XIVa

Region: Gulf
Product Class: High Sulfur

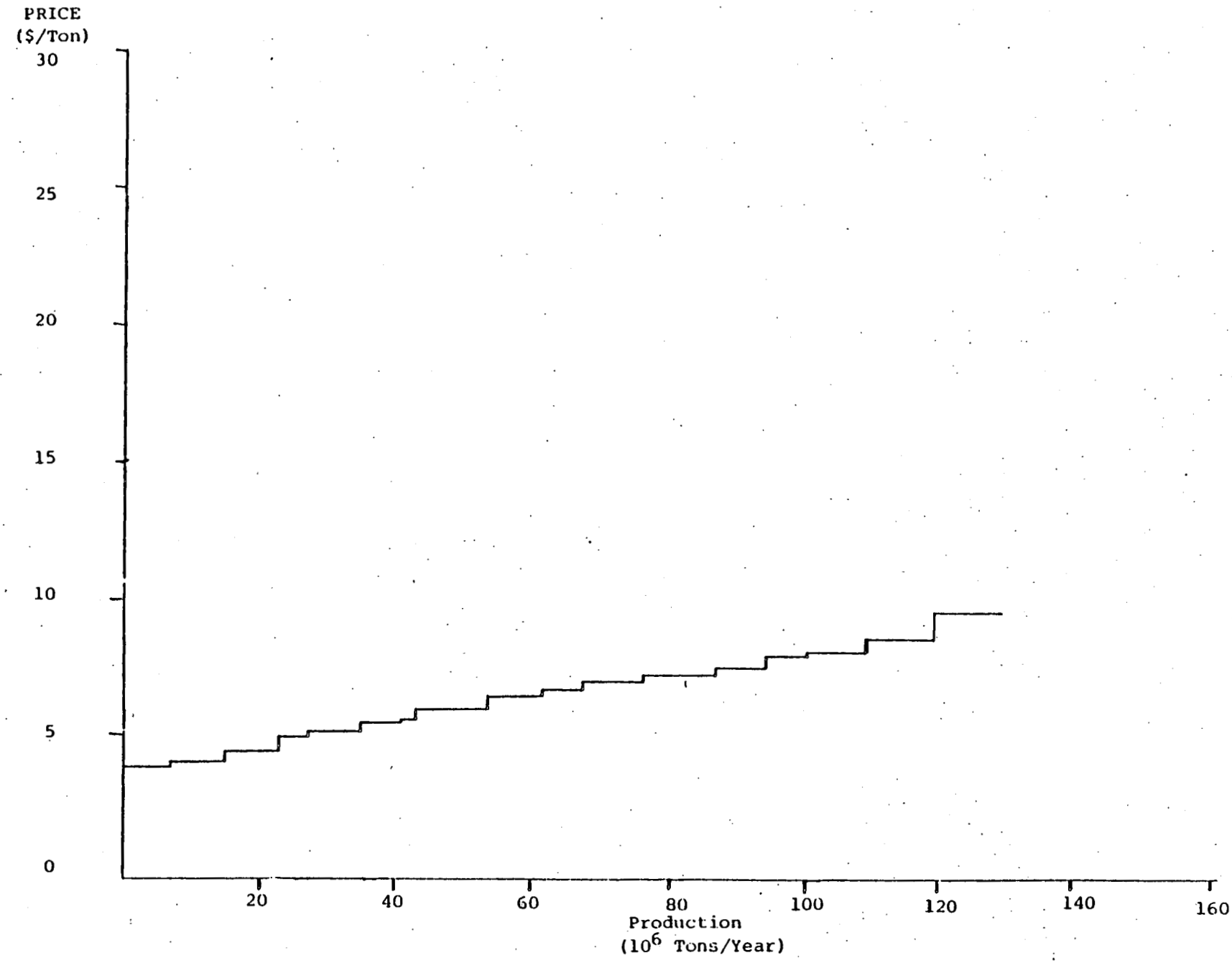


EXHIBIT A-XIVb

Region: Gulf
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 14

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	4.03	7.7	7.7	7.7	7.7	7.7	7.7
SY	4.39	9.1	9.1	9.1	16.8	16.8	16.8
S/05/3.0	4.75	6.0	6.0	6.0	22.8	22.8	22.8
S/05/2.0	5.16	4.0	4.0	4.0	26.8	26.8	26.8
S/10/4.0	5.48	8.0	8.0	8.0	34.8	34.8	34.8
S/10/3.0	5.82	6.0	6.0	6.0	40.8	40.8	40.8
S/05/1.0	5.90	3.0	3.0	3.0	43.8	43.8	43.8
S/10/2.0	6.30	10.0	10.0	10.0	53.8	53.8	53.8
S/15/4.0	6.54	8.0	8.0	8.0	61.8	61.8	61.8
S/15/3.0	6.95	6.0	6.0	6.0	67.8	67.8	67.8
S/10/1.0	7.16	9.0	9.0	9.0	76.8	76.8	76.8
S/15/2.0	7.50	10.0	10.0	10.0	86.8	86.8	86.8
S/20/4.0	7.65	8.0	8.0	8.0	94.8	94.8	94.8
S/20/3.0	8.13	6.0	6.0	6.0	100.8	100.8	100.8
S/15/1.0	8.46	9.0	9.0	9.0	109.8	109.8	109.8
S/20/2.0	8.78	10.0	10.0	10.0	119.8	119.8	119.8
S/20/1.0	9.84	9.0	9.0	9.0	128.8	128.8	128.8

EXHIBIT A-XVa

Region: Eastern Northern Great Plains
Product Class: Low Sulfur

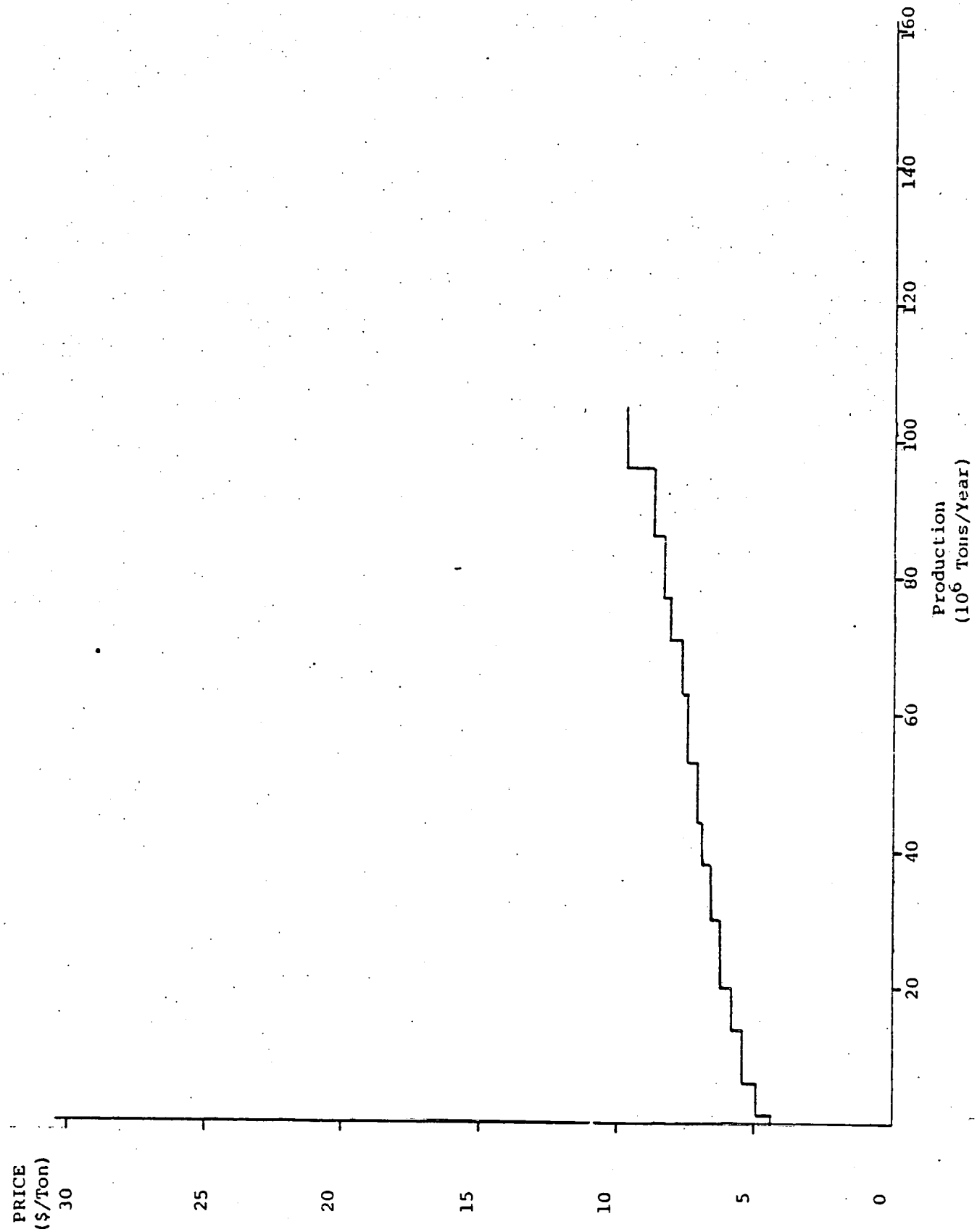


EXHIBIT A-XVb

Region: Eastern Northern Great Plains
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 14

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	4.45	1.7	1.7	1.7	1.7	1.7	1.7
SY	4.96	4.3	4.3	4.3	6.0	6.0	6.0
S/10/4.0	5.48	8.0	8.0	8.0	14.0	14.0	14.0
S/10/3.0	5.82	6.0	6.0	6.0	20.0	20.0	20.0
S/10/2.0	6.30	10.0	10.0	10.0	30.0	30.0	30.0
S/15/4.0	6.54	8.0	8.0	8.0	38.0	38.0	38.0
S/15/3.0	6.95	6.0	6.0	6.0	44.0	44.0	44.0
S/10/1.0	7.16	9.0	9.0	9.0	53.0	53.0	53.0
S/15/2.0	7.50	10.0	10.0	10.0	63.0	63.0	63.0
S/20/4.0	7.65	8.0	8.0	8.0	71.0	71.0	71.0
S/20/3.0	8.13	6.0	6.0	6.0	77.0	77.0	77.0
S/15/1.0	8.46	9.0	9.0	9.0	86.0	86.0	86.0
S/20/2.0	8.78	10.0	10.0	10.0	96.0	96.0	96.0
S/20/1.0	9.84	9.0	9.0	9.0	105.0	105.0	105.0

EXHIBIT A-XVIa

Region: Eastern Northern Great Plains
Product Class: High Sulfur

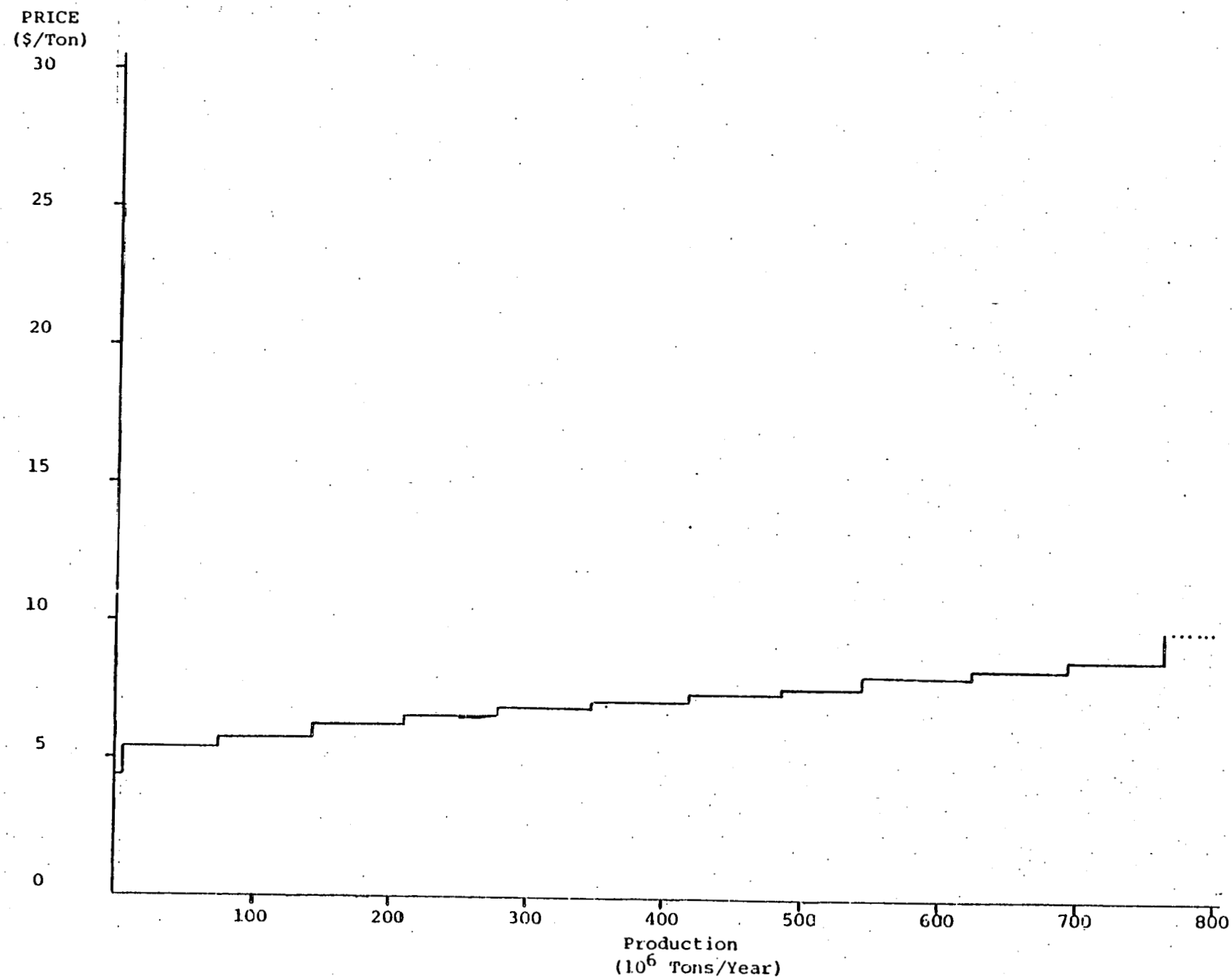


EXHIBIT A-XVIb

Region: Eastern Northern Great Plains
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 14

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	4.45	6.1	6.1	6.1	6.1	6.1	6.1
S/10/4.0	5.48	68.0	68.0	68.0	74.1	74.1	74.1
S/10/3.0	5.82	69.0	69.0	69.0	143.1	143.1	143.1
S/10/2.0	6.30	68.0	68.0	68.0	211.1	211.1	211.1
S/15/4.0	6.54	68.0	68.0	68.0	279.1	279.1	279.1
S/15/3.0	6.95	69.0	69.0	68.0	348.1	348.1	348.1
S/10/1.0	7.16	70.0	70.0	70.0	418.1	418.1	418.1
S/15/2.0	7.50	68.0	68.0	68.0	486.1	486.1	486.1
S/20/4.0	7.65	68.0	68.0	68.0	554.1	554.1	554.1
S/20/3.0	8.13	69.0	69.0	69.0	623.1	623.1	623.1
S/15/1.0	8.46	70.0	70.0	70.0	693.1	693.1	693.1
S/20/2.0	8.78	70.0	70.0	70.0	763.1	763.1	763.1
S/20/1.0	9.84	69.0	69.0	69.0	832.1	832.1	832.1

EXHIBIT A-XVIIa

Region: Western Northern Great Plains

Product Class: Low Sulfur

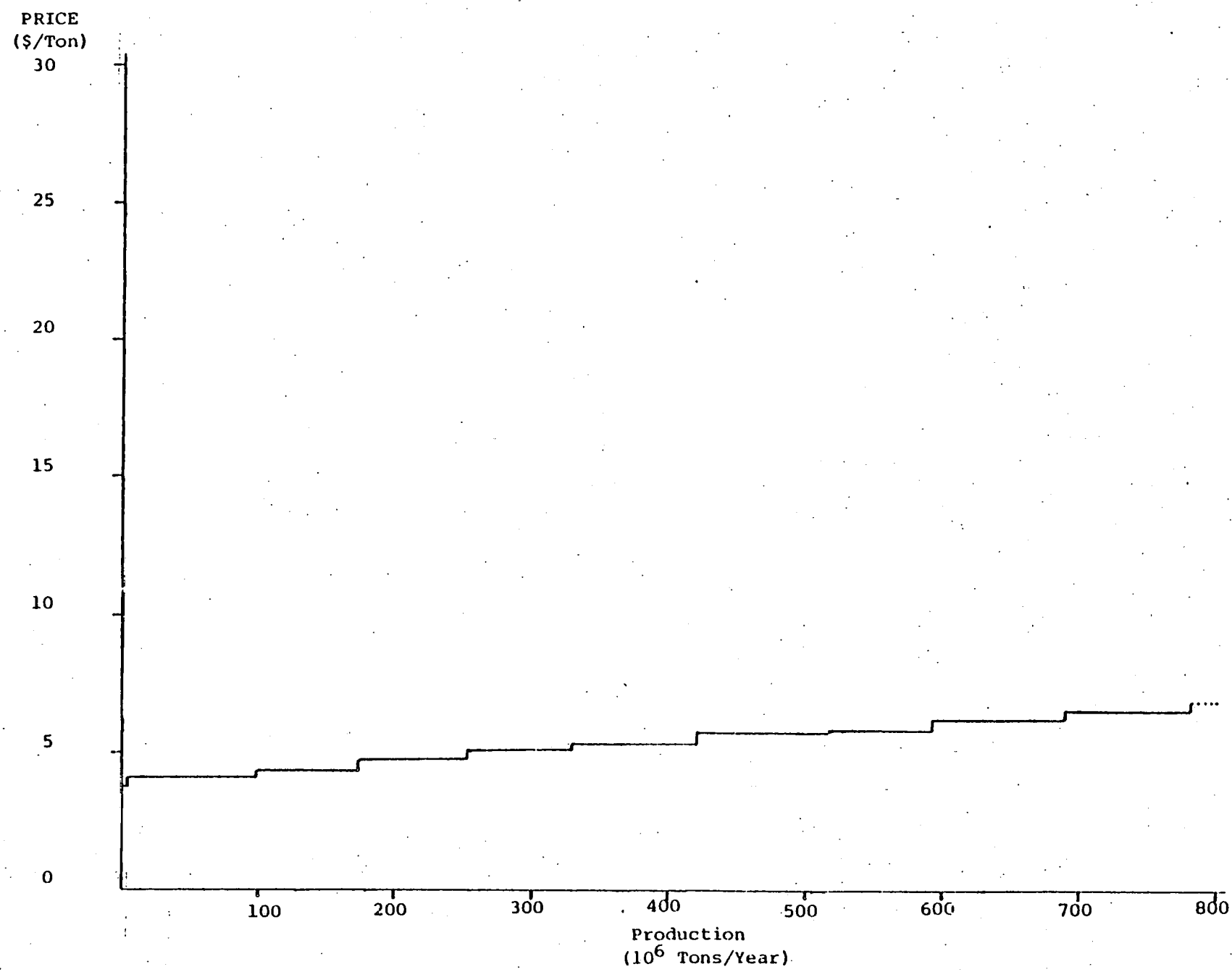


EXHIBIT A-XVIIb

Region: Western Northern Great Plains
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 19

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	3.80	2.0	2.0	2.0	2.0	2.0	2.0
SY	4.14	97.3	97.3	97.3	99.3	99.3	99.3
DX	4.38	0.1	0.1	0.1	99.4	99.4	99.4
DY	4.43	1.8	1.8	1.8	101.2	101.2	101.2
S/05/4.0	4.48	72.0	72.0	72.0	173.2	173.2	173.2
S/05/3.0	4.75	78.0	78.0	78.0	251.2	251.2	251.2
S/05/2.0	5.16	78.0	78.0	78.0	329.2	329.2	329.2
S/10/4.0	5.48	92.0	92.0	92.0	421.2	421.2	421.2
S/10/3.0	5.82	96.0	96.0	96.0	517.2	517.2	517.2
S/05/1.0	5.90	76.0	76.0	76.0	593.2	593.2	593.2
S/10/2.0	6.30	96.0	96.0	96.0	689.2	689.2	689.2
S/15/4.0	6.54	92.0	92.0	92.0	781.2	781.2	781.2
S/15/3.0	6.95	96.0	96.0	96.0	877.2	877.2	877.2
S/10/1.0	7.16	94.0	94.0	94.0	971.2	971.2	971.2
S/15/2.0	7.50	96.0	96.0	96.0	1,067.2	1,067.2	1,067.2
S/20/4.0	7.65	92.0	92.0	92.0	1,159.2	1,159.2	1,159.2
S/20/3.0	8.13	96.0	96.0	96.0	1,255.2	1,255.2	1,255.2
S/15/1.0	8.46	94.0	94.0	94.0	1,349.2	1,349.2	1,349.2
S/20/2.0	8.78	96.0	96.0	96.0	1,445.2	1,445.2	1,445.2
S/20/1.0	9.84	94.0	94.0	94.0	1,539.2	1,539.2	1,539.2
D/72/04/3.0	9.89	114.0	114.0	114.0	1,653.2	1,653.2	1,653.2
D/72/07/3.0	10.00	114.0	114.0	114.0	1,767.2	1,767.2	1,767.2
D/72/10/3.0	10.11	114.0	114.0	114.0	1,881.2	1,881.2	1,881.2
D/72/04/2.0	11.10	114.0	114.0	114.0	1,995.2	1,995.2	1,995.2
D/72/07/2.0	11.24	114.0	114.0	114.0	2,109.2	2,109.2	2,109.2
D/72/10/2.0	11.37	114.0	114.0	114.0	2,223.2	2,223.2	2,223.2
D/60/04/2.0	11.62	54.0	54.0	54.0	2,277.2	2,277.2	2,277.2
D/60/07/2.0	11.76	54.0	54.0	54.0	2,331.2	2,331.2	2,331.2
D/60/10/2.0	11.91	54.0	54.0	54.0	2,385.2	2,385.2	2,385.2
D/72/04/1.0	13.77	115.0	115.0	115.0	2,500.2	2,500.2	2,500.2
D/72/07/1.0	13.98	115.0	115.0	115.0	2,615.2	2,615.2	2,615.2
D/72/10/1.0	14.19	116.0	116.0	116.0	2,731.2	2,731.2	2,731.2
D/60/04/1.0	14.50	56.0	56.0	56.0	2,787.2	2,787.2	2,787.2
D/60/07/1.0	14.73	56.0	56.0	56.0	2,843.2	2,843.2	2,843.2
D/72/04/0.5	14.87	115.0	115.0	115.0	2,958.2	2,958.2	2,958.2
D/60/10/1.0	14.95	57.0	57.0	57.0	3,015.2	3,015.2	3,015.2
D/72/07/0.5	15.28	115.0	115.0	115.0	3,130.2	3,130.2	3,130.2
D/72/10/0.5	15.70	115.5	115.5	115.5	3,245.7	3,245.7	3,245.7
D/60/04/0.5	15.71	56.0	56.0	56.0	3,301.7	3,301.7	3,301.7
D/60/07/0.5	16.14	56.0	56.0	56.0	3,357.7	3,357.7	3,357.7
D/60/10/0.5	16.57	55.5	55.5	55.5	3,413.2	3,413.2	3,413.2
D/72/04/0.1	17.97	116.0	116.0	116.0	3,529.2	3,529.2	3,529.2
D/60/04/0.1	18.96	56.2	56.2	56.2	3,585.4	3,585.4	3,585.4
D/72/07/0.1	20.12	116.0	116.0	116.0	3,701.4	3,701.4	3,701.4
D/60/07/0.1	21.09	56.2	56.2	56.2	3,757.6	3,757.6	3,757.6
D/72/10/0.1	22.49	116.2	116.2	116.2	3,873.8	3,873.8	3,873.8
D/60/10/0.1	23.47	56.4	56.4	56.4	3,930.2	3,930.2	3,930.2

EXHIBIT A-XVIIIa

Region: Western Northern Great Plains
Product Class: High Sulfur

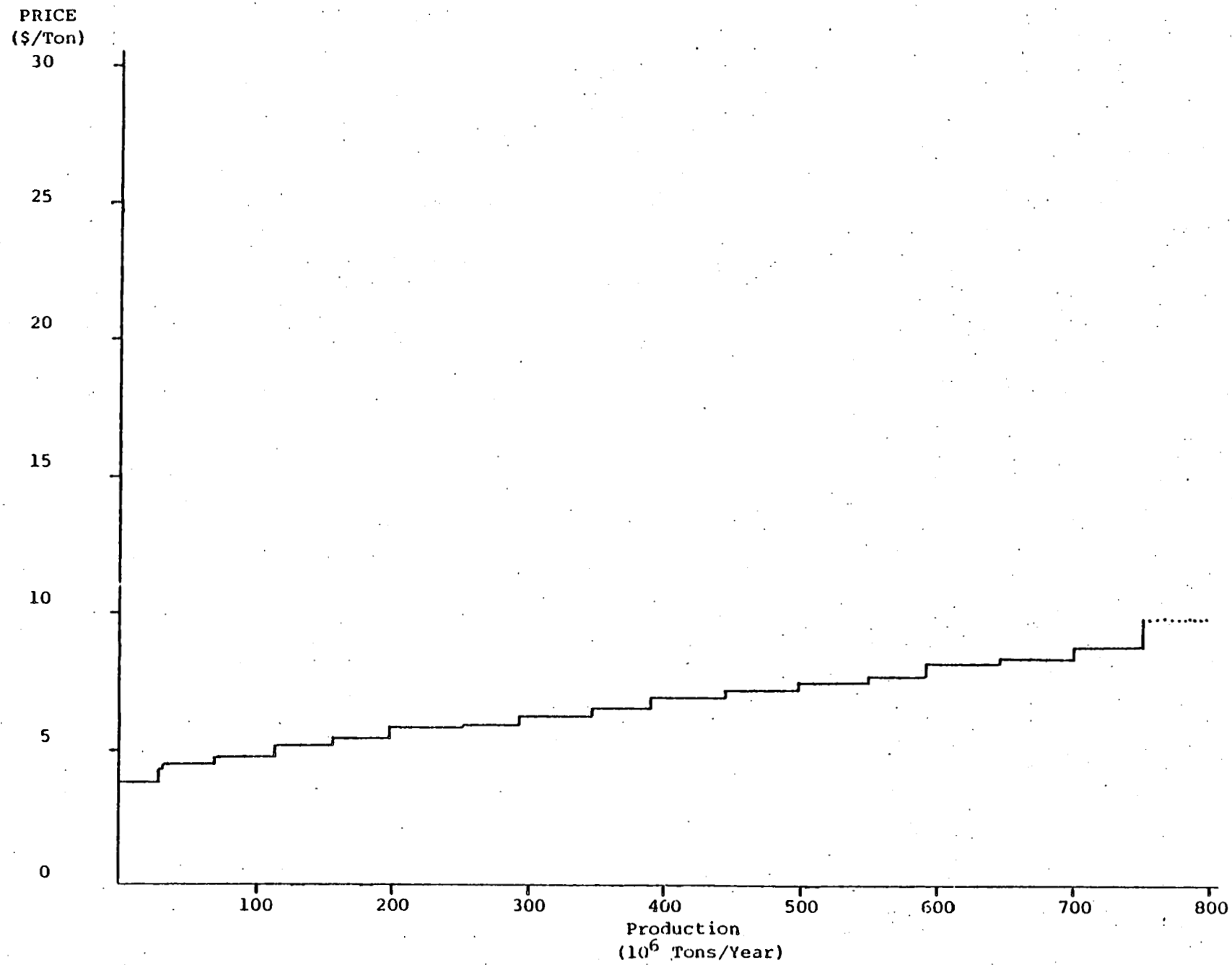


EXHIBIT A-XVIIIb

Region: Western Northern Great Plains
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 19

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	3.80	29.0	29.0	29.0	29.0	29.0	29.0
DX	4.38	1.2	1.2	1.2	30.2	30.2	30.2
S/05/4.0	4.48	40.0	40.0	40.0	70.2	70.2	70.2
S/05/3.0	4.75	45.0	45.0	45.0	115.2	115.2	115.2
S/05/2.0	5.16	42.0	42.0	42.0	157.2	157.2	157.2
S/10/4.0	5.48	42.0	42.0	42.0	199.2	199.2	199.2
S/10/3.0	5.82	54.0	54.0	54.0	253.2	253.2	253.2
S/05/1.0	5.90	43.0	43.0	43.0	296.2	296.2	296.2
S/10/2.0	6.30	52.0	52.0	52.0	348.2	348.2	348.2
S/15/4.0	6.54	42.0	42.0	42.0	390.2	390.2	390.2
S/15/3.0	6.95	54.0	54.0	54.0	444.2	444.2	444.2
S/10/1.0	7.16	54.0	54.0	54.0	498.2	498.2	498.2
S/15/2.0	7.50	52.0	52.0	52.0	550.2	550.2	550.2
S/20/4.0	7.65	42.0	42.0	42.0	592.2	592.2	592.2
S/20/3.0	8.13	54.0	54.0	54.0	646.2	646.2	646.2
S/15/1.0	8.46	54.0	54.0	54.0	700.2	700.2	700.2
S/20/2.0	8.78	52.0	52.0	52.0	752.2	752.2	752.2
S/20/1.0	9.84	54.0	54.0	54.0	806.2	806.2	806.2
D/72/04/3.0	9.89	15.0	15.0	15.0	821.2	821.2	821.2
D/72/07/3.0	10.00	15.0	15.0	15.0	836.2	836.2	836.2
D/72/10/3.0	10.11	15.0	15.0	15.0	851.2	851.2	851.2
D/72/04/2.0	11.10	18.0	18.0	18.0	869.2	869.2	869.2
D/72/07/2.0	11.24	18.0	18.0	18.0	887.2	887.2	887.2
D/72/10/2.0	11.37	18.0	18.0	18.0	905.2	905.2	905.2
D/60/04/2.0	11.62	8.0	8.0	8.0	913.2	913.2	913.2
D/60/07/2.0	11.76	8.0	8.0	8.0	921.2	921.2	921.2
D/60/10/2.0	11.91	8.0	8.0	8.0	929.2	929.2	929.2
D/72/04/1.0	13.77	18.0	18.0	18.0	947.2	947.2	947.2
D/72/07/1.0	13.98	18.0	18.0	18.0	965.2	965.2	965.2
D/72/10/1.0	14.19	18.0	18.0	18.0	983.2	983.2	983.2
D/60/04/1.0	14.50	8.0	8.0	8.0	991.2	991.2	991.2
D/60/07/1.0	14.73	8.0	8.0	8.0	999.2	999.2	999.2
D/72/04/0.5	14.87	17.5	17.5	17.5	1,016.7	1,016.7	1,016.7
D/60/10/1.0	14.95	8.0	8.0	8.0	1,024.7	1,024.7	1,024.7
D/72/07/0.5	15.28	17.5	17.5	17.5	1,042.2	1,042.2	1,042.2
D/72/10/0.5	15.70	18.0	18.0	18.0	1,060.2	1,060.2	1,060.2
D/60/04/0.5	15.71	8.5	8.5	8.5	1,068.7	1,068.7	1,068.7
D/60/07/0.5	16.14	8.5	8.5	8.5	1,077.2	1,077.2	1,077.2
D/60/10/0.5	16.57	9.0	9.0	9.0	1,086.2	1,086.2	1,086.2
D/72/04/0.1	17.97	17.7	17.7	17.7	1,103.9	1,103.9	1,103.9
D/60/04/0.1	18.96	8.8	8.8	8.8	1,112.7	1,112.7	1,112.7
D/72/07/0.1	20.12	17.7	17.7	17.7	1,130.4	1,130.4	1,130.4
D/60/07/0.1	21.09	8.8	8.8	8.8	1,139.2	1,139.2	1,139.2
D/72/10/0.1	22.49	17.5	17.5	17.5	1,156.7	1,156.7	1,156.7
D/60/10/0.1	23.47	8.4	8.4	8.4	1,165.1	1,165.1	1,165.1

EXHIBIT A-XIXa

Region: Rockies
Product Class: Metallurgical

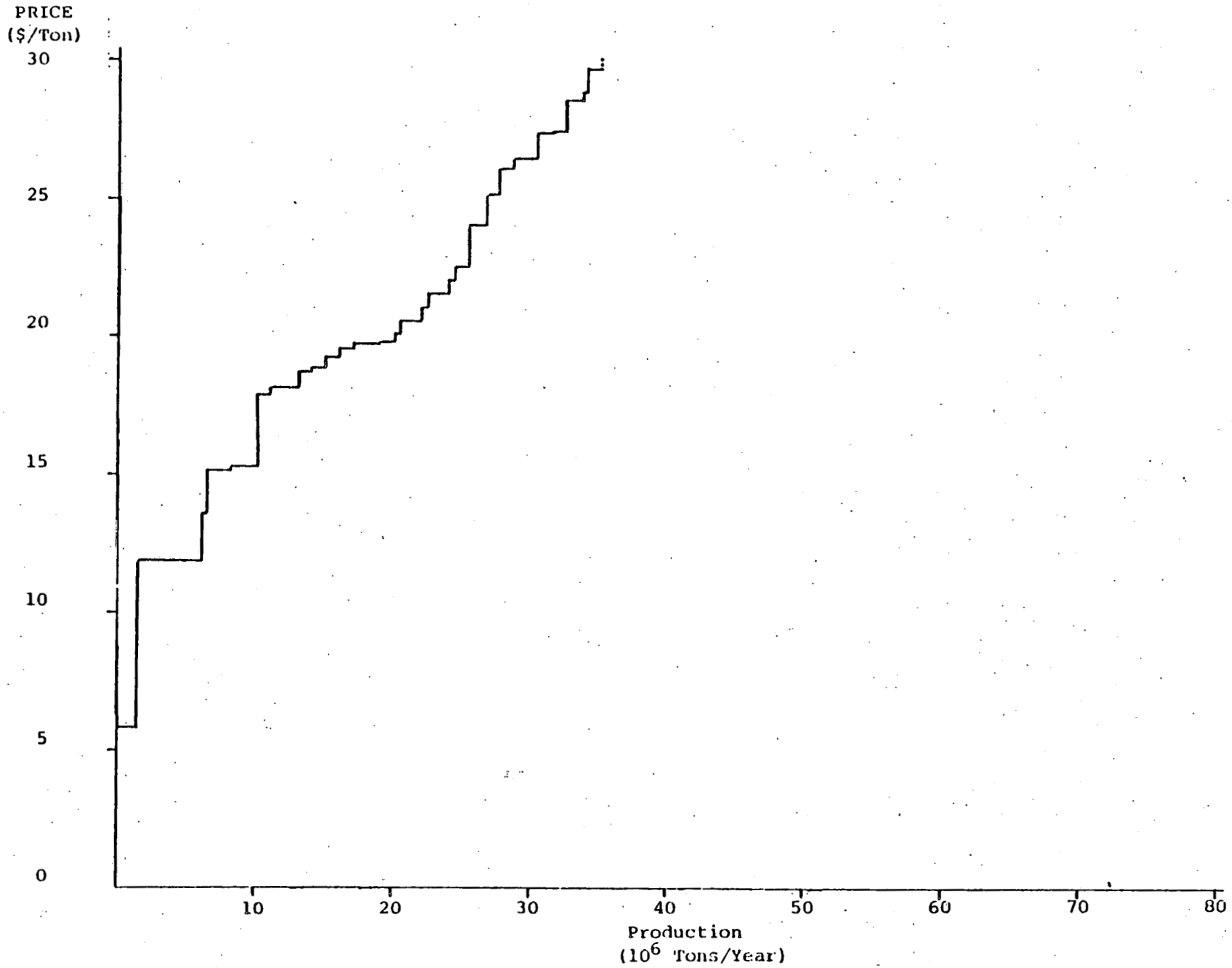


EXHIBIT A-XIXb

Region: Rockies
Product Class: Metallurgical
BTU CONTENT (10^6 BTU/TON: --

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	6.94	1.5	1.5	1.5	1.5	1.5	1.5
DX	11.95	4.6	4.6	4.6	6.1	6.1	6.1
DY	13.60	0.2	0.2	0.2	6.3	6.3	6.3
D/72/07/2.0	15.24	2.0	2.0	2.0	8.3	8.3	8.3
D/72/10/2.0	15.37	2.0	2.0	2.0	10.3	10.3	10.3
D/72/07/1.0	17.98	1.0	1.0	1.0	11.3	11.3	11.3
D/72/10/1.0	18.19	2.0	2.0	2.0	13.3	13.3	13.3
D/60/07/1.0	18.73	1.0	1.0	1.0	14.3	14.3	14.3
D/60/10/1.0	18.95	1.0	1.0	1.0	15.3	15.3	15.3
D/72/07/0.5	19.28	1.0	1.0	1.0	16.3	16.3	16.3
D/48/07/1.0	19.51	1.0	1.0	1.0	17.3	17.3	17.3
D/72/10/0.5	19.70	2.0	2.0	2.0	19.3	19.3	19.3
D/48/10/1.0	19.75	1.0	1.0	1.0	20.3	20.3	20.3
D/60/07/0.5	20.14	0.5	0.5	0.5	20.8	20.8	20.8
D/60/10/0.5	20.57	1.5	1.5	1.5	22.3	22.3	22.3
D/48/07/0.5	21.07	0.5	0.5	0.5	22.8	22.8	22.8
D/48/10/0.5	21.51	1.5	1.5	1.5	24.3	24.3	24.3
D/36/07/0.5	22.07	0.5	0.5	0.5	24.8	24.8	24.8
D/36/10/0.5	22.52	1.0	1.0	1.0	25.8	25.8	25.8
D/72/07/0.1	24.12	1.2	1.2	1.2	27.0	27.0	27.0
D/60/07/0.1	25.09	1.0	1.0	1.0	28.0	28.0	28.0
D/48/07/0.1	26.16	1.0	1.0	1.0	29.0	29.0	29.0
D/72/10/0.1	26.49	1.8	1.8	1.8	30.8	30.8	30.8
D/36/07/0.1	27.40	0.9	0.9	0.9	31.7	31.7	31.7
D/60/10/0.1	27.47	1.2	1.2	1.2	32.9	32.9	32.9
D/48/10/0.1	28.54	1.2	1.2	1.2	34.1	34.1	34.1
D/28/07/0.1	28.83	0.2	0.2	0.2	34.3	34.3	34.3
D/36/10/0.1	29.74	1.1	1.1	1.1	35.4	35.4	35.4
D/28/10/0.1	31.10	0.3	0.3	0.3	35.7	35.7	35.7

EXHIBIT A-XXa

Region: Rockies
Product Class: Low Sulfur

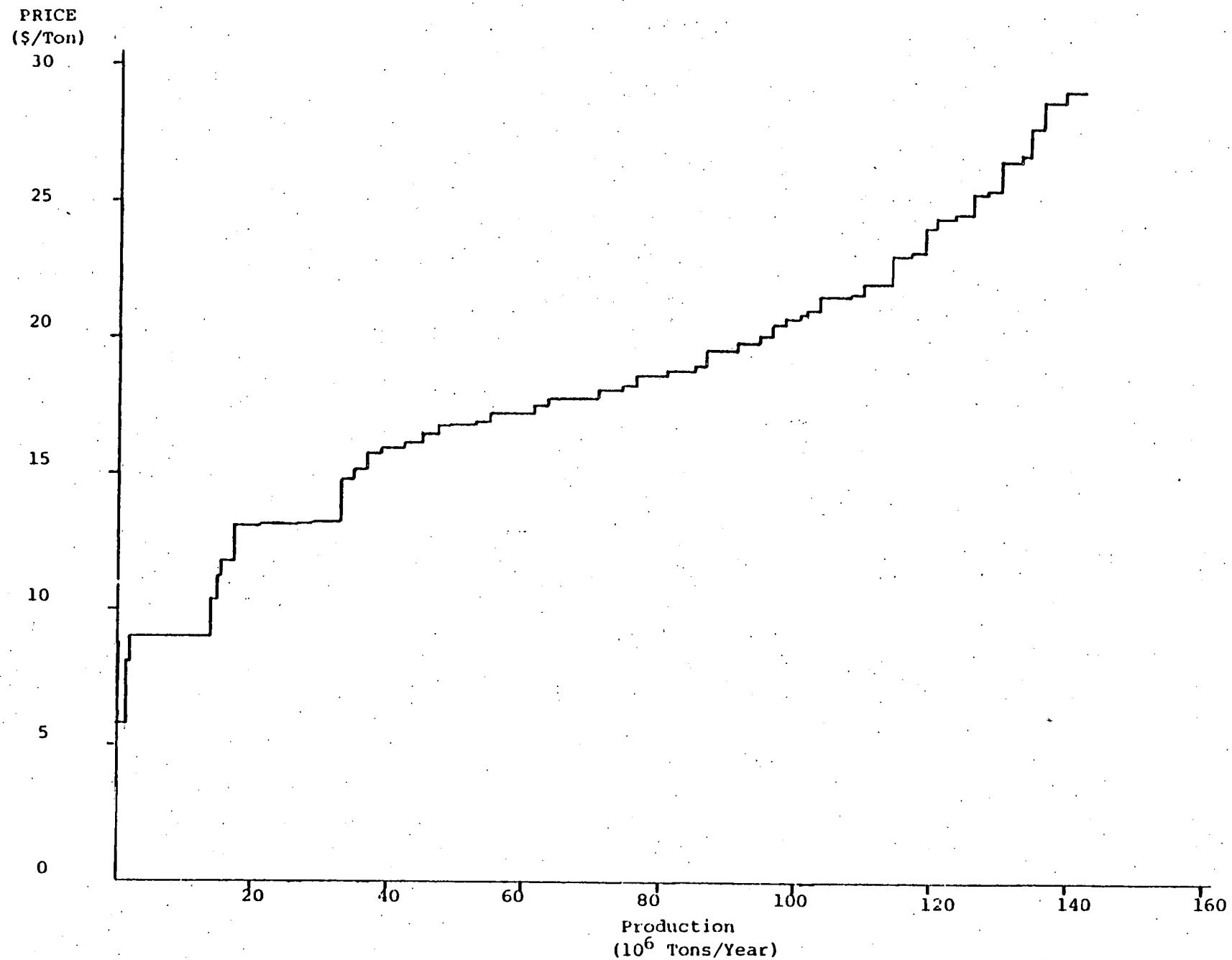


EXHIBIT A-XXb

Region: Rockies
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	6.94	1.7	1.7	1.7	1.7	1.7	1.7
SY	8.05	0.2	0.2	0.2	1.9	1.9	1.9
DX	9.06	4.2	4.2	4.2	6.1	6.1	6.1
DY	9.11	5.6	5.6	5.6	11.7	11.7	11.7
S/10/1.0	9.16	1.0	1.0	1.0	12.7	12.7	12.7
S/15/1.0	10.46	2.0	2.0	2.0	14.7	14.7	14.7
S/10/0.5	11.21	0.5	0.5	0.5	15.2	15.2	15.2
S/20/1.0	11.84	2.0	2.0	2.0	17.2	17.2	17.2
D/72/04/2.0	13.10	4.0	4.0	4.0	21.2	21.2	21.2
S/15/0.5	13.14	1.5	1.5	1.5	22.7	22.7	22.7
D/72/07/2.0	13.24	4.0	4.0	4.0	26.7	26.7	26.7
S/25/1.0	13.34	2.0	2.0	2.0	28.7	28.7	28.7
D/72/10/2.0	13.37	4.0	4.0	4.0	32.7	32.7	32.7
S/30/1.0	14.95	2.0	2.0	2.0	34.7	34.7	34.7
S/20/0.5	15.15	1.5	1.5	1.5	36.2	36.2	36.2
D/72/04/1.0	15.77	3.0	3.0	3.0	39.2	39.2	39.2
D/72/07/1.0	15.98	3.0	3.0	3.0	42.2	42.2	42.2
D/72/10/1.0	16.19	3.0	3.0	3.0	45.2	45.2	45.2
D/60/04/1.0	16.50	2.0	2.0	2.0	47.2	47.2	47.2
D/60/07/1.0	16.73	2.0	2.0	2.0	49.2	49.2	49.2
D/72/04/0.5	16.87	3.5	3.5	3.5	52.7	52.7	52.7
D/60/10/1.0	16.95	2.0	2.0	2.0	54.7	54.7	54.7
S/25/0.5	17.27	1.5	1.5	1.5	56.2	56.2	56.2
D/48/04/1.0	17.28	2.0	2.0	2.0	58.2	58.2	58.2
D/72/07/0.5	17.28	3.5	3.5	3.5	61.7	61.7	61.7
D/48/07/1.0	17.51	2.0	2.0	2.0	63.7	63.7	63.7
D/72/10/0.5	17.70	3.5	3.5	3.5	67.2	67.2	67.2
D/60/04/0.5	17.71	1.5	1.5	1.5	68.7	68.7	68.7
D/48/10/1.0	17.75	2.0	2.0	2.0	70.7	70.7	70.7
D/36/04/1.0	18.10	2.0	2.0	2.0	72.7	72.7	72.7
D/60/07/0.5	18.14	1.5	1.5	1.5	74.2	74.2	74.2
D/36/07/1.0	18.34	2.0	2.0	2.0	76.2	76.2	76.2
D/60/10/0.5	18.57	1.5	1.5	1.5	77.7	77.7	77.7
D/36/10/1.0	18.59	2.0	2.0	2.0	79.7	79.7	79.7
D/48/04/0.5	18.62	1.5	1.5	1.5	81.2	81.2	81.2
S/45/2.0	18.90	4.0	4.0	4.0	85.2	85.2	85.2
D/48/07/0.5	19.07	1.5	1.5	1.5	86.7	86.7	86.7
D/48/10/0.5	19.51	1.5	1.5	1.5	88.2	88.2	88.2
S/30/0.5	19.54	1.5	1.5	1.5	89.7	89.7	89.7
D/36/04/0.5	19.61	2.0	2.0	2.0	91.7	91.7	91.7
D/72/04/0.1	19.97	2.6	2.6	2.6	94.3	94.3	94.3
D/36/07/0.5	20.07	2.0	2.0	2.0	96.3	96.3	96.3
D/36/10/0.5	20.52	2.0	2.0	2.0	98.3	98.3	98.3
D/28/04/0.5	20.71	2.0	2.0	2.0	100.3	100.3	100.3
D/60/04/0.1	20.96	1.6	1.6	1.6	101.9	101.9	101.9
D/28/07/0.5	21.18	2.0	2.0	2.0	103.9	103.9	103.9

EXHIBIT A-XXb (Continued)

Region: Rockies
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 22

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
S/45/1.0	21.59	4.0	4.0	4.0	107.9	107.9	107.9
D/28/10/0.5	21.64	2.0	2.0	2.0	109.9	109.9	109.9
D/48/04/0.1	22.05	1.6	1.6	1.6	111.5	111.5	111.5
D/72/07/0.1	22.12	2.6	2.6	2.6	114.1	114.1	114.1
D/60/07/0.1	23.09	1.6	1.6	1.6	116.7	116.7	116.7
D/36/04/0.1	23.28	2.2	2.2	2.2	118.9	118.9	118.9
D/48/07/0.1	24.16	1.6	1.6	1.6	120.5	120.5	120.5
D/72/10/0.1	24.49	2.7	2.7	2.7	123.2	123.2	123.2
D/28/04/0.1	24.69	2.8	2.8	2.8	126.0	126.0	126.0
D/36/07/0.1	25.40	2.2	2.2	2.2	128.2	128.2	128.2
D/60/10/0.1	25.47	1.6	1.6	1.6	129.8	129.8	129.8
D/48/10/0.1	26.54	1.6	1.6	1.6	131.4	131.4	131.4
D/28/07/0.1	26.83	2.8	2.8	2.8	134.2	134.2	134.2
D/36/10/0.1	27.74	2.2	2.2	2.2	136.4	136.4	136.4
S/45/0.5	28.82	3.0	3.0	3.0	139.4	139.4	139.4
D/28/10/0.1	29.10	2.8	2.8	2.8	142.2	142.2	142.2

EXHIBIT A-XXIa

Region: Southwest
Product Class: Low Sulfur

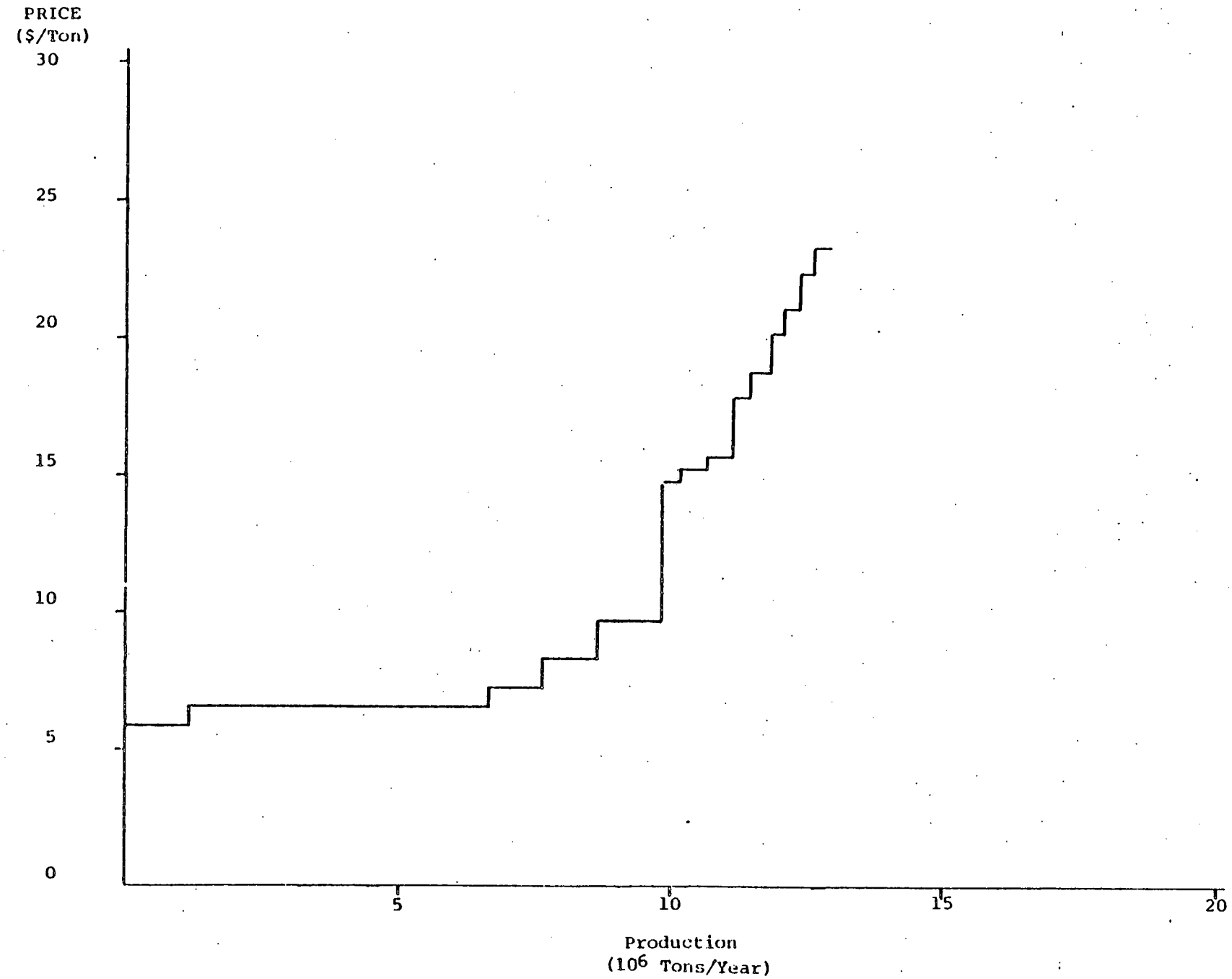


EXHIBIT A-XXIb

Region: Southwest
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 19

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	5.94	1.2	1.2	1.2	1.2	1.2	1.2
SY	6.55	5.5	5.5	5.5	6.7	6.7	6.7
S/10/1.0	7.16	1.0	1.0	1.0	7.7	7.7	7.7
S/15/1.0	8.46	1.0	1.0	1.0	8.7	8.7	8.7
S/20/1.0	9.84	1.0	1.0	1.0	9.7	9.7	9.7
D/72/04/0.5	14.87	0.5	0.5	0.5	10.2	10.2	10.2
D/72/07/0.5	15.28	0.5	0.5	0.5	10.7	10.7	10.7
D/72/10/0.5	15.70	0.5	0.5	0.5	11.2	11.2	11.2
D/72/04/0.1	17.97	0.3	0.3	0.3	11.5	11.5	11.5
D/60/04/0.1	18.96	0.3	0.3	0.3	11.8	11.8	11.8
D/72/07/0.1	20.12	0.3	0.3	0.3	12.1	12.1	12.1
D/60/07/0.1	21.09	0.3	0.3	0.3	12.4	12.4	12.4
D/72/10/0.1	22.49	0.3	0.3	0.3	12.7	12.7	12.7
D/60/10/0.1	23.47	0.3	0.3	0.3	13.0	13.0	13.0

EXHIBIT A-XXIIa

Region: Southwest
Product Class: High Sulfur

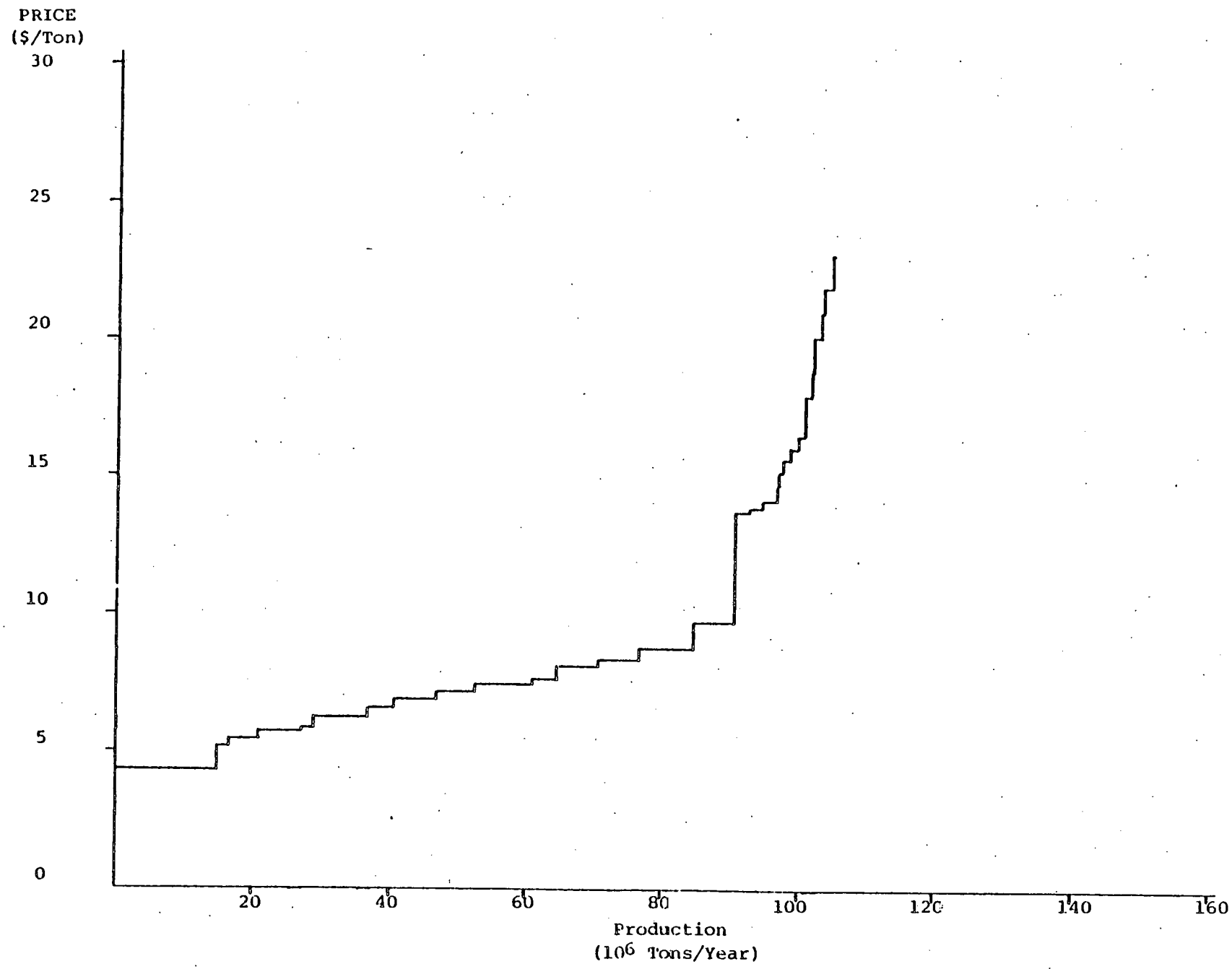


EXHIBIT A-XXIIb

Region: Southwest
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): _____

Mine Type	($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	4.40	14.8	14.8	14.8	14.8	14.8	14.8
S/05/2.0	5.16	2.0	2.0	2.0	16.8	16.8	16.8
S/10/4.0	5.48	4.0	4.0	4.0	20.8	20.8	20.8
S/10/3.0	5.82	6.0	6.0	6.0	26.8	26.8	26.8
S/05/1.0	5.90	2.0	2.0	2.0	28.8	28.8	28.8
S/10/2.0	6.30	8.0	8.0	8.0	36.8	36.8	36.8
S/15/4.0	6.54	4.0	4.0	4.0	40.8	40.8	40.8
S/15/3.0	6.95	6.0	6.0	6.0	46.8	46.8	46.8
S/10/1.0	7.16	6.0	6.0	6.0	52.8	52.8	52.8
S/15/2.0	7.50	8.0	8.0	8.0	60.8	60.8	60.8
S/20/4.0	7.65	4.0	4.0	4.0	64.8	64.8	64.8
S/20/3.0	8.13	6.0	6.0	6.0	70.8	70.8	70.8
S/15/1.0	8.46	6.0	6.0	6.0	76.8	76.8	76.8
S/20/2.0	8.78	8.0	8.0	8.0	84.8	84.8	84.8
S/20/1.0	9.84	6.0	6.0	6.0	90.8	90.8	90.8
D/72/04/1.0	13.77	2.0	2.0	2.0	92.8	92.8	92.8
D/72/07/1.0	13.98	2.0	2.0	2.0	94.8	94.8	94.8
D/72/10/1.0	14.19	2.0	2.0	2.0	96.8	96.8	96.8
D/72/04/0.5	14.87	0.5	0.5	0.5	97.3	97.3	97.3
D/72/07/0.5	15.28	0.5	0.5	0.5	97.8	97.8	97.8
D/72/10/0.5	15.70	0.5	0.5	0.5	98.3	98.3	98.3
D/60/04/0.5	15.71	1.0	1.0	1.0	99.3	99.3	99.3
D/60/07/0.5	16.14	1.0	1.0	1.0	100.3	100.3	100.3
D/60/10/0.5	16.57	1.0	1.0	1.0	101.3	101.3	101.3
D/72/04/0.1	17.97	1.0	1.0	1.0	102.3	102.3	102.3
D/60/04/0.1	18.96	0.3	0.3	0.3	102.6	102.6	102.6
D/72/07/0.1	20.12	1.0	1.0	1.0	103.6	103.6	103.6
D/60/07/0.1	21.09	0.3	0.3	0.3	103.9	103.9	103.9
D/72/10/0.1	22.49	1.0	1.0	1.0	104.9	104.9	104.9
D/60/10/0.1	23.47	0.3	0.3	0.3	105.2	105.2	105.2

EXHIBIT A-XXIIIa

Region: Northwest
Product Class: High Sulfur

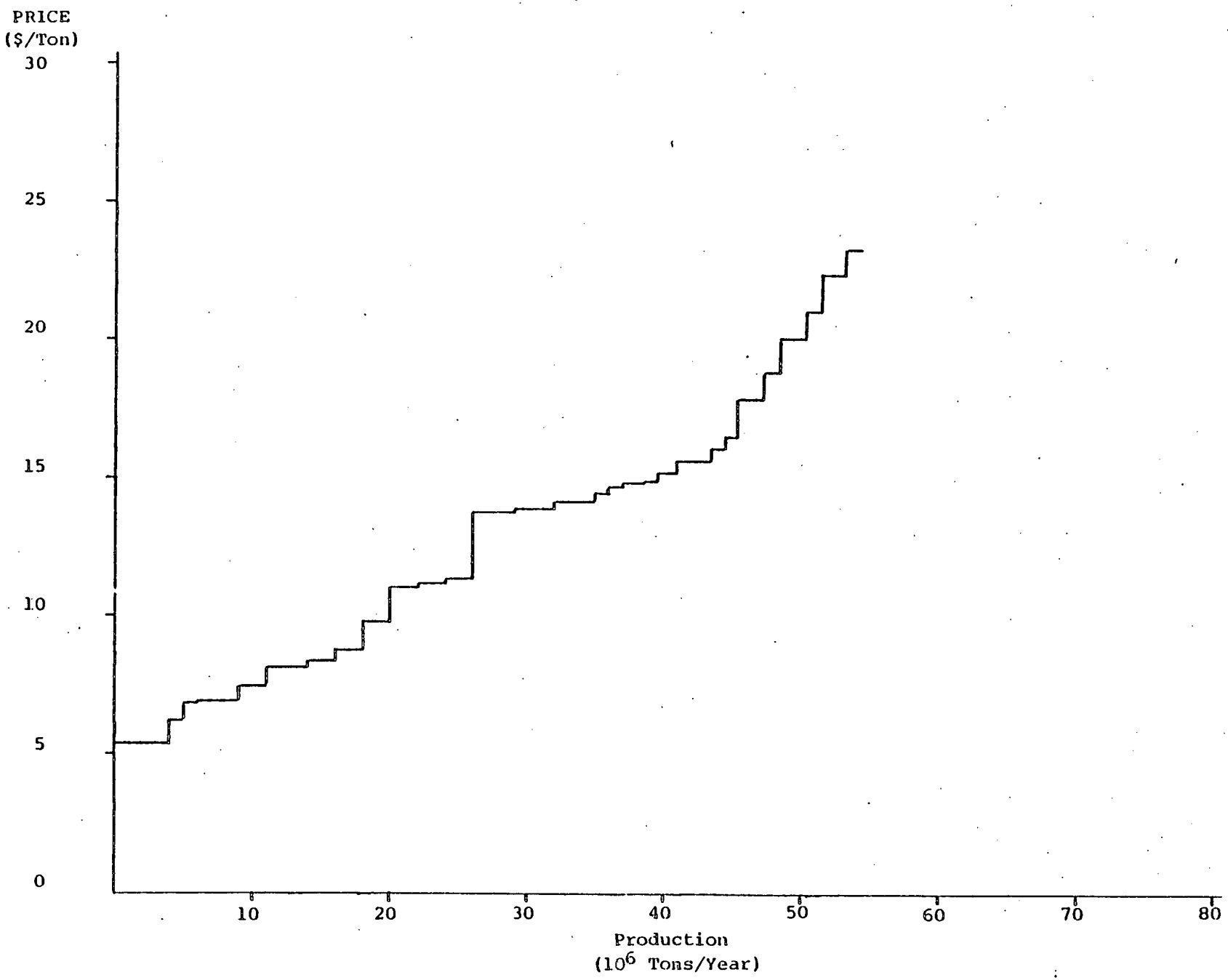


EXHIBIT A-XXIIIb

Region: Northwest
Product Class: High Sulfur
BTU CONTENT (10^6 BTU/TON): 19

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	5.45	4.0	4.0	4.0	4.0	4.0	4.0
SY	6.20	1.0	1.0	1.0	5.0	5.0	5.0
DY	6.90	1.0	1.0	1.0	6.0	6.0	6.0
S/15/3.0	6.95	3.0	3.0	3.0	9.0	9.0	9.0
S/15/2.0	7.50	2.0	2.0	2.0	11.0	11.0	11.0
S/20/3.0	8.13	3.0	3.0	3.0	14.0	14.0	14.0
S/15/1.0	8.46	2.0	2.0	2.0	16.0	16.0	16.0
S/20/2.0	8.78	2.0	2.0	2.0	18.0	18.0	18.0
S/20/1.0	9.84	2.0	2.0	2.0	20.0	20.0	20.0
D/72/04/2.0	11.10	2.0	2.0	2.0	22.0	22.0	22.0
D/72/07/2.0	11.24	2.0	2.0	2.0	24.0	25.0	24.0
D/72/10/2.0	11.37	2.0	2.0	2.0	26.0	26.0	26.0
D/72/04/1.0	13.77	3.0	3.0	3.0	29.0	29.0	29.0
D/72/07/1.0	13.98	3.0	3.0	3.0	32.0	32.0	32.0
D/72/10/1.0	14.19	3.0	3.0	3.0	35.0	35.0	35.0
D/60/04/1.0	14.50	1.0	1.0	1.0	36.0	36.0	36.0
D/60/07/1.0	14.73	1.0	1.0	1.0	37.0	37.0	37.0
D/72/04/0.5	14.87	1.5	1.5	1.5	38.5	38.5	38.5
D/60/10/1.0	14.95	1.0	1.0	1.0	39.5	39.5	39.5
D/72/07/0.5	15.28	1.5	1.5	1.5	41.0	41.0	41.0
D/72/10/0.5	15.70	1.5	1.5	1.5	42.5	42.5	42.5
D/60/04/0.5	15.71	1.0	1.0	1.0	43.5	43.5	43.5
D/60/07/0.5	16.14	1.0	1.0	1.0	44.5	44.5	44.5
D/60/10/0.5	16.57	1.0	1.0	1.0	45.5	45.5	45.5
D/72/04/0.1	17.97	1.8	1.8	1.8	47.3	47.3	47.3
D/60/04/0.1	18.96	1.2	1.2	1.2	48.5	48.5	48.5
D/72/07/0.1	20.12	1.8	1.8	1.8	50.3	50.3	50.3
D/60/07/0.1	21.09	1.2	1.2	1.2	51.5	51.5	51.5
D/72/10/0.1	22.49	1.8	1.8	1.8	53.3	53.3	53.3
D/60/10/0.1	23.47	1.2	1.2	1.2	54.5	54.5	54.5

EXHIBIT A-XXIVa

Region: Alaska
Product Class: Low Sulfur

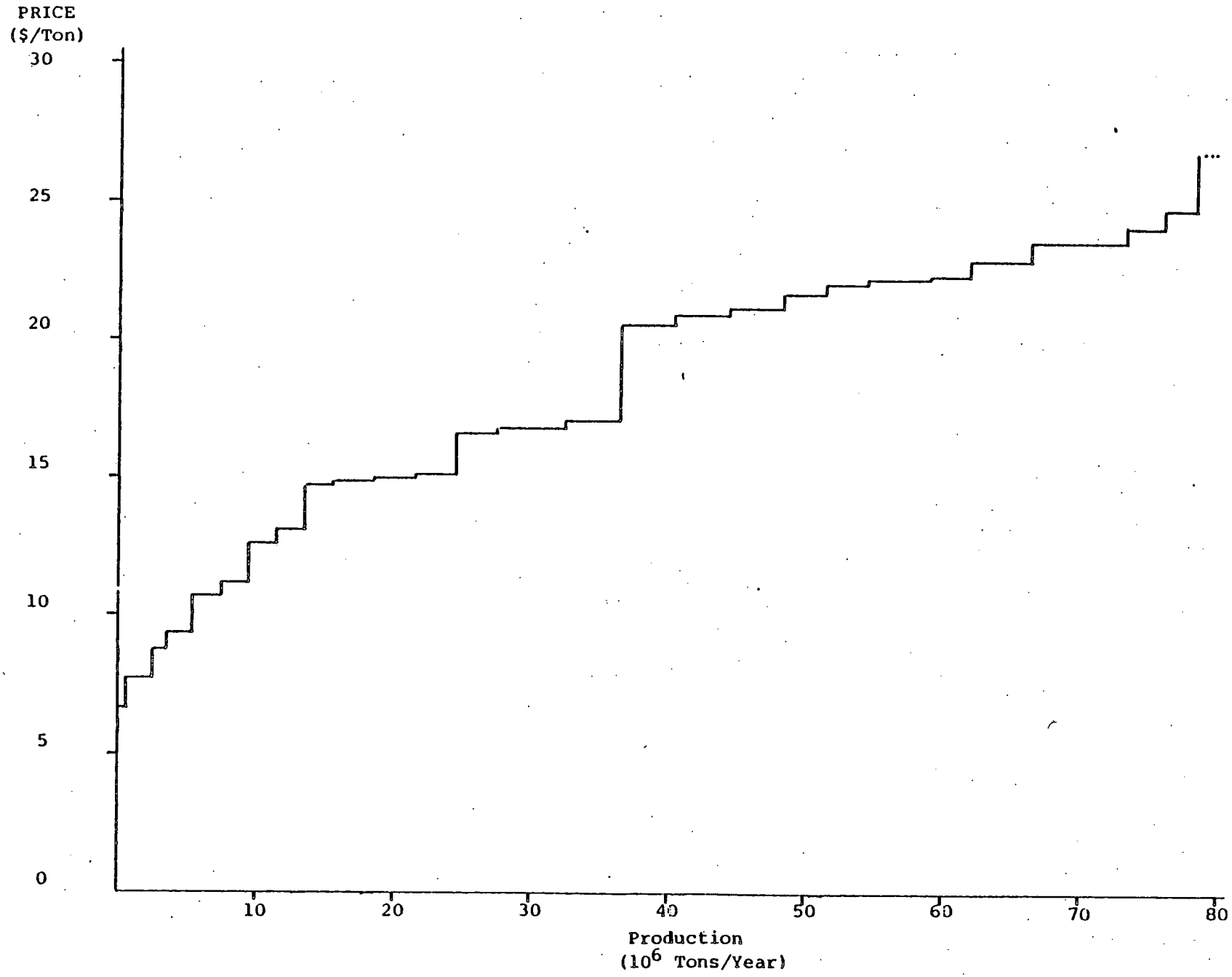


EXHIBIT A-XXIVb

Region: Alaska
Product Class: Low Sulfur
BTU CONTENT (10^6 BTU/TON): 19

Mine Type	Price ($/Ton)	Annual Production By Mine Type (10^6 Tons)			Cumulative Annual Production (10^6 Tons)		
		1980	1985	1990	1980	1985	1990
SX	6.59	0.7	0.7	0.7	0.7	0.7	0.7
S/05/2.0	7.74	2.0	2.0	2.0	2.7	2.7	2.7
S/05/1.0	8.85	1.0	1.0	1.0	3.7	3.7	3.7
S/10/2.0	9.45	2.0	2.0	2.0	5.7	5.7	5.7
S/10/1.0	10.74	2.0	2.0	2.0	7.7	7.7	7.7
S/15/2.0	11.25	2.0	2.0	2.0	9.7	9.7	9.7
S/15/1.0	12.69	2.0	2.0	2.0	11.7	11.7	11.7
S/20/2.0	13.17	2.0	2.0	2.0	13.7	13.7	13.7
S/20/1.0	14.76	2.0	2.0	2.0	15.7	15.7	15.7
D/72/04/3.0	14.84	3.0	3.0	3.0	18.7	18.7	18.7
D/72/07/3.0	15.00	3.0	3.0	3.0	21.7	21.7	21.7
D/72/10/3.0	15.16	3.0	3.0	3.0	24.7	24.7	24.7
D/72/04/2.0	16.65	4.0	4.0	4.0	28.7	28.7	28.7
D/72/07/2.0	16.86	4.0	4.0	4.0	32.7	32.7	32.7
D/72/10/2.0	17.06	4.0	4.0	4.0	36.7	36.7	36.7
D/72/04/1.0	20.66	4.0	4.0	4.0	40.7	40.7	40.7
D/72/07/1.0	20.97	4.0	4.0	4.0	44.7	44.7	44.7
D/72/10/1.0	21.28	4.0	4.0	4.0	48.7	48.7	48.7
D/60/04/1.0	21.75	3.0	3.0	3.0	51.7	51.7	51.7
D/60/07/1.0	22.10	3.0	3.0	3.0	54.7	54.7	54.7
D/72/04/0.5	22.30	4.5	4.5	4.5	59.2	59.2	59.2
D/60/10/1.0	22.42	3.0	3.0	3.0	62.2	62.2	62.2
D/72/07/0.5	22.92	4.5	4.5	4.5	66.7	66.7	66.7
D/72/10/0.5	23.55	4.5	4.5	4.5	71.2	71.2	71.2
D/60/04/0.5	23.56	2.5	2.5	2.5	73.7	73.7	73.7
D/60/07/0.5	24.21	2.5	2.5	2.5	76.2	76.2	76.2
D/60/10/0.5	24.86	2.5	2.5	2.5	78.7	78.7	78.7
D/72/04/0.1	26.96	3.9	3.9	3.9	82.6	82.6	82.6
D/60/04/0.1	28.44	2.0	2.0	2.0	84.6	84.6	84.6
D/72/07/0.1	30.18	3.9	3.9	3.9	88.5	88.5	88.5
D/60/07/0.1	31.64	2.0	2.0	2.0	90.5	90.5	90.5
D/72/10/0.1	33.74	3.9	3.9	3.9	94.4	94.4	94.4
D/60/10/0.1	35.20	2.0	2.0	2.0	96.4	96.4	96.4

APPENDIX B OIL SUPPLY CURVES

The 1985 PIES Business as Usual Oil Supply curves are shown in Table B-1. Different oil supply curves pertain for the FEA's acclerated development scenario and for other target years.

Supply curves are given for each oil type in each production region. The codes used to identify oil types are described in Table II-3. The PIES oil region in which these crudes are produced are shown in Table II-4 along with the Census Regions to which these oil regions correspond.

The production of crude oil in PIES in dependent not only upon the marginal price which obtains in a target year, but also upon the price anticipated by the industry prior to the target year. Thus the oil supply curves may include more than one increment at each price. We have listed all the increments individually, The cumulative quantity column includes all possible increments, therefore, the curves must be interpreted as quantity-cost relationships assuming that the price at any point is greater than or equal to that anticipated by the industry.

Note should be made that oil production in PIES is treated as the production of a number of joint products, i.e. oil, associated gas, gas liquids and butane. It is the overall regional requirement for all of these products within the PIES model that determines the production levels of particular crude types. Thus, the supply curves given here represent an abstraction of a more complex process within PIES.

The supply curve for West Coast blend (oil type WC) includes 200,000 barrels/day of oil from the Navel Petroleum Reserve (oil type N1).

In addition to the crudes described in the Table B-1, Table B-2 details additional production steps increments permitted in the Alaskan, NOrth Slope.

TABLE B-1 OIL SUPPLY CURVES

Oil Type	Price ($/bbl)	Quantity Increment (MB/CD)	Cumulative Quantity (MB/CD)
WT	5.0	1110.40	1110.40
	12.0	420.2 + 56.8	1587.40
	14.0	95.0	1682.40
	16.0	7.3999	1689.80
	20.0	14.6001	1704.40
LC	5.0	1899.10	1899.10
	12.0	208.3 + 734.5	2841.90
	16.0	136.2	2978.10
	20.0	224.1	3202.20
LO	5.0	674.0	674.0
	8.0	163.2 + 452.3	1289.5
	12.0	129.2	1418.7
	16.0	4.3	1423.0
	20.0	0.6	1423.6
OK	5.0	136.5	136.5
	8.0	182.0	318.5
	12.0	50.0999 + 105.4	474
	14.0	77.1001	551.10
	16.0	26.0999	577.20
	20.0	56.4001	633.60
AS	5.0	53.0000	53.00
	8.0	9.2000 + 266.2	328.40
	12.0	30.1001	358.50
	16.0	9.0998	367.60
	20.0	0.3	367.90

Oil Type	Price ($/bbl)	Quantity Increment (MB/CD)		Cumulative Quantity (MB/CD)
WC	1.45	200.00		200.00
	5.0	480.700		680.70
	8.0	21.500 + .0998		702.30
	12.0	163.100 + .0002	+ 584.800	1450.20
	16.0	19.1001		1469.30
WO	5.0	80.4000		80.40
	8.0	0.1	+ 403.3	483.80
	12.0	1.2	+ 154.9	639.90
	14.0	1.0		640.90
	16.0	1.2998		642.20
WM (O4)	5.0	135.8		135.8
	12.0	0.4		136.2
	14.0	76.8		213.0
	16.0	3.8999		216.9
	20.0	8.3999		225.3
WM (O5)	5.0	310.8		310.8
	12.0	42.8	+ 193.1	546.7
	14.0	121.8		668.5
	16.0	84.7998		753.3
	20.0	105.8		859.1
I2	5.0	131.1		131.1
	12.0	19.2 + 0.1	+ 151.2	301.6
	14.0	6.3		307.9
	16.0	9.2		310.8
	20.0	7.1001		317.9

Oil Type	Price ($/bbl)	Quantity Increment (MB/CD)	Cumulative Quantity (MB/CD)
I1 (OB)	5.0	23.2	23.2
	12.0	97.3	120.5
	14.0	95.6	216.1
	16.0	16.3	232.4
	20.0	26.7	259.1
I1 (OC)	8.0	0.1 + 128.4	128.5
	12.0	9.9	138.4
	16.0	2.5	140.9
H5 (O2)	5.35	67.0	67.0
	7.56	62.0	129.0
	12.31	75.0	204.0
H3 (O5)	8.35	6.0	6.0
	12.84	8.0	14.0
H2 (O7)	5.83	27.0	27.0
	8.44	51.0	78.0
	13.71	131.0	209.0
H2 (O9)	6.83	4.0	4.0
	10.26	5.0	9.0
TS (O4)	15.00	10.0	10.0

TABLE B-2 ADDITIONAL ALASKAN CRUDE PRODUCTION

Crude Type	Mix	Joint Price ($)	Limit (barrel/CD)
AN	One barrel + 419 cu. ft. of Natural Gas	9.49	720,000
AP	One barrel + 1,250 cu. ft. of Natural Gas	4.08	1,600,000
AB	One barrel + 642 cu. ft. of Natural Gas	7.99	448,000

APPENDIX C NATURAL GAS SUPPLY CURVES

Table C-1 contains the PIES 1985 $13 oil reference scenario natural gas supply curves. Associated gas - which accounts for some 20% of total gas production is not included in these tables (see Appendix B).

TABLE C-1 NATURAL GAS SUPPLY CURVES

Gas Region	Price ($/thousand cubic ft.)	Quantity Increment (MSCF/CD)	Cumulative Quantity (MSCF/CD)
G3	1.0	146.949	146.949
	1.2	6.1472	153.10
	1.4	14.3437	167.44
	1.7	2.0490	169.49
	2.2	25.1745	194.66
	2.4	1.1709	195.83
	2.8	2.9272	198.76
G4	1.2	16.3927	16.3927
	1.4	98.6490	115.04
	1.7	9.9527	124.99
	2.0	7.9036	132.90
	2.2	4.9763	137.87
	2.4	5.8545	143.73
G5	0.71	178.080	178.080
	0.89	117.810	295.89
	1.0	869.400	1165.29
	1.2	260.527	1425.82
	1.4	27.2231	1453.04
	1.7	67.6203	1520.66
	2.0	47.4216	1568.08
	2.2	35.4203	1603.50
	2.4	31.3217	1634.82
	2.8	60.3021	1695.13
G6	0.86	164.380	164.38
	1.0	909.503	1073.88
	1.2	779.240	1853.12
	1.4	23.7112	1876.83
	1.7	46.2503	1923.08
	2.0	52.9839	1976.07

Gas Region	Price ($/thousand cubic ft.)	Quantity Increment (MSCF/CD)	Cumulative Quantity (MSCF/CD)
	2.2	36.5909	2012.66
	2.4	16.3930	2029.05
	2.8	75.8160	2104.87
G7	1.0	2312.25	2312.25
	1.2	1761.34	4073.59
	1.4	99.5272	4173.12
	1.7	312.633	4485.75
	2.0	545.351	5031.10
	2.2	42.4454	5073.55
	2.4	468.363	5541.91
	2.8	451.678	5993.59
G8	1.0	10490.2	10490.2
	1.2	2859.35	13349.55
	1.4	471.588	13821.14
	1.7	795.040	14616.18
	2.0	560.870	15177.05
	2.2	487.974	15665.02
	2.4	330.198	15995.22
	2.8	1432.60	17427.82
G9	1.0	12296.3	12296.3
	1.7	3.8077	12300.11
	2.2	11.7091	12311.82
	2.4	4.0936	12315.91
GA	1.0	5961.97	5961.97
	1.2	2183.16	8145.13
	1.4	191.443	8336.57
	1.7	305.607	8642.18
	2.0	175.051	8817.23

Gas Region	Price ($/thousand cubic ft.)	Quantity Increment (MSCF/CD)	Cumulative Quantity (MSCF/CD)
	2.2	189.980	9007.21
	2.4	111.822	9119.03
	2.8	371.178	9490.21
GB	1.0	89.2818	89.2818
	1.7	37.7618	127.04
GC	1.0	354.200	354.20
	1.2	101.869	456.07
	1.4	132.020	588.09
	1.7	68.4981	656.59
	2.0	39.5182	696.11
	2.2	25.1745	721.28
	2.4	27.5163	748.80
	2.8	74.0596	822.86
G2	1.10	794.500	794.50