COMPUTER SERVICES OPPORTUNITIES

IN ENERGY MARKETS

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INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients'

needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

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Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

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Planning Services for Management

COMPUTER SERVICES OPPORTUNITIES IN ENERGY MARKETS

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COMPUTER SERVICES OPPORTUNITIES
IN ENERGY MARKETS

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COMPUTER SERVICES OPPORTUNITIES
IN ENERGY MARKETS

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I INTRODUCTION AND SCOPE

I INTRODUCTION AND SCOPE

A. INTRODUCTION

- This report, produced by INPUT as part of its Information Services Industry Program (ISIP), analyzes opportunities for offering computer services to basic energy markets.

- This area of research was selected because of high client interest and accelerating market growth.

- This report updates and expands upon INPUT's report, <u>Computer Services Markets In The Petroleum Industry</u>.

- The purpose of this study is to analyze both present and future markets and to provide the basic technical background and recommendations for market entry and expansion.

- Interviews were conducted during June and July 1981.

- The research conducted in this report revises and expands the research listed in Appendix C (Related INPUT Reports) and includes 50 additional user and vendor interviews.

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- Separate interview questionnaires were used for users and vendors. Copies of the questionnaires are included in Appendix D.

- Definitions of terms used in this report appear in Appendix B.

- The forecasts in this report include a 6% annual factor for inflation. The difference between 6% and the annual increase in the Gross National Product (GNP) deflator is assumed offset by technology improvements.

- Inquiries and comments from clients on the information presented in this report are invited.

B.   SCOPE

- The study considers markets for computer services in the U.S. (including Canada); that is, expenditures by U.S. companies in the U.S. as opposed to Europe, and expenditures by foreign companies (governments) where the services are accomplished by computer services companies (U.S. or foreign) in the United States.

- The report deals with expenditures for computer services by basic energy industries: petroleum, natural gas, coal, and uranium. Computer services expenditures by related industries such as engineering, construction, servicing, steel, and power utilities are discussed but not included in forecasts unless they have been specifically contracted for by the basic energy industries. For example:

    - Computer services expenditures for the design of offshore oil platforms by an engineering firm on behalf of a petroleum company are not included, but such expenditures by a petroleum company itself are.

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- Sale of a software package or computer related professional services by a seismic consulting firm to a petroleum company are included.

- Although computer services used by governments related to basic energy industries are discussed, the report concentrates on the commercial sector of the U.S. economy.

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II MANAGEMENT SUMMARY

II MANAGEMENT SUMMARY

A. COMPUTER SERVICE MARKETS IN ENERGY

- Opportunities for computer services in energy markets abound! Companies involved in bringing energy resources to market spent close to $1 billion in 1980 for computer services.

- If the price of crude petroleum does not fall during the forecast period, the market will reach $5 billion in 1985 with annual growth in some areas exceeding 40%.

1. SCOPE OF THE STUDY

- The study covers the use of EDP, including computer services, by petroleum, natural gas, coal, and uranium companies.

- The energy market has been subdivided across the four industry sectors into five functional subsectors: exploration, production, processing, transportation, marketing.

- Computer services provided to energy markets are part of the process manufacturing sector of INPUT's method of analysis for its Information Services Industry Program.

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- Companies related to energy market industries such as engineering, construction, and operational servicing firms are considered. However, only energy company expenditures for EDP when separately contracted are considered as EDP expenditures for computer services in energy markets.

2. MARKET STRUCTURE

- Revenues in 1980 for some 1,500 companies involved in energy markets exceeded $700 billion.

- Petroleum companies dominate the marketplace, as illustrated in Exhibit II-1. With 1980 revenues of nearly $650 billion, petroleum companies comprise over 90% of the market.

- In 1980, revenues of eight major integrated petroleum companies exceeded $350 billion. Another 12 semi-major companies, either fully integrated or nearly so, together with the majors comprised 75% of total petroleum industry revenues.

- Some 50 large and medium-sized coal companies, or 13% of total companies with 1980 aggregate revenues exceeding $12 billion, comprised 65% of total coal industry revenues.

- There are 84 companies involved in the production and transmission component of natural gas, 32 of which make up 85% of industry revenues.

- In the uranium industry, 15 companies, 7% of which are involved in the exploration, production, and processing (to enrichment) subsectors, control 61% of all reserves and 98% of current milling capacity.

- Petroleum companies are becoming integrated energy companies by obtaining control of major portions of other energy markets. In 1977 the 20 largest petroleum companies controlled:

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EXHIBIT II-1

STRUCTURE OF ENERGY MARKETS
BY INDUSTRY SECTOR, 1980
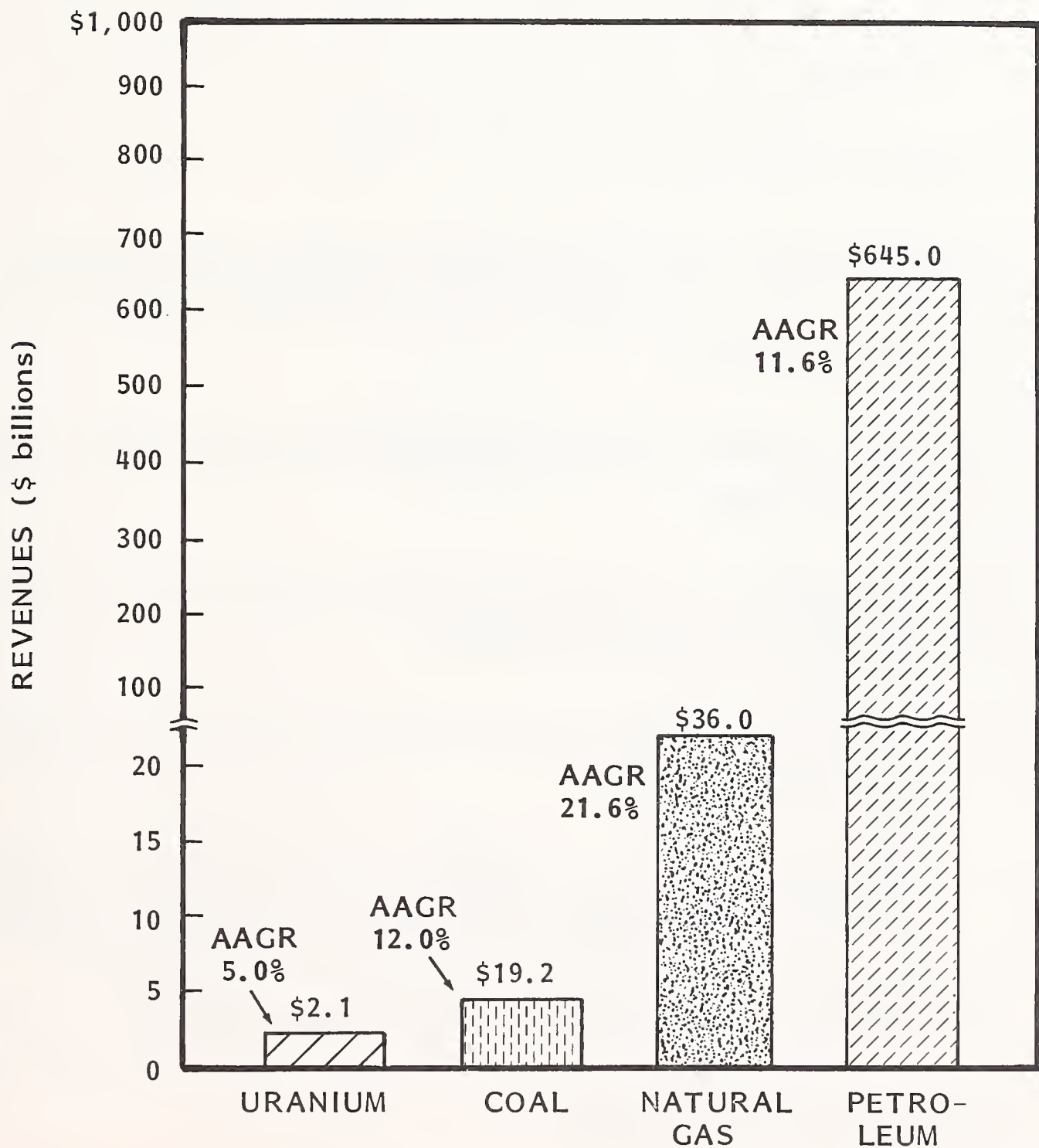
TOTAL REVENUES $702.3 billion
TOTAL COMPANIES 1,586
AAGR 12%

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- Seventy-four percent of natural gas production and transmission.

- Twenty-seven percent of coal production.

- Nearly 50% of total uranium reserves and production.

- Reviewing the market structure, INPUT concludes that the primary avenue to prospect for computer services in energy markets is with petroleum companies.

3.   MARKET FORECAST

- Companies spent nearly $5.5 billion in 1980 for EDP related to energy markets.   The major portion, nearly $4.9 billion or 89%, was spent by petroleum companies.

- As shown in Exhibit II-2, the major portion, $4.5 billion or 82%, was spent for in-house operations.

- The portion spent for computer services varies somewhat by industry sector and greatly by energy market subsector.

- Portions by industry vary from 13% for natural gas to 25% for uranium companies.

- EDP expenditures for computer services by petroleum companies vary between 4% in the marketing to 49% in the exploration subsectors.

- Expenditures by energy companies for computer services, approaching $1 billion in 1980, will grow to $5 billion in 1985, a growth rate of nearly 40% per year over the forecast period.

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EXHIBIT II-2

TOTAL EDP EXPENDITURES IN ENERGY MARKETS
BY INDUSTRY SECTOR, 1980
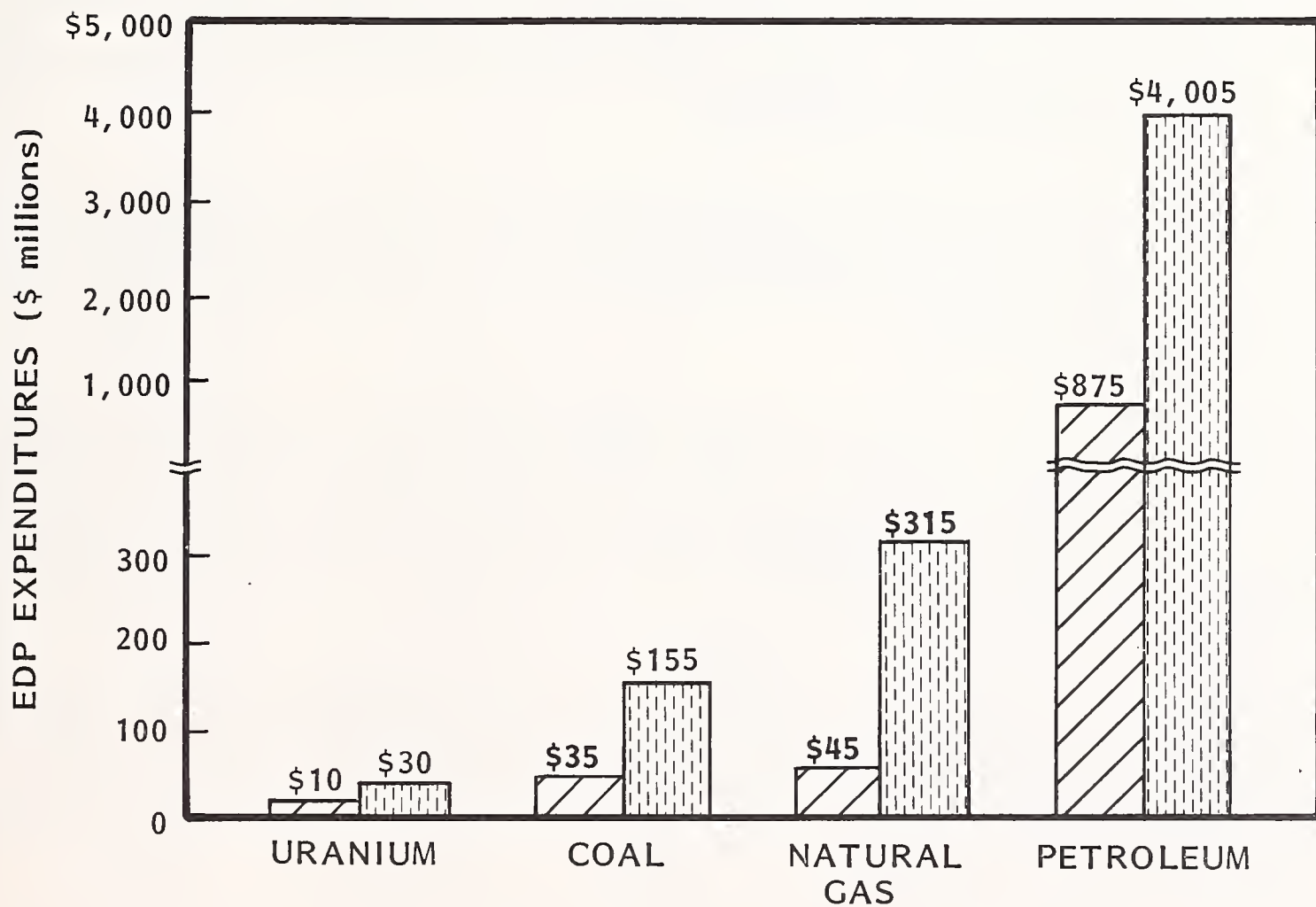
COMPUTER SERVICES TOTAL $965 million

IN-HOUSE EDP TOTAL $4,505 million

TOTAL EDP EXPENDITURES $5,470 million

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- The forecast assumes that the price of crude petroleum will not significantly decline and that there will be either stable or slow economic growth in the U.S. during the forecast period.

- The forecast includes a 6% annual price increase due to inflation and assumes that the difference between 6% and the annual increase in the GNP deflator is offset by improved technology.

- Shortage of qualified personnel, geophysicists, computer analysts, and petroleum and mining enginers trained in computer techniques is the major factor inhibiting even greater growth in computer services to energy markets.

- Although the market for computer services is significant in all energy market subsectors, the action centers around the exploration and production subsectors, as indicated in Exhibit II-3.

  - Computer services expenditures by energy companies in the exploration and production subsectors in 1980 were over $700 million, or 75% of the total market.

  - An annual growth rate approaching 50% in the exploration subsector, primarily limited by shortage of qualified personnel, clearly indicates market opportunities for capital substitution in the form of computer-aided automation.

- Processing services, nearly 73% of the total market at $700 million in 1980, as indicated in Exhibit II-4, attest to the size of geophysical data processing in energy markets.

  - Facilities management (FM) is a growth market as energy companies expand exploration budgets but have a decreasing ability to hire and retain qualified personnel.

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EXHIBIT II-3

FORECAST OF COMPUTER SERVICES EXPENDITURES
BY ENERGY MARKET SUBSECTOR, 1980-1985
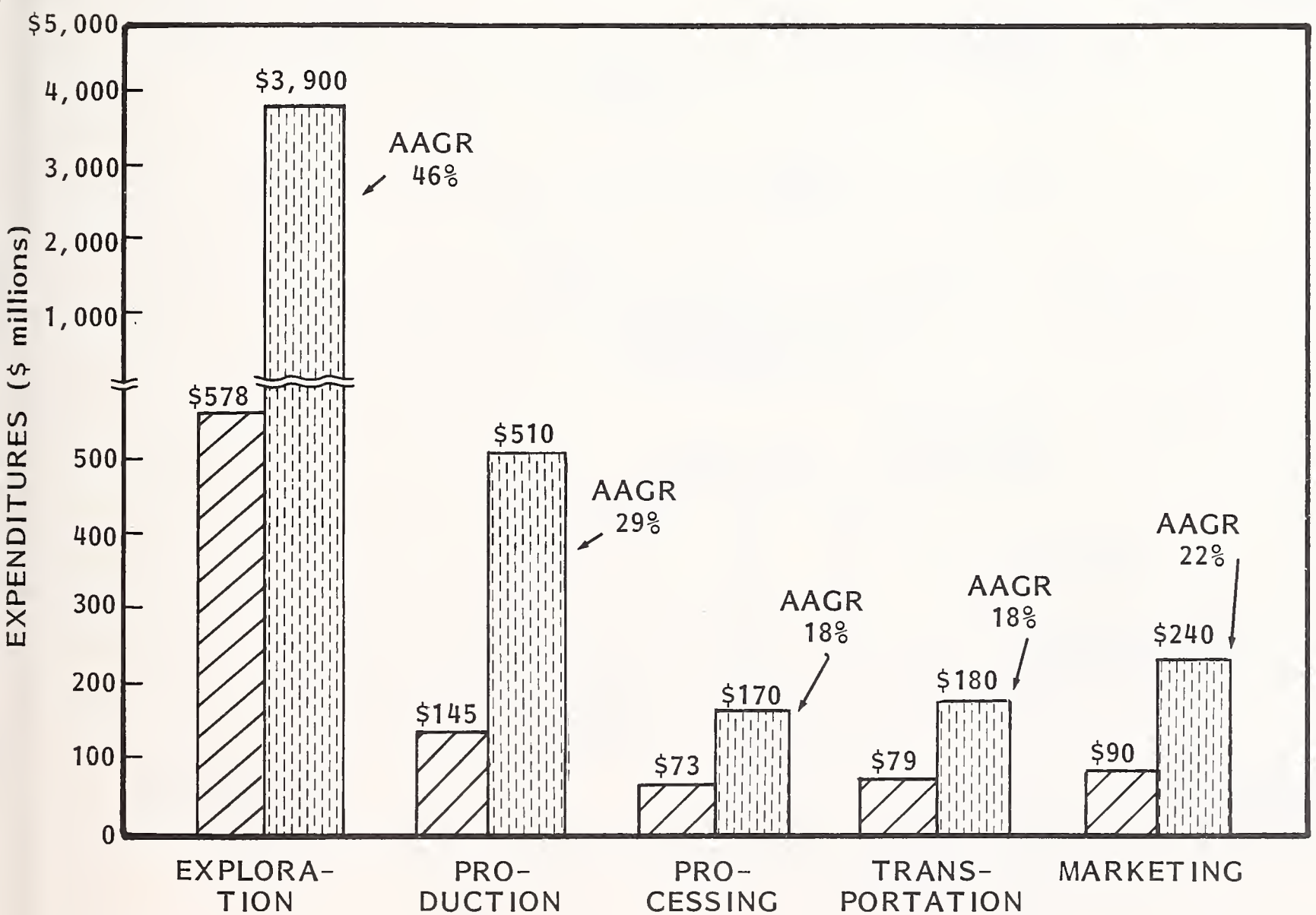
- 1980 TOTAL $965 million
- 1985 TOTAL $5,000 million

AAGR 39%

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EXHIBIT II-4

FORECAST OF COMPUTER SERVICES IN ENERGY
MARKETS BY MODE AND TYPE OF DELIVERY, 1980-1985

1980 ($ millions)

PRO-FESSIONAL SERVICES $114

SYSTEMS $100

RCS $239

TOTAL SOFTWARE PRODUCTS $150

APPLICA-TIONS $50

TOTAL PROCESSING SERVICES $701

FM $135

BATCH $327

TOTAL $965 MILLION

PROFESSIONAL SERVICES $355 AAGR 20%

1985 ($ millions)

SYSTEMS $338 AAGR 28%

APPLICATIONS $205 AAGR 33%

RCS $1,658 AAGR 47%

TOTAL SOFTWARE PRODUCTS $543 AAGR 28%

TOTAL PROCESSING SERVICES $4,102 AAGR 42%

BATCH $1,144 AAGR 28%

FM $1,300 AAGR 57%

TOTAL $5,000 MILLION, AAGR 39%

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- Batch processing, currently the major delivery mode for processing services, will give way to RCS as multitasking operating systems with user friendly interface software increase remote batch and interactive operation.

- Specialization is the key to success in offering processing services to energy companies.

  - Over 90% of processing services to the petroleum industry are industry specific.

  - Industry specific applications are also the major (60%) focus of processing services in other energy markets.

- Energy companies have unmet needs for products and services for:

  - User site systems for standalone and distributed processing of geo-physical, production, and engineering analysis.

  - Data base services.

  - Computer-aided mapping.

  - DBMS, including data dictionary and query software and services oriented toward engineering data, particularly for the exploration and production energy market subsectors.

- On-line data base services, estimated at $25 million in 1980, will exceed $250 million in 1985, an AAGR exceeding 50% over the next five years.

4. COMPETITIVE STRUCTURE

- Geophysical data processing vendors including specialist and RCS companies garner just over half of computer services revenues in energy markets, as

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shown in Exhibit II-5. Seven out of over 80 vendors currently receive about 75% of the geophysical data processing revenues.

- RCS vendors led by Control Data Corporation (CDC) and General Electric Information Services Company (GEISCO) have nearly 20% of the current market share. CDC and GEISCO and other major RCS vendors including Boeing Computer Services (BCS), University Computing Company (UCC), McDonnell Douglas Automation Company (McAuto), United Computing Systems (UCS), Sun Information Services (SIS), and Computer Sciences Corporation (CSC) offer processing and professional services in the form of timesharing resources and specialized offerings across all energy market subsectors.

- The large number of consulting, specialist, engineering, and construction firms offering services in energy markets results in a significant market for computer software products and professional services. These companies form a rich source of licensing software products to RCS vendors, and of sale of block time and network services.

- Minicomputers in the form of turnkey systems and for distributed processing are impacting the information services vendor.

    - Digicon, Western Geophysical, Geosource, and Seismographic Services offer turnkey systems using the DEC VAX II/780 with floating point systems, array processors, high-density tape systems, proprietary seismic software, and multitasking virtual operating systems.

    - Seiscon Delta and Denver Processing Center are using the SEL, and Amoco, the Perkin-Elmer mega-minis.

    - Petroleum companies are using minicomputers as nodes in distributed processing systems for geophysical analysis, modeling, and interpretation, for computer-aided design systems, and for mapping and engineering analysis.

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EXHIBIT II-5

COMPUTER SERVICES VENDOR SHARE IN
ENERGY MARKETS, 1980
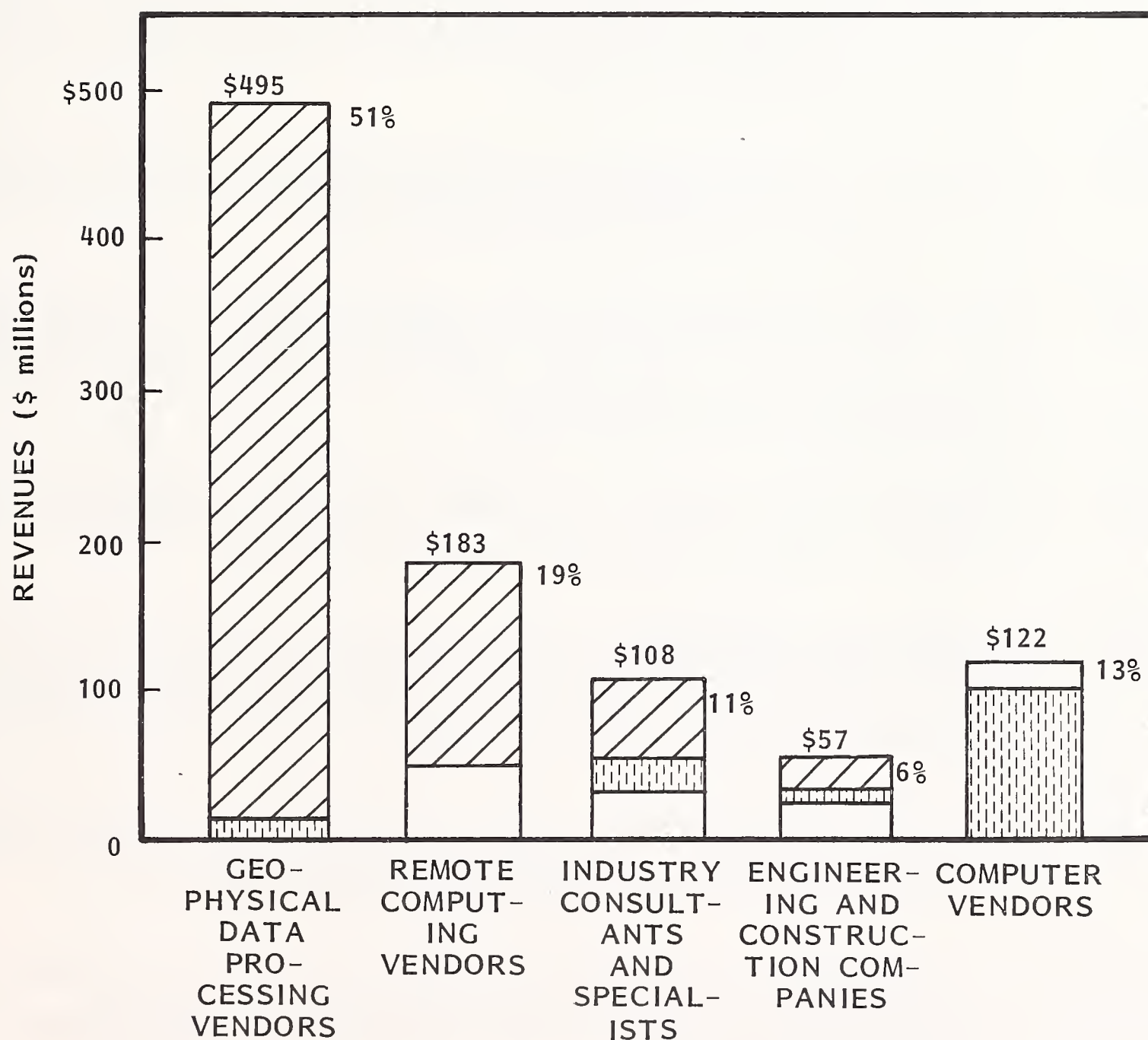
PROCESSING SERVICES $701 million

SOFTWARE PRODUCTS $150 million

PROFESSIONAL SERVICES $114 million

TOTAL $965 million

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B.   RECOMMENDATIONS

I.   PRODUCT

- Take the route of product specialization in offering computer services to companies in energy markets.

- Develop total service approaches including intelligent standalone or network distributed hardware, proprietary (licensed or developed) software, consulting personnel, and maintenance services.

- Develop user friendly operating systems, systems which are truly interactive, have virtual memory capability, and above all, work!

- Offer remote computing services (RCS) resources to both very large and large energy companies for exploration, production, and engineering simulation applications on vector supercomputers.

- Develop or license computer-aided graphic systems for mapping and for pre- and post-processing of large engineering analysis programs.

- Develop DBMS products and services, including data dictionaries and query systems, oriented toward engineering data and targeted toward exploration and production subsectors of energy markets.

- Insure that network services are reliable, responsive in the interactive mode, and give fast turnaround for large remote batch applications.

    - Geophysicists, petroleum, or other end users who become slave to the systems while waiting for the network system to respond quickly turn elsewhere for services.

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- Upgrade system support software to take optimum advantage of programmable array processors.

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2. MANAGEMENT

- Be selective in targeting market entry or expansion because market opportunities are so many and diverse.

- Form a separate marketing and support organization to respond to the large, highly technical, and rapidly growing energy market.

- Establish operational centers in Houston and Denver to offer data processing services to petroleum and natural gas companies.

- Establish offices in Denver and Tucson to offer computer services to energy industries engaged in mining.

- Pursue FM arrangements involving total services including hardware, software, personnel, site, and maintenance on a two- to five-year basis with energy companies.

- Pursue joint venture and licensing arrangements with engineering consulting companies for software products that are either directly related or can be applied to energy markets.

- Take the organization, or at least the joint-venture, route with existing seismic data processing vendors to acquire technical expertise, which is in short supply, and an existing business base.

- Investigate the use of government (DOE) sponsored software products, enhanced and documented and offered together with author consulting services on an RCS basis.

INPUT

- Look for and have developed data bases coupled with specialized software for offering high "value added" on-line data base services to energy markets.

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III INDUSTRY STRUCTURE

III   INDUSTRY STRUCTURE

A.   INTRODUCTION

- Petroleum is by far the largest of all energy forms consumed by the U.S. economy and will likely remain so at least for the next decade.

- The industries involved in the four major forms of energy shown in Exhibit III-1 are the focus of this study.

    - Petroleum.

    - Natural gas.

    - Coal.

    - Uranium.

- Declining use of petroleum and natural gas will be offset by increased use of coal and uranium in energy markets by 1985.

- Other energy forms such as solar and water were considered but excluded.

    - Hydroelectric power is so directly tied to power utilities that it is considered part of that industry sector.

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EXHIBIT III-1

DISTRIBUTION OF ENERGY CONSUMPTION IN THE UNITED STATES BY INDUSTRY SECTOR,

1980-1985

(percent)

1979
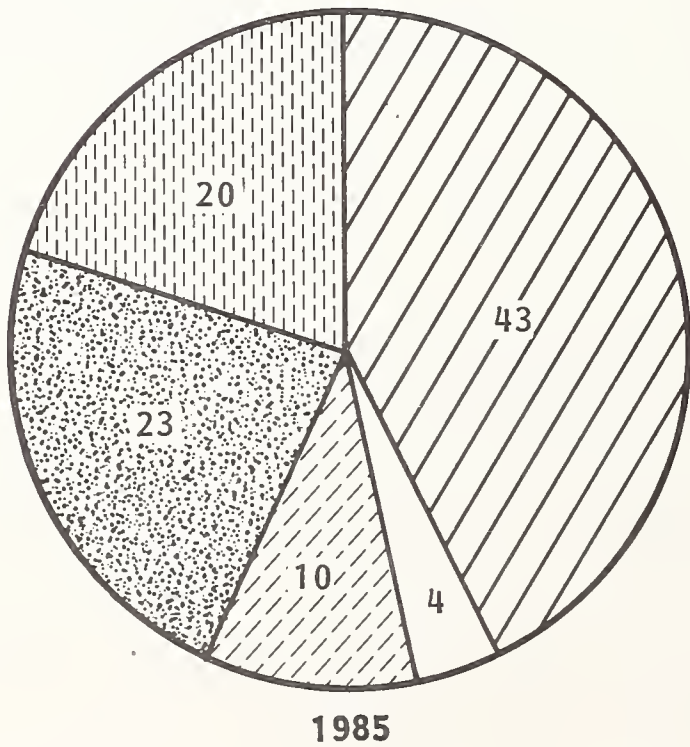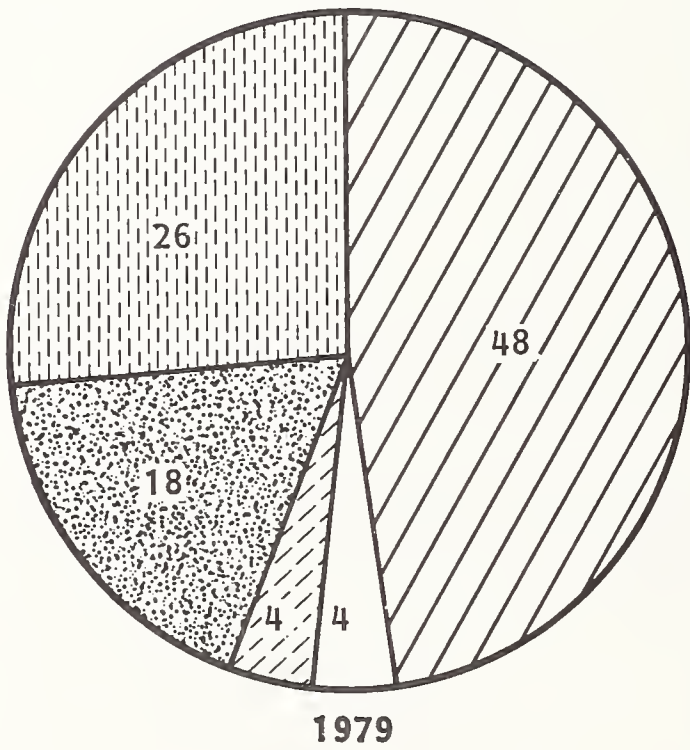
Legend:
- ▨ Petroleum
- ▥ Natural gas
- ▨ Coal
- ▨ Uranium
- ☐ Other

1985

INPUT
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- Solar power, an emerging industry heavily tied to federal sponsorship, is too small to be considered a viable marketplace within the next five years.

- Energy markets have been broken down into five major subsectors within each industry sector, along the lines of the major industry sector, petroleum.

    - Exploration.

    - Production.

    - Processing.

    - Transportation.

    - Marketing.

- Companies involved in energy markets are also active in other markets, such as chemical, shipping, electric power, and retailing. Corporate involvement in other than energy markets is not addressed in this report.

- Firms in other major industry sectors, such as construction, engineering services, and instrumentation, derive substantial related revenues from energy industries and are included in the discussion of industry structure.

- Computer services expenditures from energy companies to related industries are included when contracted for as such. Otherwise, the computer services component of a large project, such as civil engineering design of an offshore platform, would be included as an EDP or computer services expenditure in the industry sector which includes that contractor.

- Industries involved in energy markets are shown in Exhibit III-2. The exhibit depicts the four primary energy industries, related industries, the five major subsectors, and industry interrelationships. Computer services expenditures by

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EXHIBIT III-2

ENERGY MARKET STRUCTURE

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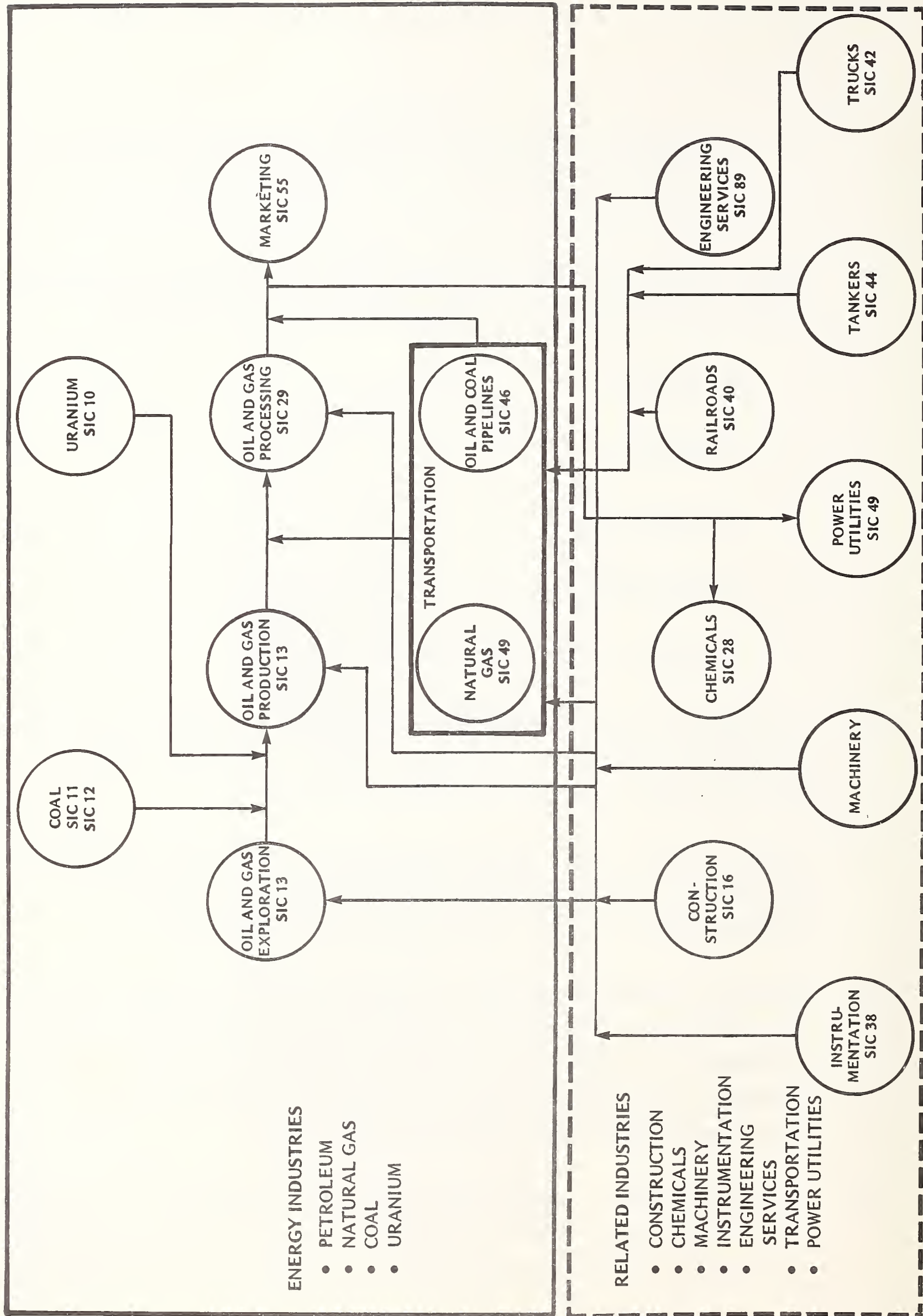
companies included in the four basic energy industries are covered in this report.

B.   ENERGY COMPANIES

I.   PETROLEUM COMPANIES

- There are eight major oil companies whose operations are integrated across all industry subsectors. As shown in Exhibit III-3, their 1980 revenues exceeded $350 billion.

- Another 12 semi-major companies, either fully integrated or nearly so, together with the majors control 75% of the total market.

- Some 60 large independent oil companies are involved in one or more industry subsectors, and some 700 or more are involved primarily in exploration, production, and refining or processing.

- Finally, there are approximately 100 independent companies involved in marketing gasoline and petroleum products.

- Other data indicate that there are perhaps another 2,000 petroleum companies. However, most of these companies are involved only in financial transactions or are in many instances inactive.

- Experiencing annual revenue growth exceeding 25% over the last three years, petroleum companies are generating the cash flow to accelerate capital expenditures for exploration, production, and processing plant construction.

- The industry plans to spend nearly $75 billion in 1981 on exploration, modification, and expansion of processing capacity, and on development of new technologies such as oil shale and synthetic petroleum from coal. Capital

INPUT

EXHIBIT III-3

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DISTRIBUTION OF U.S. PETROLEUM

COMPANIES BY SIZE, 1980

COMPANY SIZE	SIZE ANNUAL REVENUES ($ billions)	NUMBER	TOTAL 1980 ANNUAL REVENUES ($ billions)
Major	>$20	8	$350.4
Semi-Major	7-19	12	133.5
Large Independent	0.5-6.0	60	97.1
Small Independents And Marketing Companies	0.5	840	64.0
Total	-	920	$645.0

SOURCE: 1981 U.S.A. OIL INDUSTRY DIRECTORY

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spending is expected to increase at an annual rate approaching 25% over the next two to three years.

- Despite excess general refinery capacity, new units will have to be designed and built to handle specialized processing requirements of unleaded gasoline.

- By all accounts, petroleum companies will be prime candidates for computer products and services over at least the next two to four years.

2. NATURAL GAS COMPANIES

- Natural gas is most frequently a by-product of petroleum exploration and production. It is understandable that, as shown in Exhibit III-4, all the large and over 70% of the medium-sized companies are petroleum companies.

- Natural gas transmission companies, heavily regulated by the federal government and state public utilities commissions, are to a large extent separate from petroleum companies.

- Four types of companies are involved in the natural gas utility industry, as shown in Exhibit III-5.

    - Distribution companies which sell gas to either consumer-owned utilities or consumers.

    - Transmission companies gathering and delivering gas in bulk to other gas utilities.

    - Combination companies which deliver both gas and electricity to both end users and commercial customers; only their natural gas revenues are included here.

    - Integrated companies which control their gas supply from well to end user.

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EXHIBIT III-4

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DISTRIBUTION OF U.S. NATURAL GAS PRODUCTION
BY SIZE, 1979

COMPANY SIZE	NUMBER OF COMPANIES	PORTION OF GAS PRODUCTION (percent)
Large	8	42.6%
Medium	22	27.8
Small	120	29.6
Total	150	100.0%

SOURCE: AMERICAN GAS ASSOCIATION

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EXHIBIT III-5

DISTRIBUTION OF U.S. INVESTOR OWNED
GAS UTILITY COMPANIES, 1979

TYPE	NUMBER	TOTAL 1979 REVENUES ($ billions)	AAGR 1975-1979 (percent)
Distribution	60	$11.8	18.9%
Transmission	48	29.9	25.9
Combination	66	10.8	16.8
Integrated	36	14.4	19.8
Total	210	$66.9	21.6%

SOURCE: AMERICAN GAS ASSOCIATION

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- Some 84 companies, 36 of which are integrated public utilities, are involved in the pipeline or transportation subsector of the natural gas industry, with revenues related to gas transmission in 1979 of approximately $36 billion.

  - Thirty-two of the major pipeline companies account for 85% of all natural gas transmission.

  - Although transmission pipeline growth has remained static for the 1975-1979 timeframe, field and gathering pipeline miles have been growing at a 4% annual rate as new discoveries are added to the existing transmission network.

3. COAL COMPANIES

- With all the promise of energy independence, the coal industry still does not rate as a "growth" industry. Total 1979 revenues exceeding $19 billion have been growing at a faster rate (12%) over the past five years than total coal production (2%), primarily due to increasing energy prices (petroleum and natural gas).

- Some 50 large and medium-sized companies control over 65% of the current marketplace, as shown in Exhibit III-6.

- With over 2,700 underground mines in operation, primarily in Appalachia, 61% of all coal still comes from surface mining. A major shift to surface mines in the western states is expected to increase the portion above 70% by 1985.

- The primary transportation method for hauling coal is rail, with 60% going by rail, and another 12% consumed at the mine mouth.

- Public power utilities are the main users, consuming over 82% of all coal production. About 1% of production finds its way to consumers.

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EXHIBIT III-6

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DISTRIBUTION OF U.S. COAL COMPANIES
BY SIZE, 1979

COMPANY SIZE	SIZE ANNUAL REVENUES ($ millions)	NUMBER	TOTAL 1979 ANNUAL REVENUES ($ billions)
Large	$250-1,600	15	$8.1
Medium	100-249	35	4.4
Small	< 100	330	6.7
Total	-	380	$19.2

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- Increased consumption of coal by public utilities is not yet a reality as a combination of factors, including restrained economic activity and conservation, have reduced the growth rate of electricity demand.

4.   URANIUM COMPANIES

- The number of companies involved in the seven steps in the nuclear fuel cycle is shown in Exhibit III-7.

- Approximately half the uranium mined for the nuclear industry is currently imported. Most U.S. uranium is mined primarily from open pits in New Mexico, Arizona, and Wyoming. The top 30 companies mine over 90% of current production.

- Milling capacity is the limiting factor in increasing uranium production in the U.S. The output of the milling process is uranium oxide.

- Conversion of uranium oxide to uranium hexafluoride is done by only two companies in the U.S., Allied Chemical and Kerr-McGee.

- Enrichment through gaseous diffusion is accomplished under government classified control in government-owned, contractor-operated plants.

    - Union Carbide and Goodyear Atomic are the contractors.

    - The U.S. has more than 90% of non-Communist enrichment capacity.

    - The U.S. tries to control nuclear proliferation through control of enrichment capability.

- The enriched uranium hexafluoride is reconverted to uranium oxide and then fabricated into fuel rods and assemblies for the power utility industry and the U.S. Navy by seven companies, primarily nuclear reactor producers.

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EXHIBIT III-7

DISTRIBUTION OF U.S. COMPANIES INVOLVED IN
NUCLEAR ENERGY, 1978

FUNCTION	SUBSECTOR	NUMBER OF COMPANIES INVOLVED
Mining	Exploration	200
Milling	Production	21
Conversion	Processing	2
Enrichment	Processing	2 (a)
Fuel Fabrication	Processing	7
Reactor Design and Production	Power Utility	5
Reprocessing	Government	3 (b)
Waste Disposal	Government	2 (b)

(a) DOE CONTRACTORS
(b) NOT YET OPERATING

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- Four petroleum companies were involved, but currently only Exxon is involved.

- Fuel fabrication is so closely tied to the power utility industry that it is considered part of industries related to the public utility sector.

● Reactor design and production are primarily for the power utility industry or the U.S. Navy, and are considered part of industries related to the public utility sector.

● Commercial reprocessing and waste disposal companies not yet in operation are considered at this time as part of the government sector.

● The productive capacity of the U.S. uranium industry is concentrated in a small number of companies. As shown in Exhibit III-8, 15 companies control 61% of all U.S. uranium reserves, and 98% of current milling capacity.

● In 1980 the uranium industry mined and milled nearly 43 million pounds of uranium oxide valued at over $1.2 billion.

● The near-term prospects for the U.S. uranium industry are clouded by the after-affects of the Three Mile Island accident, oversupply, falling prices, and NRC licensing restrictions. The increase in the number of nuclear reactors coming on-line, and the planned number requiring refueling brighten industry prospects beyond 1983.

- Price declines have dampened exploration and development effort to $125 million in 1980, down 23% from 1979.

C.   PETROLEUM COMPANIES AS ENERGY COMPANIES

● Energy markets are dominated by large companies. As shown in Exhibit III-9, concentration of production in terms of revenues or "value" is least in coal and

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EXHIBIT III-8

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DISTRIBUTION OF URANIUM MINING AND MILLING
BY COMPANY SIZE, 1977

COMPANY SIZE	NUMBER OF COMPANIES	PORTION OF TOTAL RESERVES (percent)	PORTION OF MILLING CAPACITY (percent)
Very Large	4	42%	54%
Large	4	11	29
Medium	7	8	15
Small	185	39	2
Total	200	100%	100%

SOURCE: YELLOWCAKE: THE U.S. URANIUM INDUSTRY

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EXHIBIT III-9

CONCENTRATION OF PRODUCTION IN ENERGY MARKETS
BY INDUSTRY SECTOR, 1977

INDUSTRY SECTOR	PORTION OF TOTAL PRODUCTION (percent)	
	LARGEST 8	LARGEST 20
Petroleum	50%	73% (a)
Natural Gas	43	65 (a)
Coal	35	48 (b)
Uranium	86	100 (b)

SOURCE: FTC

(a) BASED ON REVENUE
(b) BASED ON "VALUE" OF TOTAL PRODUCTION

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greatest in uranium. The largest 20 companies in each sector control the factors of production of the major portion of energy markets.

- In turn, petroleum companies have become energy companies by obtaining control of major portions of other energy market sectors.

  - As shown in Exhibit III-10, over one-third of the eight largest coal and uranium companies are owned by petroleum companies - 100% in the case of natural gas.

  - Over 45% of the 20 largest uranium companies are owned by petroleum companies representing over 45% of total U.S. production.

- The growth of petroleum companies into energy companies is important to computer services markets because:

  - Petroleum companies are becoming an important source for buying products and services in other energy sectors.

  - Petroleum companies, highly automated, are transferring information technology to other energy markets, accelerating EDP market growth.

D. RELATED COMPANIES

1. GEOPHYSICAL EXPLORATION

- Many companies, some very large, provide a wide variety of geophysical exploration services to the petroleum and to a lesser extent the mining, including coal and uranium, industries.

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EXHIBIT III-10

CONCENTRATION OF PETROLEUM COMPANIES
IN ENERGY MARKETS
BY INDUSTRY SECTOR, 1977

INDUSTRY SECTOR	TOTAL PORTION CONTROLLED BY PETROLEUM COMPANIES (percent)	
	LARGEST 8	LARGEST 20
Petroleum	100%	100% (a)
Natural Gas	74	100 (a)
Coal	27	33 (a)
Uranium	42	47 (b)
	33	53 (c)

SOURCES: FTC, DOE, NPI

(a) IN TERMS OF REVENUES
(b) IN TERMS OF RESERVES
(c) IN TERMS OF MILLING

INPUT
MERMR

- Companies such as Geosource field seismic crews, vessels, and land equipment to acquire land and marine seismic digital data, which are then processed to create data for interpretation by petroleum company geophysicists.

- The data processing involved in seismic data acquisition is such a small portion of total personnel and equipment exploration costs that the industry, including the Society of Exploration Geophysicists (SEG), has never attempted to separate the data acquisition component from total acquisition costs, usually contracted for in terms of line miles (land or marine).

- However, the costs of seismic data reduction, processing, and analysis are separately contracted for. Seismic data processing is believed by experts to be the largest data processing application outside of the federal government, and represents the major portion of EDP expenditures for computer services in this study.

- Seismic contractors such as Digicon have become turnkey vendors by integrating mega-minicomputers with seismic software and floating point array processors, offering a total system including maintenance to petroleum companies and other seismic processing services vendors.

- Seismic processing vendors like Seismographic Services Corporation (SSC) have entered the FM market by offering dedicated centers including personnel, facilities software, and computers on long-term contracts to petroleum companies.

- Geophysical data acquisition and processing are also done, but to a much lesser extent, for the mining industry, including coal and uranium. According to the SEG, nearly $80 million was spent worldwide in 1980 for mineral exploration including coal and uranium.

INPUT

- Large drilling and oil field services contractors provide computer services in connection with exploration drilling. Companies like Schlumberger use mini-computers as well as RCS services for data acquisition and processing of core samples, electric and other well log data.

- Companies like Core Labs specialize in data analysis and correlation of well log data.

- A number of consulting firms like Tecknica provide geophysical consulting services together with software packages and processing services.

2. PRODUCTION

- Large oil field services companies like Halliburton provide data processing services related to well drilling. The services are produced by both on-site minicomputers and RCS.

- Engineering firms like Brown and Root and Marathon Marine Engineering provide engineering analysis and design services for drilling rigs and offshore platforms. The services include contracting for RCS services for structural and dynamic analysis as well as project management services.

- Engineering firms like Mintec and M. Baker provide computer-aided mine planning services, as well as software packages for in-house installation.

- Gas and oil reservoir evaluation and planning engineering services are offered by such companies as Intercomp and Scientific Software Corporation, including professional services software packages and processing services.

3. PROCESSING

- Construction companies such as Ralph Parsons offer engineering services including computer-aided structural analysis, process simulation, and project management services to petroleum companies for building or upgrading oil refineries.

INPUT

- Engineering companies such as Fluor Mining and Metals offer professional services, computer simulation, and software packages for mine production planning, scheduling, and control.

- Engineering companies such as Systems Science and Software also supply services including nuclear transport and processing simulation programs and services to the uranium industry.

E.   GEOGRAPHIC CONSIDERATIONS

- Texas and the Gulf states currently account for over 50% of current U.S. production exceeding 8.6 million barrels per day. California and Alaska with increasing production from Prudhoe Bay account for 30%. Intense exploration and development in states surrounding Denver will contribute to production beyond 1985.

- Over 75% of all natural gas comes from Texas, Louisiana, and Oklahoma.

- Houston, frequently referred to as "oil city," and more recently Denver are the prime centers of petroleum company activity. Other areas of importance are Louisiana, Oklahoma, Dallas, and Bakersfield, California.

    - Vendor presence is a must in Houston and Denver.

- Over 55% of current coal production comes from Appalachia, 24% from the Midwest, and 21% from the West. Production is rapidly shifting westward. By 1985 western states will produce over 45% of the total.

- Uranium production is concentrated in western states. In 1979, 40% came from New Mexico, 27% from Wyoming, and 33% from Arizona and other western states.

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INPUT

- Growing centers for the mining of coal and uranium are Denver and Tucson. Pittsburgh is the center for Appalachia and St. Louis or Cleveland for the Midwest.

F.   INFLUENCING FACTORS

I.   ECONOMIC

- The primary factor influencing energy markets is the price of crude petroleum. The price, though currently stable, is still expected to rise to or above $50 per barrel by 1985. Cash flow generated from petroleum operations forms the basis for massive increases in capital expenditures for exploration, production, and upgrading refineries, etc.

- Increasing petroleum prices raise the relative value of other energy sources, stimulating development in:

    - Enhanced recovery of tertiary oil

    - Oil shale.

    - Deep well drilling for natural gas.

    - Coal gasification.

    - Coal slurry pipelines.

- Growth in total energy consumption is currently declining due to:

    - Higher energy prices sparked by petroleum which affect consumer disposable income.

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INPUT

- Low growth in U.S. economic activity.

- Industrial and consumer conservation.

- Growth in energy consumption, expected to increase with expanding U.S. economic activity in 1982-1983, will moderate but not significantly affect the rapid growth of expenditures for computer services in energy markets in the 1980-1985 timeframe.

- Shortage of qualified personnel is the next factor most influencing growth in petroleum exploration and production.

  - Seismic crews for exploration data acquisition.

  - Seismic analysts for data reduction.

  - Geophysicists for seismic analysis and interpretation.

  - Drilling crews for drilling rig operation.

  - Oil field construction and servicing crews.

- Otherwise expenditures for geophysical data processing would double annually through at least 1983, given that the price of crude does not decline.

- Lacking qualified personnel, large petroleum companies are shifting geophysical data acquisition and processing to geophysical services vendors.

  - Use of FM arrangements for dedicated seismic processing centers is increasing.

- Suffering from the effects of cartel prices in excess of $43 per pound for uranium oxide, prices have fallen to $27 per pound, causing serious dislocation in the uranium industry. This, coupled with the after-effects of Three Mile

INPUT

Island, has taken the glow off industry growth, now expected at 2.5% annually through the end of the decade.

- In an era of spiraling costs and decreased margins between production costs and market prices for energy, operators are turning to computer-aided planning systems in such areas as mine planning and scheduling, reservoir evaluation, production planning, and process optimization.

- The shift to self-service gasoline stations, forecasted to exceed 50% of total outlets in 1981 is induced by decreasing cost/price margins caused by inflation. Major petroleum companies are developing completely automated gasoline pumps; using a debit card the motorist will access, dispense, and be billed for his gas by microcomputers, which in turn will access electronic funds transfer (EFT) networks.

2. GOVERNMENT

- Deregulation of petroleum prices will greatly stimulate expenditures for exploration and production in the U.S. as government policy supports greater U.S. energy independence.

- By requiring conversion of selected electric utilities from petroleum to coal, the Power Plant and Industrial Fuel Use Act (PIFUA) is projected to cause a 10% shift from the use of petroleum to coal by public power utilities.

- The Natural Gas Policy Act (NGPA) abolished the two-tier structure, initiating phased decontrol of natural gas prices. Rising natural gas prices will stimulate expenditures in areas such as:

  - Exploration for gas below 15,000 feet.

  - Coal gasification.

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- Production is forecasted to increase between 2% and 4% annually through 1985.

- Despite the existence of excess general refinery capacity, stiffer environmental quality regulations requiring unleaded gas will require new refinery units.

- Title I of the Energy Security Act established the Synthetic Fuel Corporation (SFC) under which major programs were initiated for:

    - Coal gasification: $165 million in 1979.

    - Coal liquefaction: $200 million in 1979.

- The fate of SFC is in doubt under the current administration, but coal projects are expected to continue.

- Benefiting from the current administration's support, and changes in management of the Nuclear Regulatory Commission, 5 of 11 nuclear power plants nearing completion are likely to be licensed in 1981. The upturn in demand for nuclear fuel is expected to stimulate uranium production and processing by 1983-1984.

- The coal industry expects favorable support from the current administration in moderating the growth restrictive aspects of the:

    - Clean Air Act with respect to emissions from coal-burning power utilities.

    - Federal Surface Mining Act with respect to mine planning, permits, and environment.

    - Mine Safety Act with respect to certifying mine environmental and safety control systems.

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INPUT

- The net result will be increased production through 1985.

- Forced to justify price increases before public utility commissions, natural gas transmission companies are turning to computer-aided economic and financial planning models to support pricing decisions.

3. TECHNOLOGY

- Data acquisition technology is exponentially increasing the amount of seismic data acquired for each survey line mile. Over the past three years recording channels have increased from 46 to 92, and in the case of marine data have risen to 1,024. Sampling rate has more than doubled. In selected areas, data acquisition has shifted from two to three dimensions (3D).

- Improved information processing technologies have reduced the cost of front-end geophysical data processing. Examples are:

  - Programmable pipeline array processors.

  - Large seismic conductor memories.

  - High-density magnetic tapes.

- Image enhancement of satellite data is being integrated into computer-aided mapping for mineral geological exploration.

- Engineering analysis has resulted in the increasing complexity of exploration, production, and processing analysis and modeling software in such areas as:

  - Stratigraphic analysis.

  - Synthetic modeling.

  - 3D seismic processing.

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- 3D oil reservoir simulation.

- Process simulation, design, and optimization.

- Structural analysis.

- Computer-aided graphic systems are evolving to support exploration, production, and processing.

    - Color CRT and plotting.

    - Data base systems.

    - Computer-aided mapping.

    - Pre- and post-processing systems.

- Minicomputer technology is being widely applied in all subsectors:

    - On-site micro-minis for data acquisition.

    - Mega-minis for geophysical data processing.

    - Minicomputers for refinery process control connected to mainframes for production optimization.

    - Turnkey minisystems for bulk terminal delivery control and accounting.

    - Mine production and environmental control systems connected to mainframes for inventory and production control.

- Supercomputers are required to do oil (mineral) field reservoir (reserve) evaluation, modeling, planning, and production scheduling, handling vector computations on a scale not possible in the 1970s.

INPUT

IV USER ANALYSIS

IV   USER ANALYSIS

A.   INTRODUCTION

- Companies involved in energy markets are major users of automation in all aspects of their businesses. Petroleum companies have some of the largest data centers in the world located in Houston.

- Petroleum and natural gas companies and more recently coal companies use computers for both data processing and process control.

- Energy companies are increasingly integrating process control operations with data systems through telecommunications for both data gathering and optimization of process operations. The distinction between the use of computer systems for data versus process control is blurring, making determination of expenditures related to EDP increasingly more difficult.

- Expenditures outlined in this chapter are for EDP as opposed to process control functions and only in the related subsectors for each of the four industry sectors comprising energy markets as outlined in Chapter III, Industry Structure.

INPUT

B.   USE OF EDP

- Energy companies spend between 0.75% and 2.0% of total revenues for EDP. As shown in Exhibit IV-1, total 1980 EDP expenditures were nearly $5.5 billion. The major portion (82%) of total EDP expenditures was for in-house operations.

- Petroleum companies, spending 0.75% of total revenues, account for nearly 90% of total EDP expenditures in energy markets.

  - Coal and natural gas companies spend about 1.9% of total revenues.

  - Uranium companies spend 2%.

- Having gone through the "seven year" EDP centralization cycle, large petroleum companies are finding that the information pipeline is becoming clogged. Major efforts are underway, particularly in exploration, to distribute computer power to district offices, and allow production groups to have separate computers for engineering applications.

  - Mega-minicomputers are being used for selected seismic processing, synthetic analysis, stratification modeling, and computer-aided interpretation.

  - Minicomputer driven computer-aided design (CAD) systems are being applied to exploration and production mapping applications, using distributed data bases transferred from host systems.

  - Separation of scientific and engineering from MIS applications is occurring to the point of using other than IBM computers for engineering work.

INPUT

EXHIBIT IV-1

DISTRIBUTION OF EDP EXPENDITURES IN ENERGY MARKETS
BY INDUSTRY SECTOR, 1980

INDUSTRY	EDP EXPENDITURES ($ millions)		
	IN-HOUSE	COMPUTER SERVICES	TOTAL
Petroleum	$4,005	$875	$4,880
Natural Gas	315	45	360
Coal	155	35	190
Uranium	30	10	40
Total	$4,505	$965	$5,470

INPUT
MERMR

- An independent petroleum comany is using the DEC/VAX 11/780 for seismic processing and an IBM 4331 for data base applications, interconnecting them with a Com Ten communication processor.

- Major petroleum companies have shifted engineering, exploration, and production work from IBM to CDC mainframes.

• Recognizing the importance of information as a resource, major coal companies are upgrading EDP systems, installing comprehensive communications networks with intelligent terminals in all mines and engineering and division offices for mine planning and materials management.

• Having applied advanced computer technology to process and production control operations, petroleum companies, in acquiring coal producers, are accelerating coal company automation through technology transfer to their subsidiaries.

C.   USE OF COMPUTER SERVICES

• Energy companies use computer services in all market subsectors but more so in exploration and production.   Companies use computer services for the following reasons:

- To obtain technical specialization.

- On an overflow basis to meet heavy demand.

- On an interim basis while upgrading systems.

- For faster turnaround than is available in-house.

- To obtain computational resources not available in-house.

- 50 -

INPUT

- The increased use of seismic data processing vendors by petroleum and natural gas companies results from widespread industry personnel shortages, and from the need to use proprietary vendor-developed state of the art processing software.

- Energy companies make widespread use of consulting services to develop and use petroleum reservoir simulation models, coal dragline simulation systems, oil shale production planning and scheduling systems, and nuclear processing transport codes.

- Petroleum companies run programs developed in-house on a remote batch basis using RCS resources when their in-house systems are overloaded.

  - Operating divisions frequently prefer user friendly RCS systems which give faster turnaround than unresponsive in-house systems.

- Petroleum and uranium companies having to develop simulators for large problems such as 3-D reservoir or uranium milling systems design simulators which will use large-scale vector computer resources from RCS vendors for program development on an interim basis, and transfer the completed system to an in-house supercomputer when installed.

- Petroleum companies spend about 18% of total EDP expenditures for computer services. The portion varies greatly by subsector. As shown in Exhibit IV-2, petroleum companies spend just under half of total EDP expenditures for exploration on computer services, primarily geophysical data processing.

- The 30% portion that petroleum companies spend in the production subsector is divided between reservoir (black oil and enhanced recovery) simulation, where 50% is used for computer services, and other applications where only 20% is expended outside.

- In the marketing subsector, where current price, delivery and financial decisions in world money markets are time sensitive, petroleum companies

INPUT

EXHIBIT IV-2

DISTRIBUTION OF EDP EXPENDITURES BY PETROLEUM COMPANIES
BY SUBSECTOR, 1980

SUBSECTOR	PORTION (percent)		
	IN-HOUSE	COMPUTER SERVICES	TOTAL
Exploration	51%	49%	100%
Production	70	30	100
Processing	88	12	100
Transportation	90	10	100
Marketing	96	4	100
WEIGHTED AVERAGE	82%	18%	100%

INPUT
MERMR

have built elaborate on-line in-house management information systems (MIS).
Only 4% of nearly $2 to $3 billion in EDP expenditures is spent for computer
services including credit verification and card processing, econometric fore-
casting, financial and management planning, and funds management computer
services.

- Other energy companies spend between 12% and 20% of total EDP expendi-
  tures on computer services.

  - Coal companies spend about 15% of total EDP expenditures on
    computer services, particularly in engineering applications such as mine
    planning, in reserve evaluation, and in corporate planning.

  - Natural gas and uranium companies spend 12% and 20%, respectively,
    primarily on engineering applications.

D.   APPLICATIONS ANALYSIS

I.   EXPLORATION

- Exploration for petroleum and natural gas is accomplished primarily by
  geophysical techniques, whereas for coal and uranium primarily by geological
  ones.

- The five major applications in petroleum and natural gas exploration are shown
  in Exhibit IV-3.

  - Exploration geophysicists report that they spend over 85% of the EDP
    portion of their budgets on seismic data processing, a declining portion
    on well log analysis now that it is more frequently acquired in digital
    form, and a rapidly growing portion on mapping.

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INPUT

EXHIBIT IV-3

DISTRIBUTION OF EDP EXPENDITURES FOR PETROLEUM AND
NATURAL GAS EXPLORATION BY APPLICATION, 1980-1985

APPLICATION	PORTION (percent)		
	1980	1982	1985
Initial Seismic Processing	19%	18%	17%
Initial Seismic Interpretation	37	36	35
Seismic Reprocessing, Analysis, and Modeling	30	31	32
Well Log Analysis	4	3	2
Mapping	10	12	14
Total	100%	100%	100%

INPUT
MERMR

- Seismic data acquisition is accomplished by oil company (primarily by geophysical construction) land and marine crews, who acquire dynamic seismic wave data in digital form from geophones in response to surface excitation.

- In 1980, seismic crews recorded worldwide over 1 million line miles, 65% of which were for marine areas. Although line miles increased 17% over 1979, total data acquisition costs rose over 50% as the number of data recording channels per mile continued to rise from 46 to 92 on up to 1,024 for marine data, the sampling frequency more than doubled, and data in selected areas were taken in three versus two dimensions.

- Seismic data are acquired using increasingly more sophisticated mini-computers, on board either land vehicles or naval craft. Shortage of qualified seismic crew personnel is inducing geophysical contractors to accomplish preliminary data reduction on selected seismic data in or near the place of acquisition to insure its quality and accuracy. Major petroleum companies are experimenting with satellite transmission of seismic data from overseas locations.

- The Society of Exploration Geophysicists reported that energy companies spent in 1980 over $2 billion or 76% of geophysical exploration budgets on seismic data acquisition. The actual cost to record the seismic data by computer systems is so small compared to personnel and equipment (trucks, ships, etc.) as to be not separately measurable. In any event the mode of delivery is almost exclusively by turnkey minicomputer systems.

- Seismic data, field recorded on magnetic tape, are delivered to seismic data processing centers for initial seismic data reduction and processing. The volume of data is too great to handle in an economic manner by tele-communications yet.

INPUT

- Seismic data reduction has been and to a large extent will continue to be a specialized and massive batch processing application. Remote batch is beginning to be used for processing parameter selection and for task rebundling.

    - U.S. petroleum companies spent over $210 million in 1980 for initial seismic processing, 42% more than in 1979, about half in-house and half with seismic processing vendors.

- Working with the responsible petroleum (gas) company geophysicists, seismic analysts apply computerized data synthesis and correlation techniques to produce seismic sections using electrostatic (black and white), inkjet (color), or photographic plotters. The initial data may be processed several times before final interpretation. The processing is currently accomplished primarily in the batch mode, but remote batch and interactive techniques are becoming more widespread. Actual interpretation decisions are made by the responsible petroleum company geophysicist.

    - U.S. petroleum companies spent over $410 million in 1980 for initial seismic interpretation, 44% more in this more labor-intensive application than in 1979, again about half in-house and half wth seismic processing vendors.

- Seismic data processing, analysis, and interpretation is a highly specialized applicational area requiring high-density magnetic tape, large central memories (1 on 6 or more), high-speed floating point array computation, and sophisticated software.

    - Most processing is currently done in two dimensions.

    - Widespread use of 3D processing in the future will require vector computers.

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- Geophysicists estimate that seismic data are reprocessed about 30% of the time at a later date and as new and related (i.e., well log) data become available. Stratigraphic analysis and synthetic modeling tehniques are used on a remote batch and, more frequently, interactive basis to assist in improved interpretation.

    - Color graphics, both CRT and plotting, are being used with increasing frequency.

    - User friendly graphic software is the order of the day.

- Magnetic, acoustic, and nuclear data taken at the well site during drilling are field digitized and computer analyzed to integrate with seismic data first in the exploration and later in the production process. The data more frequently acquired by site mini/microcomputers form part of the data base for the mapping application.

- The creation of maps for exploratory drilling showing geographic boundary, contour, layer boundary, and contour data, a complex and highly labor-intensive application, is being impacted by minicomputer driven CAD systems with sophisticated interactive graphics software.

    - With an expected 55% AAGR over the forecast period, petroleum companies' EDP expenditures for mapping applications will exceed $1 billion in 1985.

2. PRODUCTION

- The six major applications in petroleum and natural gas production are shown in Exhibit IV-4.

    - Directors of production research report that over 35% of petroleum production related EDP expenditures are for black oil and enhanced recovery simulation for production evaluation, planning, and scheduling.

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INPUT

EXHIBIT IV-4

DISTRIBUTION OF EDP EXPENDITURES FOR PETROLEUM
AND NATURAL GAS PRODUCTION BY APPLICATION

	PORTION (percent)		
APPLICATION	1980	1982	1985
Reservoir Simulation	30%	27%	25%
Enhanced Recovery	5	11	15
Valuation	5	7	10
Drilling Assistance	15	14	12
Engineering Analysis And Design	20	19	18
Production Accounting And Reporting	25	22	20
Total	100%	100%	100%

-   Decontrol of petroleum prices will, once the excess profits tax is moderated, allow production decisions to be made on the basis of engineering economics, increasing the relative portion spent on valuation while reducing the portion spent on accounting and reporting.

-   Expenditures for drilling assistance will increase as deeper wells are drilled for petroleum and natural gas.

-   Improved technology in distributed processing for pre-and post-processors and supercomputers will improve the cost effectiveness of petroleum and natural gas structural analysis and design.

-   Reservoir simulation of fields modeled in 3-D, with over 5,000 grid points using closely coupled equation solution approaches, requires the resources of supercomputers such as the Cyber 205 and Cray 1S. Major petroleum companies develop their own models but use RCS resources for about 30% of over $80 million in 1980 EDP expenditures. Lacking qualified personnel, semi-majors and large independents use both vendor models and RCS resources well over 75% of the time.

-   Enhanced recovery simulation using steam, CO_2, and heat, adding nearly an order of magnitude to the computational requirements, is increasingly employed on smaller fields to plan recovery of up to 90% of tertiary petroleum.

-   Reserve valuation, frequently using data base services, applies geological judgment and production engineering economies to new fields based on seismic, well log, and prior production data for purposes of lease bids, financial return on investment, and determination of tax consequences of partnership arrangements. To insure due diligence, energy companies frequently use the professional services of consulting engineers, as well as proprietary programs and programs available on RCS networks.

INPUT

- The drilling assistance application is accomplished through RCS services and more frequently by on-site minicomputer-driven turnkey systems integrated with the drilling rig. The computer program optimizes drilling costs by controlling drilling variables as a function of site geology and depth. With wells, particularly natural gas, being drilled deeper (16,000-20,000 feet) EDP expenditures for drilling assistance services will continue to rise.

- Although most engineering services for production subsector functions such as offshore platform design and construction are contracted for through related civil engineering and construction firms, petroleum and natural gas companies still do a significant amount of engineering analysis and design in-house and through vendor-supplied software packages offered in RCS vendor libraries.

  - Ability to use graphic pre- and post-processing subsystems to model input and analyze output of remote batch processed large engineering analysis and design packages is a strong inducement for petroleum and natural gas companies to use RCS services.

- Production accounting is used for both company and partnership financial record-keeping, and to report to state and federal agencies (DOE). Except for the windfall profits tax, decontrol of petroleum prices will simplify pricing and monthly reporting by the four classifications of old, new, freed, and stripped oil.

3. PROCESSING

- Processing subsector EDP applications are primarily engineering oriented. Applications include:

  - Refinery modeling.

  - Process simulation.

  - Thermal design.

INPUT

- Structural analysis.

- Process planning and scheduling.

• Petroleum refineries are highly automated. Extensive use is made of turnkey mini/microcomputer systems for process-controlling the quantity, quality, and variety of petroleum products. The same is true for uranium enrichment, coal gasification and liquefaction processing.

• Process control systems are increasingly linked to EDP systems for data gathering, and for optimization of the procuring process.

- Linear programming techniques are used to simulate and optimize process performance, taking into consideration such parameters and variables as demand, energy consumption, pollution, type and quality of input, and safety.

• The design and engineering of coal gasification and liquefaction processing plants make heavy use of simulation software developed through federal R&D financing.

• Engineering applications are frequently designed and developed by consulting engineering companies and offered as software packages for in-house installation or through RCS companies. Some engineering companies buy block time from RCS vendors, offering software, processing, and professional consulting services to energy companies.

- Petrochemical and Refinery Modeling System (PRMS), offered by Bonner and Moore as a software package or through their own data processing subsidiary, is an economic modeling system for planning refinery complexes.

- PROGRESS, offered by Profimatics, is a refinery operations simulation package available for in-house installation on a lease basis or by RCS

INPUT

through GEISCO. Cracking and reforming process simulation systems are also available on the same basis.

- Products and Resources Optimization Model (PROM), offered by Sun Information Services, is a computerized planning system for optimizing processes using linear program technology.

- Thermal design offered by Gulley Computer Associates is a software package to design shell and tube heat exchangers.

- PROCESS, offered by Simulation Sciences both as a software package for in-house installation, and through numerous RCS vendors including UCS, UCC, CDC, McAuto, CSC, and GEISCO, is a comprehensive process simulation system for designing petroleum refineries and other hydrocarbon related energy processes.

- HEX NET, offered by Profimatics as a software package and on an RCS basis through GEISCO, is used to solve complex heat exchange problems.

- ANSYS, offered by Swenson Analysis Systems, widely available on RCS vendor networks including CSC, CDC, UCC, UCS, and McAuto, is a comprehensive finite element program for static and dynamic structural analysis and petroleum refinery and other energy process designs.

4. TRANSPORTATION

- A primary application for oil and natural gas pipeline transmission companies is product accounting of the quantity of input and output of carbon products by seller and buyer. Petroleum pipelines are used between producers and refiners and crude swapping frequently occurs between majors and independents.

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- Petroex is a pipeline exchange accounting service subscribed to by participating petroleum companies using the GEISCO network.

- Petrodata, offered by Scientific Software through its service bureau subsidiary, is a fully integrated petroleum accounting system for petroleum and natural gas pipeline transportation.

• Natural gas transmission companies, forced to better support gas rate price structures before state and federal public utility commissions, are increasingly using computer-aided financial management and planning systems.

- Planmetrics offers PRMS tailored to client needs through professional services, for either on-site installation, or on an RCS basis through buying block time from Tymshare.

• Day-to-day pipeline operations are automated by minicomputer driven process control systems for controlling pressures, temperature, and flow rate, and for data acquisition. The process control systems are being integrated with host EDP systems for data recording and for optimization of transmission flow.

• Another primary use of EDP in the tranportation subsector is scientific and engineering applications. Applications include:

- Pipeline design.

- Flow analysis and optimization.

- Engineering analysis.

- Tanker scheduling and loading.

• Engineering applications are frequently designed, developed, and offered by engineering companies as software packages for in-house installation or through RCS companies.

INPUT

- TRIFLEX, developed by AAA Technology and offered through various RCS companies including CSC, UCC, CDC, McAuto, and UCS, performs pipeline stress analysis.

- GASUS and GASSS, developed by Stoner Associates and offered both as a software package for in-house installation and through National CSS, are used for unsteady- and steady-state flow modeling natural gas transportation systems.

- McAuto Pipeline is used for static and dynamic piping stress analysis for petroleum, natural gas, and coal slurry pipelines.

- ADSIP, offered by SIS, produces isometric drawings and deals with all material handling functions associated with pipeline construction.

- Piping Analysis Systems, offered by CDC Cybernet, performs static, dynamic, and thermal analysis of three-dimensional piping systems.

5. MARKETING

- The major portion of EDP for the day-to-day marketing operations of most energy companies is done in-house. Large data centers, primarily IBM or IBM compatible, have been installed to support on-line operations using CRT terminals and DBMS. General timesharing has been largely shifted in-house. Applications cover the full range of MIS applications including:

    - Market planning.

    - Financial accounting.

    - Credit card operations.

    - Order entry.

INPU

- Inventory control.

- Corporate reporting.

- Computer services, only 4% of total marketing EDP expenditures, are in specialized areas, including:

  - Econometric forecasting.

  - Financial management and strategic planning.

  - Credit authorization and processing.

  - Cash management.

  - Consumer fuel oil scheduling and invoicing.

- Chase Econometric, through Interactive Data Corporation, and DRI specialize in energy industry interactive econometric forecasting using on-line data bases for energy industries.

- Execucom specializes in tailoring its Interactive Financial Planning System (IFPS) available through Cybernet for petroleum and natural gas industries.

- Arco, American Petrofiner, Crown Central, and other independent oil companies use National Data Corporation (NDC) under FM arrangements for credit authorization and card processing. FM services include application processing, card issuance, credit authorization, invoice and statement processing, remittance processing, and customer service.

- Petroleum companies use First Data Resources Corporation (American Express) and other bank card processors for processing bank credit card charges at retail gasoline stations.

INPUT

- Operating in both national and international financial markets, petroleum companies use cash management services including those offered by NDC, Chase Manhattan, Chemical Bank, and ADP.

- Petroleum and liquefied natural gas (LNG) companies use computer services vendors including Petrodata Corporation and Tymshare's Tele-Fuel to schedule the delivery and handle the invoicing of fuel and LNG to businesses and consumers primarily in the northeastern, eastern, and upper midwestern states. The services include delivery scheduling using degree day data bases, delivery route optimization, burner service inventory control, and all general accounting functions.

- Turnkey systems are also used by energy companies in the marketing subsector. Petroleum and LNG companies use Automated Bulk Terminal (ABT) systems to control and account for dispensing products to company and dealer trucks. ABTs are purchased to improve productivity and cash flow by on-site preparation of invoices and bills of lading, and for physical and product security, product allocation, and inventory management.

  - Computer networks to decentralize systems, handle satellite ABTs, and collect usage and accounting data are increasing in importance.

  - Of 2,000 bulk terminals, over 70% are owned by major (8) and semi-major (12) petroleum companies.

  - With only one-third of bulk terminals currently automated, the ABT market, currently over $20 million, will rise to nearly $90 million by 1986, a 32% AAGR.

6. GOVERNMENT RELATED

- Applications involving expenditures by energy companies for the Department of Energy (DOE) and other government unit related activities, including reporting, financial accounting, and R&D, are covered above within each of

INPUT

the five market subsectors. Government related EDP expenditures, including those for computer services, by energy companies are included in total energy market EDP and computer services expenditures.

- The federal government itself is involved in almost every step of the energy cycle, in all subsectors of the energy market. EDP and computer services expenditures related to the federal government are described in the INPUT report, Computer Services in Federal Government Energy Programs.

- DOE spent nearly $140 million in FY 1982 for computer services.

- Professional services is the largest component accounting for 45% of total expenditures.

- FM is the major processing delivery mode accounting for 71% of total processing services.

- Boeing Computer Services is one of the largest DOE FM vendors.

E. NEEDED PRODUCTS AND SERVICES

1. DATA BASE MANAGEMENT SYSTEMS (DBMS)

- Energy industries are well on the way to applying DBMS systems to create data bases and manage the day-to-day business of their operations. However, the best that can be said for the massive amounts of engineering data is that, with few exceptions, data management systems have been broadly applied.

- There is a significant need for the application of DBMS services to engineering data in energy industries. The need is particularly strong in the petroleum and natural gas sectors.

INPUT

- There is a shortage of personnel qualified in DBMS techniques with industry knowledge to apply existing DBMS systems to engineering data and improve the systems.

- Existing DBMS including data dictionaries and query systems need to be made "user friendly" to the geophysicist, geologist, and petroleum and process engineer.

- DBMS and services are needed in the exploration subsector for handling interpreted seismic data, well, geographic, and surface contour data for computer-aided interpretation and mapping.

- Equally, DBMS and services are needed in the production subsector for lease, well log, core, seismic, well history, and production and field grid point data for black oil and enhanced recovery simulation, for valuation, and for production scheduling.

2. COMPUTER-AIDED MAPPING SYSTEMS

- Expanded exploration activity by energy industries has accelerated the demand for effective computer-aided mapping systems to direct exploratory drilling. These systems now follow seismic exploration by months as opposed to a former one- to two-year lag.

- Computer-aided mapping systems which are either turnkey systems or can become nodes on a distributed network, RCS or in-house, combine CAD technology with:

  - User friendly interactive operator.

  - Distributed DBMS.

  - Advanced mapping systems.

INPUT

- Regular and high-resolution color CRTs.

- Improved resolution electrostatic and color plotting.

3. DATA BASE SERVICES

● There is a wealth of available but not yet organized data related to energy markets which would find eager use by at least exploration and production managers.

- Information about mineral rights and leases, state and federal related, is currently poorly catalogued and unreliable.

- Information about area geology, exploratory well history, past production history, and other related data is currently gathered predominantly by hand for reservoir simulation, validation, planning, and scheduling.

● Investment decisions involving high risk and large dollars imply that generic data coupled with rapid delivery and proprietary software will be high in "value added" for on-line data base services vendors.

4. ADVANCED SOFTWARE PRODUCTS

● The availability of large scientific computers using vector architecture offers new opportunities for approaching solutions to engineering problems in energy industries that but a few years ago were considered too large or complex for digital solution.

● New and improved mathematical approaches are needed to improve cost/effectiveness of solutions to 3-D seismic data processing.

● Improved computer aided approaches are needed to assist the geophysicist and directly support the ecologist in exploration decision making.

INPUT

- Advanced application and system software is required to more efficiently use the procuring process and supercomputers for 3-D reservoir simulation, production scheduling, and planning.

- With oil shale, coal gasification and liquefaction, and open pit coal mining projects each projected to cost in the billions of dollars, advanced engineering software is required to analyze project design planning, scheduling, production and profitability.

5. FINANCIAL MANAGEMENT AND PLANNING SYSTEMS

- Decontrol of petroleum and natural gas prices, and the projected increase in demand for coal and other energy sources, is resulting in the demand for more rational approaches to reserve valuation, production cost and pricing, and financial decision making.

- There is a need to interface on an interactive basis financial management and strategic planning models with the output of engineering simulation models such that exploration, production, and processing management can rapidly interact with corporate management in operating budget, capital expenditure planning, and in long-range strategic and financial planning.

6. MINE PRODUCTION AND ENVIRONMNTAL CONTROL SYSTEMS

- Underground coal mines are run by men doing hard work using big equipment, in a rough and tumble environment. Use of electronic automation to improve productivity has not until recently been a high-priority item. With increasing cash flow resulting from increased price and demand, coupled with entry of petroleum companies bringing experience in process automation, coal companies are looking at micro-minicomputer driven "floor plan" production and environmental control systems to improve operational efficiency and at the same time underground mine safety.

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INPUT

V COMPUTER SERVICES MARKET FORECAST

V   COMPUTER SERVICES MARKET FORECAST

A.   SCOPE AND METHODOLOGY

1.   SCOPE

- Computer services for energy markets are part of the process manufacturing sector.

- The market subsectors covered within each of the four energy industry sectors are shown in Exhibit V-1.

- Computer services offered in all market subsectors are included in the computer services market forecast for petroleum companies. Major integrated companies use computer services across all five subsectors, whereas independent petroleum companies may specialize in only one area such as refining or marketing.

- Petroleum companies are heavily involved in the exploration of natural gas, whereas gas transmission companies are involved primarily in storage, processing, and transportation of natural or liquefied natural gas.

- Gas is delivered primarily to public utilities which market it to consumers. Thus computer services related to the marketing subsector of the natural gas industry are counted in the utility sector.

INPUT

EXHIBIT V-1

SUBSECTORS INCLUDED IN COMPUTER SERVICES
MARKET FORECAST BY INDUSTRY SECTOR

MARKET SUBSECTOR	INDUSTRY SECTOR			
	PETRO-LEUM	NATURAL GAS	COAL	URANIUM
Exploration	Yes	Yes	Yes	Yes
Production	Yes	Yes	Yes	Yes
Processing	Yes	Yes	Yes	Yes
Transportation	Yes	Yes	No	No
Marketing	Yes	No	No	No

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INPUT
MERMR

- The major portion of coal production is used by the power utility industry. Coal production is either captive to the power utility (and to a lesser extent steel) industry, burned at the mine mouth for power generation, or shipped by rail to power utilities.

    - Computer services related to coal transportation are considered as part of the transportation sector.

    - Computer services related to marketing coal are, apart from captive operations or the power utility industry, so small as not to be measurable.

- Uranium processing beyond conversion is either government controlled or so directly tied to the power utility industry that computer services related to the remaining portion of the processing subsector, and to the transportation and marketing subsectors, are counted as expenditures in the utility or government sectors.

2. METHODOLOGY

- Current and forecasted expenditures for computer services by companies involved in each energy market subsector (petroleum, natural gas, coal, uranium) were separately determined by analysis of major applicational areas within each of the five subsectors (exploration, production, processing, transportation, marketing), as applicable. The four sectors were then summarized to determine expenditures by subsector for the total energy market.

- A determination was made on a subsector basis by industry of the portion of related expenditures used for computer services by mode of delivery. The subsectors were then summarized for each industry sector, and the four sectors in turn summarized to determine current and forecasted computer services expenditures by mode of delivery.

INPUT

- Returning to the subsector data, a determination was made of the portion of related expenditures used for processing services by type of delivery for each industry sector. The sectors were then summarized to determine current and forecasted computer services processing expenditures by type of delivery.

- Expenditures for computer services for each energy industry by subsector, by computer services mode, and by processing type of delivery are found in Appendix A, Data Base.

- Again, computer services expenditures are for companies whose primary business is energy. Thus petroleum company EDP expenditures for software products in-house, or use of RCS structural analysis services for construction are counted. Contracted services from a company to design and construct an offshore petroleum platform, where the construction company uses RCS services for structural analysis, are counted as computer services expenditures by the construction industry.

B.   COMPUTER SERVICES EXPENDITURES BY SUBSECTOR

- Spurred by sharply increased expenditures by petroleum companies, the exploration subsector, as shown in Exhibit V-2, currently nearly 60% of total 1980 computer services, will rise to nearly 80% by 1985.

- Petroleum companies spend nearly half of total EDP budgets on exploration data processing for computer services.

    - The majors spend up to 40% of their geophysical data processing budgets with seismic processing vendors.

    - Small independents use seismic vendors well over 90% of the time.

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INPU

EXHIBIT V-2

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FORECAST OF COMPUTER SERVICES EXPENDITURES IN
ENERGY MARKETS BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$578	$3,900	46%
Production	145	510	29
Processing	73	170	18
Transportation	79	180	18
Marketing	90	240	22
Total	$965	$5,000	39%

INPUT
MERMR

- Shortage of qualified geophysicists and computer analysts coupled with escalating exploration activity is forcing the top 20 petroleum companies to shift major portions of their seismic data processing to services vendors.

- With nearly $150 million in 1980 expenditures, the production subsector garners 15% of the current total for computer services.

  - Sixty million dollars or 40% is related to oil reservoir simulation analysis, production planning, and scheduling.

  - Majors spend some 30% while independents 100% of EDP budgets for production research on computer services for reservoir simulation.

- Petroleum companies are by far the largest users of computer services among companies involved in energy markets. Exhibit V-3 forecasts computer services expenditures by petroleum companies, in contrast with Exhibit V-4 which shows computer services expenditures in other energy markets (natural gas, coal, uranium).

  - Current expenditures by petroleum companies are nearly 10 times those of other energy companies.

  - By 1985 petroleum companies are forecast to spend nearly 20 times more.

- Clearly the action is and will remain in the petroleum exploration and production market subsectors.

  - Petroleum exploration and production account for 68% of 1980 total computer services expenditures.

  - Petroleum companies account for over 95% of total computer services expenditures for exploration and over 70% for production.

INPUT

EXHIBIT V-3

FORECAST OF COMPUTER SERVICES EXPENDITURES IN
THE PETROLEUM INDUSTRY BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$555	$3,840	47%
Production	105	380	29
Processing	60	140	18
Transportation	65	150	18
Marketing	90	240	22
Total	$875	$4,750	40%

INPUT
MERMR

EXHIBIT V-4

FORECAST OF COMPUTER SERVICES EXPENDITURES IN
OTHER ENERGY MARKETS BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$23	$ 62	22%
Production	40	129	26
Processing	13	27	16
Transportation	14	32	18
Marketing	-	-	-
Total	$90	$250	23%

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- In 1985 petroleum company computer services expenditures for exploration and production will exceed $4 billion, accounting for over 85% of total energy market computer services expenditures.

- The market for computer services in the petroleum industry, approaching $5 billion in 1985, limited primarily by the shortage of qualified personnel, is contingent on the price of crude petroleum remaining level or slowly rising to approach $40/barrel by 1983.

- Of $45 million in 1980 computer services expenditures by the natural gas industry, 33% is spent in each of the production and transportation subsectors primarily on engineering applications.

- The main portion (57%) of the $35 million spent on computer services by the coal industry in 1980 is in the production subsector and relates to the use of computer services for mine planning, scheduling, and production.

- Half of the $10 million in total computer services expenditures in the uranium industry is spent on production planning and scientific simulation.

C.   MARKET FORECAST BY MODE OF DELIVERY

- Computer processing, nearly 73% of total services, at $700 million attests to the size of geophysical data processing in energy markets, as shown in Exhibit V-5. Processing will exceed $4 billion in 1985, a 42% AAGR constrained primarily by personnel availability to get the job done in reasonable time. Clearly capital substitution for labor is in order.

- Batch processing of seismic data is the major (46%) processing delivery mode. However, technology in the form of multitasking virtual operating systems, mega-minicomputers, programmable array processors, and large semiconductor memories is enabling more use of RCS in the data reduction,

INPUT

EXHIBIT V-5

FORECAST OF COMPUTER SERVICES IN ENERGY
MARKETS BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$239	$1,658	47%
Facilities Management		135	1,300	57
Batch		327	1,144	28
Subtotal Processing Services		$701	$4,102	42%
Software Products	Systems	100	338	28
	Applications	50	205	33
Subtotal Software Products		$150	$ 543	29%
Professional Services	Services	114	355	26
	Facilities Management	-	-	-
Subtotal Professional Services		$114	$ 355	26%
Total		$965	$5,000	39%

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interpretation, and mapping applications. With a 47% AAGR over the five-year forecast period RCS will become the major (40%) processing delivery mode in 1985.

- Software products (16%) and professional services (12%) are also attractive markets. Petroleum companies have some of the largest EDP centers outside of the federal government. The market for IBM-compatible systems products including operating systems, DBMS, and systems aids will reach over $500 million by 1985.

  - Application products including seismic analysis and modeling, valuation systems, process design simulations, graphic software, mine planning and scheduling, and financial planning systems are in high demand.

  - Professional services include oil reservoir evaluation and simulation, reserve valuation, custom design analysis systems, dragline simulation, and data base design and development.

- Exhibit V-6 contains petroleum industry computer services expenditures by delivery mode and contrasts them with those of other energy markets, shown in Exhibit V-7.

  - Current processing services expenditures are primarily (95%) those of petroleum companies.

  - There is a viable market for FM arrangements. Major petroleum companies are contracting on a long-term (two-three year) basis for geophysical data processing centers, including computer hardware, software, personnel, and maintenance.

  - Other energy markets (natural gas, coal, uranium) represent over 20% of the current combined software product and professional services markets.

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INPUT

EXHIBIT V-6

FORECAST OF COMPUTER SERVICES IN THE PETROLEUM
INDUSTRY BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$215	$1,590	49%
Facilities Management		135	1,300	57
Batch		315	1,110	29
Subtotal Processing Services		$665	$4,000	43%
Software Products	Systems	80	285	29
	Applications	35	155	35
Subtotal Software Products		$115	$ 440	31%
Professional Services	Services	95	310	27
	Facilities Management	-	-	-
Subtotal Professional Services		$ 95	$ 310	27%
Total		$875	$4,750	40%

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EXHIBIT V-7

FORECAST OF COMPUTER SERVICES IN OTHER
ENERGY MARKETS BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$24	$ 68	23%
Facilities Management		–	–	–
Batch		12	34	23
Subtotal Processing Services		$36	$102	23%
Software Products	Systems	20	53	22
Software Products	Applications	15	50	27
Subtotal Software Products		$35	$103	24
Professional Services	Services	19	45	19
Professional Services	Facilities Management	–	–	–
Subtotal Professional Services		$19	$ 45	19%
Total		$90	$250	23%

INPUT
MERMR

- Other energy markets use batch services for geophysical and geological data processing.

- The major portion (55%) of RCS services in other energy markets is used by natural gas companies in engineering areas such as network analysis, structural analysis, and design and process optimization.

D.   PROCESSING SERVICES BY TYPE OF DELIVERY

- Computer processing services to energy markets are applications oriented, as shown in Exhibit V-8. The major portion (70%) of processing expenditures are specific to energy markets.

    - The major applications are seismic data processing, analysis, and interpretation.

    - Use of computer-aided mapping systems is rapidly rising.

- Energy companies are major users of RCS computer resources for running a wide variety of analysis, design, and simulation programs. Programs are developed in-house but used on an RCS basis; expenditures are counted as utility processing services.

    - Black oil reservoir and enhanced recovery simulation programs developed by production research departments of major oil companies, requiring vector computer resources, fall into this category. Over 17% of total services processing expenditures fall into this category.

- Energy companies also use a wide variety of scientific and engineering software, resident in RCS vendor libraries, available on a fee basis from specialist vendors, and applicable to a broad spectrum of functions across

INPUT

EXHIBIT V-8

FORECAST FOR PROCESSING SERVICES IN ENERGY
MARKETS BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 66	$ 314	36%
	Industry Specific	57	759	68
	Utility	117	487	33
Subtotal		$240	$1,560	46%
Facilities Management	Function Specific	25	75	24
	Industry Specific	110	1,225	62
	Utility	–	–	–
Subtotal		$135	$1,300	57%
Batch	Function Specific	2	3	9
	Industry Specific	324	1,139	29
	Utility	–	–	–
Subtotal		$326	$1,142	29%
Total Processing Services	Function Specific	93	392	33
	Industry Specific	491	3,123	45
	Utility	117	487	33
Total		$701	$4,002	42%

INPUT
MERMR

multiple industries. Energy companies spend 13% of total processing expenditures on these and other function specific processing services.

- Use of finite element structural analysis programs to design oil and natural gas pipelines, or process design simulation systems for unleaded gas refinery design are typical examples in engineering areas.

- Use of data base oriented MIS packages to develop and report energy production, or financial modeling systems to evaluate reserves or project profitability are examples in production and marketing areas.

- Exhibit V-9 contains petroleum industry computer services processing expenditures by delivery type and contrasts them with those of other energy markets, shown in Exhibit V-10.

- The major portion (95%) of industry specific type delivery occurs in the petroleum industry.

  - FM arrangements, 23% of petroleum company expenditures, are for dedicated geophysical data processing centers.

  - Batch, 67% of the total, is for seismic data processing on a job-by-job basis.

- Function specific delivery in the FM mode is nearly 30%. This type of expenditure by petroleum companies is for petroleum company credit verification and coal processing services.

- Industry specific applications are also the major (58%) focus of processing services in other energy markets. Here RCS services for mine planning and production scheduling, and specific engineering analysis and modeling are more important (70% of total expenditures) than geophysical processing services delivered in the batch mode.

INPUT

EXHIBIT V-9

FORECAST FOR PROCESSING SERVICES IN THE
PETROLEUM INDUSTRY BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 60	$ 300	38%
	Industry Specific	45	720	74
	Utility	110	470	34
Subtotal		$215	$1,490	47%
Facilities Management	Function Specific	25	75	24
	Industry Specific	110	1,225	62
	Utility	-	-	-
Subtotal		$135	$1,300	57%
Batch	Function Specific	-	-	-
	Industry Specific	315	1,110	29
	Utility	-	-	-
Subtotal .		$315	$1,110	29%
Total Processing Services	Function Specific	85	375	35
	Industry Specific	470	3,055	45
	Utility	110	470	34
Total		$665	$3,900	43%

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EXHIBIT V-10

FORECAST FOR PROCESSING SERVICES IN OTHER
ENERGY MARKETS BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 6	$ 14	18%
	Industry Specific	12	39	27
	Utility	7	17	19
Subtotal		$25	$ 70	23
Facilities Management	Function Specific	-	-	-
	Industry Specific	-	-	-
	Utility	-	-	-
Subtotal		-	-	-
Batch	Function Specific	2	3	9
	Industry Specific	9	29	26
	Utility	-	-	-
Subtotal		$11	$ 32	23%
Total Processing Services	Function Specific	8	17	16
	Industry Specific	21	68	26
	Utility	7	17	19
Total		$36	$102	23%

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E.   EMERGING MARKETS

I.   TURNKEY SYSTEMS

- The mega-minicomputer is impacting the marketplace for seismic data processing services. Seismic services vendors like Digicon are integrating VAX 11/870 mega-minicomputers, floating point systems array processing, and high-density tapes with seismic processing software, offering the system, including maintenance, for sale or on an FM basis to petroleum companies, and to other seismic data processing services companies. Other seismic companies are using 32-bit SEL, Perkin-Elmer, and Data General mega-minis.

  - Besides offering multitasking virtual operating systems and cost-effective seismic data processing throughput for under $1 million, the systems offer remote interactive processing, processing through multiple CRTs for seismic analysis, modeling, and production scheduling.

  - Seismic processing and semi-major petroleum companies are using the mega-mini systems as mainframes dedicated to seismic processing, and major petroleum companies are using them as nodes in a hierarchical network for selected line processing, computer-aided interpretation, well log analysis, and selected mapping.

- Caught in the cost/price squeeze, other mining companies are applying manufacturing floor production control techniques to mine control. With technology transfer from Europe, turnkey vendors are offering turnkey systems for mine processing, safety, and environmental control.

  - The systems are designed to interface with computer mainframes for data gathering, processing, and process optimization.

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2.   DATA BASE SERVICES

- The market for data base services both on-line and by magnetic medium, is growing rapidly. On-line data base services energy markets, estimated at $25 million in 1980, will exceed $250 million in 1985, an AAGR of over 50% in the five years.

- Having acquired and processed a significant number of miles of nonproprietary seismic data, seismic vendors sell selected seismic data bases to petroleum companies, currently on magnetic tape. Reduction in communication costs through satellite or other wideband communication systems will enable seismic processing vendors to offer such services on-line.

- Types of on-line data base services used in energy markets are covered in detail in the INPUT report, Market Opportunities for Data Base Services.

- There are over 40 on-line data bases in energy markets. Selected examples are:

    - Census of coal mines offered by ADP network services containing annual coal production and mine information on 95% of U.S. and Canadian mines.

    - CHEMTRON data base offered by UCC, Tymshare, and other RCS vendors containing proprietary data on 730 compounds used for designing petroleum, coal liquefaction, and other energy processes.

    - Energy and coal data bases offered by DRI covering 25,000 time series on energy sources and uses for financial planning and econometric forecasting in energy markets.

    - Dwight's energy data offered by GEISCO covering production history of over 400,000 gas wells and oil leases.

INPUT

- DOE energy data base available through BRS, SDC, and LIS covering bibliographic abstracts and citations on world literature in all energy fields.

- Drilling Activity Analysis Systems (DAAS) data base offered by Petroleum Information Corporation through GEISCO, containing nation-wide drilling costs and activities on virtually all petroleum and gas wells and leases.

- Minerals Data System containing a data base of over 45,000 mineral resources records of all U.S. and some worldwide mines, offered by GEISCO.

- National Coal Resouces data base offered by CSC containing data on all U.S. coal resources and quality assessment.

- PCS Energy data bases on consumption, exploration, production, and supply, offered by Proprietary Computer Systems containing over 10,000 time series from DOE, Hughes Rig Count, API, and Joint Associations survey data.

3.   COMPUTER-AIDED MAPPING (CAM)

- Computer-aided design systems are beginning to be applied to the complex problem of mapping, land and marine exploration, drilling (mining), and field production in energy markets.

- The oil field research areas of major oil companies are heavily involved in evaluating and upgrading CAD systems for eventual use in district offices to automate currently highly manual and very expensive mapping groups.

- Key to the successful use of CAM will be the establishment of data bases containing:

INPUT

- Digitized seismic interpretation data.

- Digitized well log data.

- Digitized geographic data.

- Successful implementation of CAD to mapping will include:

    - User friendly interactive graphics.

    - High-resolution color CRT and plotting.

- Petroleum and other energy companies are also turning to imaging systems to incorporate land and satellite data into exploration mapping applications.

4.   FINANCIAL TRANSACTION SYSTEMS

- With nearly 50% of current gas stations operating on a self-service basis, petroleum companies are testing plastic-card-driven microcomputer controlled automated pumps. The microprocessor can then be interconnected to a financial transaction network to:

    - Debit the customer's financial transaction account.

    - Bill the customer as a credit card transaction.

    - INPUT believes the market is very large for processing services through interfacing financial transaction networks with automated gasoline stations for either bank or oil company card transaction.

- Credit card charge transactions, nearly $4 billion in 1980, are expected to more than double by 1985. Charge dollar volume over $62 billion in 1980 will

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grow to nearly $200 billion in 1985, a 26% AAGR. Oil company credit card sales currently account for 88% of total sales whereas consumers use bank cards for 12% of the dollar volume.

VI COMPETITIVE STRUCTURE

VI   COMPETITIVE STRUCTURE

A.   COMPETITIVE ENVIRONMENT

I.   VENDOR TYPES

- Competition between companies offering processing services software products and professional services in energy markets varies greatly between market subsectors, as shown in Exhibit VI-I.

- Petroleum companies such as Amoco and Shell, but with the exception of Sun, whose data processing subsidiary, Sun Information Services (SIS), is counted as an RCS vendor, offer software products, primarily industry oriented, for engineering analysis and design in three subsectors.

- Seismic data processing vendors such as Western Geophysical are specialist firms concentrating in exploration data processing. Some, like Geosource, offer engineering services including data processing and software packages in production applicational areas.

- Remote computing vendors offer processing services and to a degree professional consulting services across all market subsectors.

    - The two major vendors, CDC and GEISCO, offer services across all subsectors.

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EXHIBIT VI-1

COMPETITION AMONG COMPANIES FOR COMPUTER SERVICES IN ENERGY MARKETS BY SUBSECTOR

COMPANY TYPE	MARKET SUBSECTOR				
	EXPLOR-ATION	PRODUC-TION	PROCES-SING	TRANSPOR-TATION	MARKET-ING
Petroleum Companies	–	S	S	S	–
Seismic Data Pro-cessing Vendors	C,T	C,T	–	–	–
Remote Computing Services Vendors	C,P	C,P	C,P	C,P	C,P
Industry Consultants and Specialists	S,P	S,P,C	–	–	–
Engineering and Construction Firms	P,S,C	P,S,C	P,S,C	P,S,C	–
Computer Vendors	S,P	S,P	S,P	S,P	S,P
Turnkey Systems Vendors	T	T	T	T	T

C = COMPUTER PROCESSING
S = SOFTWARE PRODUCTS
P = PROFESSIONAL SERVICES
T = TURNKEY SYSTEMS

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-       Other RCS vendors like McAuto offer services in several but not all subsectors, but most tend toward specialization in one.

- Industry consultants and specialists such as Intercomp, Scientific Software, Garret, and Earth Technology offer professional services, software products, and RCS services through buying block time from RCS vendors. They are concentrated where the action is, in the exploration and production subsectors.

- Engineering and consulting firms such as Stoner Associates, Gulley Associates, Profimatics, and Fluor Mining and Metals offer professional consulting services and software products primarily through licensing arrangements with RCS vendors. Each company specializes in one or two, and together they cover all but the marketing subsector.

- Combining mini/micro and more recently mega-minicomputers with specialized software products, turnkey vendors like Digicon, ESI, Minetics, and Foxboro offer a wide variety of turnkey systems for data processing, process control, and increasingly overlapping automation functions across all energy market subsectors.

- Computer vendors, primarily IBM and CDC, supply software products and professional services for in-house EDP operations.

2.   VENDOR MARKET SHARE

- Petroleum company revenues from software products are minimal.

- Only the software component of turnkey vendor revenues for data as opposed to process control is considered as part of computer services revenues. That component represents software licensed from other vendors, such as computer vendors or software specialists. Such revenues are included as part of the revenues of the applicable company providing the software product.

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- Seismic data processing vendors have just over half the total market share, as shown in Exhibit VI-2. Providing bundled computer processing, software, and professional services by job, under FM arrangements, and through turnkey systems, new vendors are appearing almost daily in Denver and Houston.

- RCS vendors led by CDC and GEISCO hold nearly 20% of the current market.

- The professional services component of computer services revenues is significant due to the large number of consultants, specialists, and engineering and construction firms such as Scientific Software, Profimatics, and Chemshare.

- Computer vendors, including IBM, CDC, Univac, and DEC share (13%) in the market primarily through licensing of system software for in-house and turnkey system use.

B.   KEY VENDOR PRODUCTS AND SERVICES

1.   SEISMIC DATA PROCESSING VENDORS

- Seven out of over 80 vendors, as shown in Exhibit VI-3, currently control over 75% of total computer services for seismic data processing.

- The major portion (75%) of large seismic companies' revenues is derived from land and marine exploration including data acquisition.

- About 90% of geophysical company revenues are currently derived from a combination of work done for U.S. petroleum and natural gas companies and from work done in the U.S. for foreign organizations.

    a.   Western Geophysical

- Western Geophysical, a subsidiary of Litton Industries, with over $500 million

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EXHIBIT VI-2

VENDOR SHARE OF COMPUTER SERVICES IN
ENERGY MARKETS BY TYPE, 1980

COMPANY TYPE	COMPUTER SERVICES REVENUES ($ millions)			
	PROCESSING SERVICES	SOFTWARE PRODUCTS	PROFES- SIONAL SERVICES	TOTAL
Seismic Data Processing Vendors	$480	$ 15	–	$495
Remote Computing Services Vendors	155	–	$ 28	183
Industry Consultants and Specialists	45	25	38	108
Engineering and Construction Firms	21	10	26	57
Computer Vendors	–	100	22	122
TOTAL	$701	$150	$114	$965

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EXHIBIT VI-3

VENDOR SHARE OF THE UNITED STATES SEISMIC
DATA PROCESSING SERVICES MARKET, 1980

VENDOR	SEISMIC PROCESSING REVENUES ($ million)	MARKET SHARE (percent)
Western Geophysical (Litton)	$ 90	18%
Geophysical Services Inc. (TI)	85	17
Geosource Inc.	75	16
Geodigit (CGG)	55	11
Seismographic Services Inc. (Raytheon)	35	7
Digicon Inc.	25	5
Seiscon Delta Inc.	20	4
Others	110	22
TOTAL	$495	100%

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in 1980 related revenues, has estimated U.S. seismic data processing revenues of $90 million.

- Western uses three IBM 3033 systems in Houston and one 370/165 III in Denver for seismic data processing.

- Specializing in both marine data acquisition and 3-D seismic processing, Western is developing a specialized seismic data processing system, the LRS 3200, using a DEC VAX 11/780 CPU, floating point systems, programmable array processors, and its own pipeline I/O subsystem.

b.   Geophysical Services, Inc.

● Geophysical Services, Inc. (GSI), a subsidiary of Texas Instruments (TI) with total 1980 revenue exceeding $400 million has estimated U.S. 1980 seismic data processing revenues of $85 million.

- In addition to seismic data processing on large-scale IBM mainframes, GSI markets a TI minicomputer-based turnkey system for sequential batch processing of seismic data.

- TI minicomputers are also heavily used in seismic data acquisition.

c.   Geosource

● Geosource, Inc., with total 1980 revenues exceeding $450 million, has the largest number of land crews worldwide.

- Seismic processing is currently accomplished using IBM plug compatible mainframes and its TEMPUS system.

- Geosource is upgrading the sequential batch processing TEMPUS system with the DEC VAX 11/780 to create a multitasking seismic processing operating environment.

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d.   Geodigit

- Geodigit, the U.S. subsidiary of CGG (France), uses CDC mainframes for seismic processing both in Houston and Denver.

  - Satellite centers operating on a remote batch basis are operating in California and Canada.

e.   Seismographic Services

- Seismographic Services, Inc. (SSI), a subsidiary of Raytheon, with 1980 revenues exceeding $220 million has shifted its seismic data processing to two DEC/VAX 11/780s.

f.   Digicon

- Digicon, with nearly $50 million in 1980 revenues, has integrated the DEC VAX 11/780 with FPS array processing, high-density magnetic tapes, and its seismic processing software. The system is used for seismic data processing and very unsucessfully sold as a turnkey system to petroleum companies and seismic computer services vendors.

g.   Seiscon Delta

- Seiscon Delta, with 1980 revenues approaching $70 million, is using SEL mega-minis to upgrade its MEGDESIS system for seismic data processing. Seiscon has a number of FM contracts with major petroleum companies for dedicated centers.

h.   Other Vendors

- It is not necessary to field land or marine crews to capture seismic data in order to successfully offer seismic data processing services. There are some

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70 smaller geophysical vendors specializing primarily in seismic data processing.

- Golden Geophysical with 1980 annual revenues of $4 million uses a DEC VAX 11/780 system from Digicon.

- Denver Processing Center with 1980 annual revenues of $3 million also uses a DEC VAX 11/780 Digicon system.

- Denver Processing Center with 1980 annual revenues approaching $10 million is shifting from multiple TI sequential batch systems to a system built around an advanced SEL 32-bit mega-mini.

2. RCS VENDORS

● CDC and GEISCO are the leading RCS vendors in energy markets.

● CDC brings to bear formidable resources including:

- Cybernet services including Cyber 203/205 supercomputers for engineering applications.

- SBC for MIS data processing.

- A petroleum industry processing and professional services group in Houston.

- A mining industry processing and professional services group with offices in Denver and Tucson.

- A recently announced user-site mini-driven Geo Cyber Mining Industry workstation operating either as a standalone system or as a distributed node to Cybernet.

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- A recent acquisition is Computer Associates International (CAI), a leading engineering consulting and software company to the mining industry.

- GEISCO, long established as a vendor in energy markets, has:

  - A reliable and extensive telecommunications network reaching remote field locations worldwide.

  - A variety of intelligent workstations.

  - An extensive and growing author program library of both GE and author licensed engineering and MIS programs.

  - On-line data base services.

  a. CDC Cybernet Services

- CDC Cybernet Services offer Unified Structural Design System (UNISTRUC), a highly interactive graphics pre- and post-processing system to finite element structural analysis programs for design of petroleum refineries, pipelines, and uranium processing plants. Structural analysis programs include:

  - STARDYNE.

  - ANSYS.

  - NASTRAN.

  - EAC/EASE 2.

  - ADINA.

  - SUPER B.

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- CDC Cybernet services offer a wide variety of computer-aided design and engineering applications for petroleum pipelines and refineries and for uranium processing. Applications include:

  - Process simulation.

  - Pipe stress analysis.

  - Isometric preparation.

  - Hangar analysis and design.

  - Vessel analysis and design.

  - Pipe rupture.

  - Thermal hydraulics.

  - Graphics.

- CDC offers professional petroleum consulting services in applying computers to the petroleum industry including:

  - Interactive pattern analysis.

  - Image processing.

  - 3-D seismic processing.

  - DBMS services for exploration and production data.

  - Modeling and simulation.

INPUT

- CDC offers professional mining consulting services in applying computers to the coal and uranium industries including:

  - Mine planning.

  - Exploration, evaluation.

  - Environmental planning.

  - Uranium milling and processing.

- PROPLAN is offered by CDC Cybernet Services to automate planning and scheduling of open pit coal mining projects.

- CDC Cybernet Services offer three CAI mine planning packages.

  - MINERAL to evaluate uranium and other mineral deposits.

  - MSCDES a multiseam coal deposit evaluation system.

  - Polygon for modeling uranium deposits.

- CDC Cybernet Services offer APEX III, a linear programming system used for evaluating alternative energy production costs and for optimizing petroleum refinery production runs.

- XPLOR, a group of programs that processes and enhances LANDSOT aerial and radar data to assist in petroleum and mineral exploration, is also offered by CDC Cybernet Services.

  b.   GEISCO

- Using over 30 separate computer programs developed by Amoco, GEISCO offers, through its Mark III service, assistance to drilling crews to increase

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- drilling accuracy, optimize drilling equipment usage, and improve drilling safety.

- GEISCO offers to petroleum production companies, through its Mark III network, an integrated accounting system, including a continuously updated government reporting system.

- GEISCO offers a series of engineering programs through its Marklink III system to analyze and design refineries, including reformers and catalytic columns, fluid flow, heat exchange, and process optimization.

- PETROEX, a Petroleum Exchange Data Clearinghouse Product system, is offered by GEISCO, enabling refiners and petroleum marketing companies to bid for and trade production and transportation of both crude and refined petroleum products.

- GEISCO offers gas pipeline companies Pipeflow for performing multiphase gas-liquid pipe flow analysis, as well as a library of programs for computer-aided pump and pipeline analysis and design.

- LOGAN, a well log analysis system, offered by GEISCO on its Mark III service, aids geophysicists and geologists in computer-aided well log interpretation.

- Three on-line data bases, University of Oklahoma on-line data base, Petroleum Data System (PDS), Minerals Data System (MDS), and American Petroleum Institute (API), and American Association of Petroleum Geologists (AAPG) well data are offered by GEISCO on its Mark III system. The data bases contain information on all oil fields and pools in the U.S. and Canada, resource information on all mineral deposits, including coal and uranium, and exploratory well information.

c.   Boeing Computer Services (BCS)

- With its Cray IS, BCS is expanding its offerings through its Mainstream-EKS to energy markets.

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- The library of structural analysis and design programs for various engineering disciplines is shown in Exhibit VI-4.

  d.   University Computing Company (UCC)

- UCC currently uses Cyber 170-750, Univac 1100, and IBM 370 mainframes for servicing energy markets with engineering analysis, design, and for providing resources for large simulations in the remote batch mode.

- UCC is in the process of expanding services to energy markets through upgrading to a supercomputer.

- Selected offerings are shown in Exhibit VI-5.

  e.   McDonnell Douglas Automation Company (McAuto)

- McAuto uses both Cyber and IBM 370 processors for serving energy markets.

- McAuto has developed powerful pre- and post-processor graphics systems for interfacing with large analysis programs.

  -    Unigraphics for 3-D input to CAD/CAM manufacturing control systems.

  -    FASTDRAW/3 for finite element structural analysis.

  -    VIVIGRAPH and VIVIDATA for interactive creation of standard and color graphic plots and charts.

- McAuto offers a wide range of programs from Phillips Petroleum.

- Selected offerings are shown in Exhibit VI-6.

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EXHIBIT VI-4

SELECTED PROGRAM OFFERINGS TO ENERGY MARKETS BY BOEING COMPUTER SERVICES COMPANY

APPLICATION AREA

MAINSTREAM-EKS

- STRUCTURAL DESIGN SERVICES
  - GTSTRUDL
  - STARDYNE
  - MCS/NASTRAN
  - ANSYS
  - E3SAP
  - SYSPRO-SYSTEM PROFESSIONAL
  - MARC
  - SUPERTAB

- SPECIAL INDUSTRY PRODUCTS
  - NUCLEAR
    - PDQ7
    - TPIPE
  - CIVIL
    - HEC-2, WATSIM, CAPDET

- SUPPORT PRODUCTS
  - MATHEMATICS/STATISTICS
    - APEX III-PDS/MG
    - NETG & IOPNET
    - GPSS V & SIMSCRIPT 2.5
    - SPSS
    - SIR
  - PROJECT MANAGEMENT
    - PROJECT/2
    - PMS IV, PROJACS

- GRAPHICS
  - DISSPLA

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EXHIBIT VI-5

SELECTED PROGRAM OFFERINGS TO ENERGY MARKETS
BY UNIVERSITY COMPUTING COMPANY

APPLICATION AREA
CHEMICAL ENGINEERING   - IRIS, PDSMS   **STRUCTURAL ENGINEERING**   - ANSYS, NASTRAN/COSMIC, NASTRAN/MAC NEAL-SCHWENDLER, PCA, SACM, SAP 4-6, SEPSI-5, SPACE IV, STRESS II, STRUDL-II, TRI DRILL   **MARINE ENGINEERING**   - MRI/MARRS, SACS II, SHIP HULL CHARACTERISTICS   **PIPING ANALYSIS**   - ADLPIPE, AUTOFLEX, DYNAFLEX, EZFLEX, FLANGE DESIGN, TRIFLEX, WERCO   **HEAT TRANSFER**   - AC-2, AIDEX, FRNC-5, HTRI, SINDA   **PROCESS ENGINEERING**   - AMOCO, CHEMSHARE, NGPA, SSI/100, SSI/DR 01   **NUCLEAR (MAJOR CATEGORIES)**   - TRANSIENTS AND THERMAL HYDRAULICS   - LICENSING AND SAFETY ANALYSIS   - CONTAINMENT ANALYSIS   - SHIELDING ANALYSIS   - CROSS-SECTION DATA SET   - IN-CORE MANAGEMENT   **OTHER**   - PROJECT MANAGEMENT (N5500)   - VESSEL DESIGN (VESSEL AND WERCO)

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EXHIBIT VI-6

SELECTED PROGRAM OFFERINGS TO ENERGY MARKETS
BY McDONNELL DOUGLAS AUTOMATION COMPANY

- PROCESS ENGINEERING

  - GENERAL PROCESS SIMULATION (GPS) (PHILLIPS)
  - HEAT EXCHANGE (PHILLIPS)
  - PROCESS (SIMULATION SCIENCES INC.)
  - PROCESS DESIGN (PHILLIPS)
  - SEPARATION (PHILLIPS)

- CIVIL ENGINEERING

  - GAS NETWORK DESIGN AND ANALYSIS (PEOPLES GAS)
  - GEO SYSTEM 1
  - HYDRAULIC NETWORK DESIGN AND ANALYSIS
    (PEOPLES GAS)
  - PIPE PROCESSING (PHILLIPS)

- MECHANICAL AND STRUCTURAL ENGINEERING

  - NASTRAN (MACNEAL-SCHWENDLER)
  - PIPELINE
  - TRIPLEX (APA TECHNOLOGIES AND SPECIALITIES)
  - ANSYS (SWANSON)
  - EASE/2 (ENGINEERING ANALYSIS)
  - STRUDL
  - STARDYNE (SDC)
  - SEA ENVIRONMENT LOADING ON OFFSHORE
    STRUCTURES (SELOS)

- NUCLEAR

  - ANISN-ORNL
  - GENERAL ECONOMIC MODEL (GEM) (HTH ASOCIATES)
  - DOT 3.5
  - PDQ

- PROJECT MANAGEMENT

  - CONSTRUCTION MANAGEMENT CONTROL SYSTEM (CMCS)
    COST PLANNING AND EVALUATION SYSTEM (COPES)

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f.   United Computing Systems (UCS)

- Front-ending its Cray 1S/1000 with two Cyber 175s, UCS offers super-computing through its SPER/SL Service to energy markets. The systems feature:

    -    Main memory: 1 million words (60 bits).

    -    Mass storage: 2.4 billion bytes.

- UCS is aggressively expanding its library of author programs. Current selected offerings are shown in Exhibit VI-7.

    g.   Sun Information Services (SIS)

- SIS offers computer processing services to energy markets using both Cyber and IBM mainframes.

- Many of the engineering programs developed by its parent, Sun Oil Company, are available, some as software products but most as network services.

- Selected offerings are shown in Exhibit VI-8.

    h.   Computer Sciences Corporation (CSC)

- CSC offers both computer resources and professional services for MIS and engineering applications through its INFONET service, primarily on Univac but more recently on IBM 370/168 mainframes.

- Energy related product offerings include:

    -    CORE, a computer-aided ore reserves evaluation system.

    -    NASTRAN, ANSYS, STRUDL, TRIFLEX, and SDRC library.

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EXHIBIT VI-7

SELECTED PROGRAM OFFERINGS TO ENERGY MARKETS
BY UNITED COMPUTING SYSTEMS

APPLICATION AREA

• KEY SCIENTIFIC AND ENGINEERING PRODUCTS
 	
   - COMPACT (CIRCUIT DESIGN)
   - PIPING ANALYSIS (AUTOFLEX, DYNAFLEX, TRIFLEX, ADLPIPE)
   - SACM (MAPPING)
   - CHEMSHARE (REFINERY SIMULATION)
   - ECUBE (ENERGY ANALYSIS)
   - POGOS (POWER PLANT SIMULATION)
 	
• ENGINEERING (NUMEROUS PROGRAMS)
 	
   - CIVIL
   - MECHANICAL
   - ELECTRICAL
   - CHEMICAL
   - PETROLEUM
   - ENERGY
   - COMMUNICATIONS
   - MARINE
   - NUMERICAL CONTROL
 	
• STRUCTURAL ANALYSIS
 	
   - ANSYS
   - NASTRAN
   - GIFTS
   - SPACE 4
   - MARC
 	
• FINANCIAL MANAGEMENT AND PLANNING
 	
   - FORESIGHT
 	
• DATA BASES
 	
   - CENSUS
   - COMPUSTAT
   - TELSTAT (SECURITY PRICING)
   - INSIGHT (ECONOMETRIC DATA)
 	
• GRAPHICS
 	
   - UNIGRAPH
   - DISSPLA
   - CALMAGRAPHIC INTERACTIVE (CGI)

EXHIBIT VI-8

SELECTED PROGRAM OFFERINGS TO ENERGY MARKETS
BY SUN INFORMATION SYSTEMS

- PROCESS ENGINEERING

  - PROCESS (SIMULATION SCIENCES INC.)
  - GENERALIZED DISTILLATION SYSTEM (GENDIS)
  - MULTICOMPONENT FRACTIONATION (MFRAC)
  - GENERALIZED PROCESS FLOW SIMULATOR (GPFS)
  - HEAT EXCHANGERS (MEDER)
  - SHELL AND TUBE HEAT EXCHANGE (STHER)
  - AIR COOLED HEAT EXCHANGE (ACHED)

- MECHANICAL AND STRUCTURAL ENGINEERING

  - TURBO DYNAMIC (TURBO RESEARCH INC.)
  - ANSYS (SWANSON)
  - SMUG (STRUCTURAL MEMBERS USER'S GROUP)
  - STRUCTURAL STEEL (ADSTEEL)
  - FLARE DESIGN (FDR)
  - VERTICAL PRESSURE VESSEL DESIGN (VPVD)
  - HORIZONTAL PRESSURE VESSEL DESIGN (HPVD)
  - OFFICE DESIGN AND RATING (ODR)
  - ISOMETRIC PIPING DRAWINGS (ADSIP)
  - STRUCTURAL ANALYSIS AND DESIGN (STAAD)
    (RESEARCH ENGINEERS, INC.)

- PROJECT MANAGEMENT

  - PROJECT RESOURCE EVALUATION AND MANAGEMENT
    SYSTEM (PREMIS)

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- DISSPLA graphics (Software Systems Corporation).

- Coal and petroleum data bases.

i. Other Vendors

- Focusing on energy markets, On-line Business Systems has established energy offices in Houston and Denver. Computer services, primarily specialized and customized MIS applications, are run on IBM 370/3033 mainframes.

- American Management Systems (AMS) has established offices in Denver and Houston to concentrate on professional services to energy markets.

- National Data Corporation provides FM services for credit authorization and card processing to major and independent oil companies including Arco, Crown, and American Petrofiner.

- Tymshare provides MIS oriented RCS services to energy markets through its energy center in Houston.

  - Energy companies use Tymnet to reach remote locations worldwide.

  - Telefuel offers scheduling, inventory control, invoicing, and accounting services to fuel oil and LNG dealers through Tymnet.

3. INDUSTRY CONSULTANTS AND SPECIALISTS

- Simulation Sciences, Inc., offers its PROCESS Simulation Program together with a physical properties data base of more than 800 components on the GEISCO Mark II system for design of petroleum production pipelines, and refineries.

- Comspect Exploration's Comsearch 1000 software offered through GEISCO on Mark III service and through CDC Cybernet, provides well log analysis, seismic

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analysis, synthetic seismograms, stratigraphic, structural, and seismic inversion modeling.

- Coopers and Lybrand's Oil Refiner, DOE cost reports, and other petroleum and natural gas related financial programs are offered by GEISCO on its Mark III system.

- PSI Energy Software offers POGO, an economic model of profitability of oil and gas opportunities, through GEISCO Mark III network services for petroleum production companies to determine the potential value of leased or potential purchased acreage before bidding on drilling rights.

- Petroleum Information Corporation, a subsidiary of A.C. Nielsen, offers Drilling Activity Analysis System (DAAS), on-line data base for all U.S., Alaskan, and offshore well drilling data. The data base service is available on GEISCO's Mark III network; users can extract data useful for assessing lease bids for petroleum exploration and production.

- Simulation Sciences offers three programs for petroleum refinery engineering through CDC Cybernet:

    - SSI/100 for calculation of process heat and material balance.

    - SSI/VLE for predicting vapor/liquid equilibrium.

    - SSI/Process for vigorous mass and energy balances.

- Dwight's Energy Data, an on-line data base of production history on over 400,000 oil leases and gas wells, is offered by GEISCO.

- Core Labs petroleum applications library of engineering and economic modeling programs including reserve estimation, core analysis, decline curve analysis, cash flow analysis, and production information is offered by GEISCO on its Mark III service.

INPUT

- TCR Consultants' Generalized Logging Analysis System GOLOG is offered by Cybernet Services for wireline, and lithology well log analysis.

- CDC Cybernet Services offers INTERCOMP programs for analysis and design of petroleum and natural gas pipeline transmission systems:

  - HCOMP, TCON, and MTRON for fluid flow in pipeline networks.

  - SSTRAN for steady state gas transmission.

  - TRANSFLOW for transient gas flow.

- Whitney and Whitney Inc.'s MINECON is offered by CDC Cybernet Services for estimating the cost of exploration, development, and production of uranium and other mineral mining ventures.

- Execucom Systems Corporation's Interactive Financial Planning System (IFPS) is offered by CDC's Cybernet Services to assess profitability of off-shore gas exploration ventures.

- Garret Computing Systems (GCS) concentrates on developing petroleum-oriented computer programs for geophysicists, geologists, petroleum engineers, and scientists. GCS offers the end user a total service including terminals, telecommunications arrangements, maintenance, and professional services. GCS in turn contracts for block time from GEISCO, UCS, and Tymnet.

- Intercomp Resources Development, a subsidiary of KANEB Industries, specializes in petroleum reservoir simulation and in petroleum base valuation. Noted for their 3-D models for both black oil and enhanced recovery, developed using professional services, and run on their own Harris/800 and through leased time on supercomputers, the company is looking at marketing services to large independent petroleum companies using mega-minicomputers.

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- Scientific Software Corporation develops black oil and enhanced recovery simulators and petrodata financial and accounting data through professional services. Models are run on their in-house Data General MV8000 vector mega-minicomputer, through leased time on CDC and Cray supercomputers, and installed for clients as software packages.

4. ENGINEERING AND CONSTRUCTION FIRMS

- DX Industries' series of programs for designing well-head and production pipelines is offered by GEISCO on its Mark III service.

- Bonner and Moore Associates Surface Mining Simulation System (SMSS), a system of 17 models used for engineering, planning, and economic/financial evaluation of surface coal mining, is offered by GEISCO on its Mark III system.

- Profimatics, Inc.'s fluid catalytic cracking simulation (FCCSIM) and Reforming Simulation (REFSM) for petroleum refinery analysis and design are offered by GEISCO on its Mark III system.

- The Structural Dynamics Research Corporation (SDRC) Mechanical Design Library (MDL), including ANSYS DAGS, NASTRAN SAGS, and SUPER B for finite element structural analysis, is offered by GEISCO on its Mark III System.

- SYS Comp Corporation's library of civil engineering programs is offered by Cybernet Services for oil platform, refinery, and pipeline and mine construction. Programs include:

  - Structural engineering.

  - Mapping.

  - Geotechnical.

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- Mechanical.

- Construction management.

- Environmental.

- Engineering/Analysis Corporation's EDC/EASE 2 is offered through CDC Cybernet services to perform linear elastic static and dynamic analyses of finite element structural models.

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VII PRODUCT AND MARKETING ISSUES

VII   PRODUCT AND MARKETING ISSUES

A.   PRODUCT STRATEGIES

- Except in selected engineering areas and with very large and large organizations, product specialization is increasingly the route to take in offering computer services to energy companies.

- This is especially important in the exploration subsector where offering RCS resources in not enough. Caught in an area of rapidly increasing demand with inability to obtain or retain qualified personnel, petroleum and other energy companies are looking for total solutions - hardware, software, personnel, and maintenance.

- By initially offering seismic data processing services on a batch basis, computer services vendors can expand RCS offerings through remote site minicomputers for other exploration applicational areas.

  - Synthetic modeling.

  - Stratigraphic analysis.

  - Well log analysis.

  - Computer aided interpretation.

INPUT

- Mapping.

- Companies are looking for user friendly operating systems that operate in multitasking modes with virtual memory capability, and which work!

- Seismic processing host systems have operating characteristics including:

    - 1-2 mb on a semiconductor central memory.

    - 32-bit floating point programmable array or vector processing capability.

    - High-density magnetic tapes.

- The host system must be interconnected to intelligent nodes where the geophysicist/analyst can:

    - Select and revise processing priorities and parameters.

    - Accomplish synthetic and stratigraphic modeling.

    - Accomplish well log analysis.

    - Process selected seismic lines just before drilling.

- Computer-aided design systems are needed to integrate or interface with intelligent nodes for the mapping application. Subsystem characteristics are:

    - Multiple high-resolution standard and color CRTs.

    - High-quality standard and color plotting.

    - User friendly interactive graphics software.

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- Contour mapping software.

• Very large and large petroleum and natural gas companies develop black oil and enhanced recovery simulation models in-house. As such they are prime candidates for selling RCS resources for engineering applications. The models frequently cover oil fields containing 10,000-40,000 grid points, requiring supercomputer resources to even begin to adequately solve such problems. Characteristic of such resources are:

- Very high-speed vector arithmetic.

- High-speed eight-color computation.

- 1-4 mb semiconductor memory.

- 32-bit dual pipeline and 64-bit pipeline very high speed; floating point arithmetic.

- User friendly multitasking; virtual memory operating system.

• The importance of scientific and engineering applications in energy markets implies requirements for efficient support software including:

- FORTRAN IV compilers that optimize generated code and consider the vector and scalar processing capabilities of the object CPU.

- DBMS including data dictionaries and query systems that are user friendly and industry tailored to the education and experience of the end users such as geophysicists, geologists, and petroleum and mining engineers.

- Efficient and user friendly system utilities including data sorting.

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- Black oil reservoir and particularly enhanced recovery simulation software and professional services are required to support semi-major and large independent petroleum companies in valuation, production planning, and scheduling.

    - A combination of RCS computer resources (even mega-minicomputers), software products, and professional consultants are needed for tailoring generalized models to meet particular field characteristics.

    - Problems with more than 3,000 to 5,000 grid points, 3 to 5 layers, and more than a 10-year timeframe require vector supercomputers.

    - Use of mega-minicomputers for smaller fields, 300-400 grid points for enhanced recovery, the most rapidly growing area for most independent petroleum companies, either standalone or on a user site RCS basis, is a viable approach.

- Network services must be responsive and give fast turnaround time.

    - User friendly terminal interaction is a must.

    - Companies are turned off to network services when end users become slaves to the system when operating CRTs in the interactive mode.

    - Companies turning to RCS vendors in in-house overload situations are looking for same-day or better turnaround for running large remote batch applications.

- Energy companies are just turning their attention to the application of DBMS to engineering data. Data management personnel have been in such high demand and short supply in MIS areas that little attention has been given to the growing mass of engineering data being accumulated.

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- In the exploration subsector, DBMS including data dictionary and query subsystems user friendly to the geophysicist/computer analyst are needed as part of product and services offerings. Data base requirements include:

  - Digitized layer boundary data.

  - Digitized well log data.

  - Contour surface data.

  - Lease boundary data.

  - Geographic data.

- For production applications, the DBMS products and services need to be tailored to the petroleum production engineer first for production research and then for production scheduling and operations. Data base requirements include:

  - Field grid data.

  - Correlation and interpolation across grid points.

  - Update of predicted versus actual production data over time.

  - Contouring between pre- and post-processing grid point data.

- Computer services offerings of large engineering analysis programs including offshore platform structural analysis, refinery and pipeline design can be expanded through user friendly graphic subsystems to aid the end user in data generation in the preprocessing phase and analysis and evaluation of results in post-processing. Characteristics of such graphics subsystems are:

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-   Pre- and post-processing on user site minicomputers as nodes to large RCS mainframes.

-   Common interface at the software operating and data input/output levels with a wide variety of engineering analysis programs.

-   Interface with CAD/CAM systems for engineering design at the data base level.

-   High-resolution standard and color CRTs.

-   System response times of no more than 2 to 5 seconds with complex animation up to 30 seconds, and large mesh alteration up to 60 seconds.

B.   MARKETING STRATEGIES

*   Computer services opportunities in energy markets are excellent in all subsectors, and in the near term outstanding in exploration and production. Market opportunities are so diverse that vendors must be selective in targeting market entry or expansion.

*   Applications in energy markets tend to be highly technical, particularly in the exploration and production subsectors, requiring computer resources, software products, and consulting report expertise.

*   Vendors considering computer services offerings to energy markets must form separate groups to target offerings and support to selected markets.

*   Offering geophysical data processing services to the petroleum and natural gas industries requires establishment of operational centers in Houston and Denver.

INPUT

- RCS vendors must be prepared to offer a total package to exploration geophysicists:

    - Batch and RCS resources.

    - Networking.

    - State-of-the-art software.

    - Consulting computer analysts.

    - Maintenance and support.

- Offering facilities management including dedicated data centers or dedicated block time in large data centers is a viable arrangement.

- Shortage of qualified personnel, geologists, geophysicists, and trained computer analysts is a factor inhibiting even greater computer services growth. Acquisition of or joint-venture arrangements with existing seismic data processing vendors are the best ways to obtain technical expertise and, in selected instances, state-of-the-art software.

- Growth in mining of mineral, coal, oil shale, and uranium reserves in states west of the Mississippi implies that the primary action for computer services in support of these industries will be in the west.

- Offering computer services to energy industries engaged in mining requires establishment of separate services groups, located in Denver and probably in Tucson. In that processing services offerings include primarily RCS, separate data centers are not required.

- An excellent source for developing RCS revenues in energy markets is through joint-venture and licensing arrangements for software products with

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engineering consulting companies already supplying services to energy companies.

- Energy industry software products developed under DOE sponsorship, enhanced and documented for maintenance by the author, and offered together with consulting services on an RCS basis is another avenue to pursue. DOE-sponsored computer programs include:

    - Mine scheduling and planning.

    - Nuclear transport codes.

    - Coal dragline simulation.

    - Coal gasification.

    - Coal liquefaction.

- Data bases coupled with specialized software for access, analysis, and modeling, are a high "value added" area for offering on-line data base services to energy companies. Areas include:

    - Mineral rights leases.

    - Engineering component and scientific properties.

    - Land satellites.

    - Geodetic mapping.

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APPENDIX A: DATA BASE

FORECAST OF COMPUTER SERVICES EXPENDITURES IN
ENERGY MARKETS BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$578	$3,900	46%
Production	145	510	29
Processing	73	170	18
Transportation	79	180	18
Marketing	90	240	22
Total	$965	$5,000	39%

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FORECAST OF COMPUTER SERVICES EXPENDITURES IN THE PETROLEUM INDUSTRY BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$555	$3,840	47%
Production	105	380	29
Processing	60	140	18
Transportation	65	150	18
Marketing	90	240	22
Total	$875	$4,750	40%

INPL
MERM

FORECAST OF COMPUTER SERVICES EXPENDITURES IN THE
NATURAL GAS INDUSTRY BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$10	$ 30	25%
Production	15	55	30
Processing	6	13	16
Transportation	14	32	18
Marketing	–	–	–
Total	$45	$130	24%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES EXPENDITURES IN THE COAL INDUSTRY BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$ 10	$25	20%
Production	20	60	24
Processing	5	10	18
Transportation	–	–	15
Marketing	–	–	–
Total	$ 35	$95	22%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES EXPENDITURES IN THE
URANIUM INDUSTRY BY SUBSECTOR, 1980-1985

SUBSECTOR	USER EXPENDITURES ($ millions)		AAGR 1980-1985 (percent)
	1980	1985	
Exploration	$ 3	$ 7	19%
Production	5	14	22
Processing	2	4	15
Transportation	-	-	-
Marketing	-	-	-
Total	$10	$25	20%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES IN ENERGY

MARKETS BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$239	$1,658	47%
Facilities Management		135	1,300	57
Batch		327	1,144	28
Subtotal Processing Services		$701	$4,102	42%
Software Products	Systems	100	338	28
	Applications	50	205	33
Subtotal Software Products		$150	$ 543	29%
Professional Services	Services	114	355	26
	Facilities Management	–	–	–
Subtotal Professional Services		$114	$ 355	26%
Total		$965	$5,000	39%

INPU
MERM

FORECAST OF COMPUTER SERVICES IN THE PETROLEUM INDUSTRY BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$215	$1,590	49%
Facilities Management		135	1,300	57
Batch		315	1,110	29
Subtotal Processing Services		$665	$4,000	43%
Software Products	Systems	80	285	29
	Applications	35	155	35
Subtotal Software Products		$115	$ 440	31%
Professional Services	Services	95	310	27
	Facilities Management	–	–	–
Subtotal Professional Services		$ 95	$ 310	27%
Total		$875	$4,750	40%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES IN THE NATURAL
GAS INDUSTRY BY MODE OF DELIVERY, 1980–1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980–1985 (percent)
Remote Computing Services		$12	$ 35	24%
Facilities Management		–	–	–
Batch		8	27	28
Subtotal Processing Services		$20	$ 62	25%
Software Products	Systems	10	27	22
	Applications	7	21	25
Subtotal Software Products		$17	$ 48	23%
Professional Services	Services	8	20	20
	Facilities Management	–	–	–
Subtotal Professional Services		$ 8	$ 20	20%
Total		$45	$130	24%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES IN THE
COAL INDUSTRY BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$ 8	$23	24%
Facilities Management		-	-	-
Batch		4	7	12
Subtotal Processing Services		$12	$30	20%
Software Products	Systems	9	24	22
	Applications	6	23	30
Subtotal Software Products		$15	$47	26%
Professional Services	Services	8	18	18
	Facilities Management	-	-	-
Subtotal Professional Services		$8	$18	18%
Total		$35	$95	22%

INPUT
MERMR

FORECAST OF COMPUTER SERVICES IN THE URANIUM INDUSTRY
BY MODE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services		$ 4	$10	20%
Facilities Management		-	-	-
Batch		-	-	-
Subtotal Processing Services		$ 4	$10	20%
Software Products	Systems	1	2	15
	Applications	2	6	25
Subtotal Software Products		$ 3	$ 8	22%
Professional Services	Services	3	7	18
	Facilities Management	-	-	-
Subtotal Professional Services		$ 3	$ 7	18%
Total		$10	$25	20%

EXHIBIT A-11

FORECAST FOR PROCESSING SERVICES IN ENERGY

MARKETS BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 66	$ 314	36%
	Industry Specific	57	759	68
	Utility	117	487	33
Subtotal		$240	$1,560	46%
Facilities Management	Function Specific	25	75	24
	Industry Specific	110	1,225	62
	Utility	–	–	–
Subtotal		$135	$1,300	57%
Batch	Function Specific	2	3	9
	Industry Specific	$324	$1,139	29%
	Utility	–	–	–
Subtotal .		$326	$1,142	29%
Total Processing Services	Function Specific	93	392	33
	Industry Specific	491	3,123	45
	Utility	117	487	33
Total		$701	$4,002	42%

INPUT
MERMR

EXHIBIT A-12

FORECAST FOR PROCESSING SERVICES IN THE
PETROLEUM INDUSTRY BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 60	$ 300	38%
	Industry Specific	45	720	74
	Utility	110	470	34
Subtotal		$215	$1,490	47%
Facilities Management	Function Specific	25	75	24
	Industry Specific	110	1,225	62
	Utility	-	-	-
Subtotal		$135	$1,300	57%
Batch	Function Specific	-	-	-
	Industry Specific	315	1,110	29
	Utility	-	-	-
Subtotal		$315	$1,110	29%
Total Processing Services	Function Specific	85	375	35
	Industry Specific	470	3,055	45
	Utility	110	470	34
Total		$665	$3,900	43%

INPU
MERMF

FORECAST FOR PROCESSING SERVICES IN THE
NATURAL GAS INDUSTRY BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 3	$ 7	19%
	Industry Specific	7	23	27
	Utility	2	5	20
Subtotal		$12	$35	24%
Facilities Management	Function Specific	-	-	-
	Industry Specific	-	-	-
	Utility	-	-	-
Subtotal		-	-	-
Batch	Function Specific	-	-	-
	Industry Specific	8	27	28
	Utility	-	-	-
Subtotal		$ 8	$27	28%
Total Processing Services	Function Specific	3	7	19
	Industry Specific	15	50	27
	Utility	2	5	20
Total		$20	$62	25%

INPUT
MERMR

EXHIBIT A-14

FORECAST FOR PROCESSING SERVICES IN THE
COAL INDUSTRY BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$ 2	$ 5	20%
	Industry Specific	4	13	27
	Utility	3	7	19
Subtotal		$ 9	$25	23%
Facilities Management	Function Specific	-	-	-
	Industry Specific	-	-	-
	Utility	-	-	-
Subtotal		-	-	-
Batch	Function Specific	2	3	9
	Industry Specific	1	2	15
	Utility	-	-	-
Subtotal		$ 3	$ 5	11%
Total Processing Services	Function Specific	4	8	15
	Industry Specific	5	15	25
	Utility	3	7	18
Total		$12	$30	20%

INP
MERN

EXHIBIT A-15

FORECAST FOR PROCESSING SERVICES IN THE
URANIUM INDUSTRY BY TYPE OF DELIVERY, 1980-1985

COMPUTER SERVICE		USER EXPENDITURES		
MODE	TYPE	1980 ($ millions)	1985 ($ millions)	AAGR 1980-1985 (percent)
Remote Computing Services	Function Specific	$1	$ 2	15%
	Industry Specific	1	3	25
	Utility	2	5	20
Subtotal		$4	$10	20%
Facilities Management	Function Specific	–	–	–
	Industry Specific	–	–	–
	Utility	–	–	–
Subtotal		–	–	–
Batch	Function Specific	–	–	–
	Industry Specific	–	–	–
	Utility	–	–	–
Subtotal		–	–	–
Total Processing Services	Function Specific	1	2	15
	Industry Specific	1	3	25
	Utility	2	5	20
Total		$4	$10	20%

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INPUT
MERMR

APPENDIX B: DEFINITIONS

APPENDIX B: DEFINITIONS

COMPUTER SERVICES

- These are services provided by vendors which perform data processing functions using vendors' computers (processing services) or assist users to perform such functions on their own computers (software products and/or professional services).

- The following are definitions of the modes of service used in this report.

  - Remote Computing Services (RCS) provide data processing to a user by means of terminals at the user's site(s) connected by a data communications network to the vendor's central computer. There are three submodes of RCS:

    - Interactive (timesharing) is characterized by the interaction of the user with the system, primarily for problem-solving time-sharing but also for data entry and transaction processing: the user is on-line to the program/files.

    - Remote Batch is where the user hands over control of a job to the vendor's computer, which schedules job execution according to priorities and resource requirements.

INPUT

- Data Base is characterized by the retrieval and processing of information from a vendor-maintained data base. The data base may be owned by the vendor or a third party.

- User Site Hardware Services (USHS). These offerings provided by RCS vendors place programmable hardware on the user's site (rather than the EDP center). USHS offers:

  - Access to a communications network.

  - Access through the network to the RCS vendor's larger computers.

  - Significant software as part of the service.

- Batch Services include data processing performed at vendors' sites of user programs and/or data which are physically transported (as opposed to electronically, by telecommunications media) to and/or from those sites. Data entry and data output services, such as keypunching and COM processing, are also included. Batch services include those expenditures by users who take their data to a vendor's site, where a terminal connected to a remote computer is used for the actual processing.

- Processing Services Facilities Management (FM). (Also referred to as "Resource Management" or "Systems Management.") The management of all or a significant part of a user's data processing functions under a long-term contract (not less than one year). To qualify as processing services FM, the contractor must directly plan and control as well as operate its own computers/communications network, including providing computers at the client's site, to deliver the service. Simply providing resources, even though under a long-term contract, and/or providing for all of a user's processing needs, does not necessarily qualify as FM.

INPU

TYPES OF PROCESSING SERVICES

● Processing services encompass processing services facilities management, remote computing services, and batch services. They are categorized by type of services bought by users as follows:

- Function Specific services are the processing of applications that are targeted to specific user departments (e.g., finance, personnel, sales) but cut across industry lines. Most general ledger, accounts receivable, payroll, and personnel applications fall into this category. General purpose tools such as financial planning systems, linear regression packages, and other statistical routines are also included in this category. However, when the application or tool is designed for specific industry usage, then the service is industry specific.

- Industry Specific services provide processing for particular functions or problems unique to an industry or industry group. The software is provided by the vendor either as a complete package or as an applications "tool" which the user employs to produce a unique solution. Specialty applications can be either business or scientific in orientation; data base services, where the vendor supplies the data base and controls access to it (although it may be owned by a third party), are also included under this category. Examples of industry specialty applications are seismic data processing, numerically controlled machine tool software development, and demand deposit accounting.

- Utility services are those where the vendor provides access to a computer and/or communications network with basic software that enables any user to develop its own problem solution or processing system. These basic tools include terminal-handling software, sorts, language compilers, data base management systems, information retrieval software, scientific library routines, and other systems software.

INPUT

USE OF PROCESSING SERVICES

- Processing can be categorized by use as follows:

    - <u>Transaction Processing</u> indicates those services where the primary or predominant purpose of the application is to process transactions, usually in a highly repetitive fashion. Most business accounting fits into this category. Payroll, accounts receivable, order entry, portfolio accounting, and inventory control are all good examples of transaction processing.

    - <u>Information Analysis</u> services are processing services where the primary or predominant purpose of the application is to convert data into information through the use of mathematical, statistical, or financial analysis tools that readily and easily display the results in report or graphical form. The tools may be rapidly adapted to address a variety of nonrepetitive problems. These tools are often in the areas of financial analysis, marketing, planning, and statistical analysis. Many of the techniques incorporated have their origins in scientific and engineering applications, which also generally fall within this category.

    - <u>User Data Base Management</u> services are processing services where the primary or predominant purpose of the application is to organize and maintain a data base of user information in a manner that facilitates its rapid and efficient retrieval and display according to user-defined parameters, either in <u>ad hoc</u> or fixed form.

    - <u>Vendor Data Base</u> services are processing services where the primary or predominant purpose of the application is to retrieve and/or process data supplied by the vendor who controls access to it (although it may be owned by a third party). There are two modes of delivery of this service:

INPUT

- Inquiry data base services provide a means of selection and retrieval of data only. They neither provide, nor usually allow, for the subsequent processing of the data. Stock market statistics, news services, and bibliographic data bases are commonly offered in this mode.

- Application Processing services, in addition to providing a means of selection and retrieval, also provide a means of further processing the data into information through the full use of information analysis tools and data base management systems, which permit the merging of vendor data with user data. Demographic, marketing, and financial and economic data bases are commonly offered in this mode.

PROFESSIONAL SERVICES

- This category is made up of services related to EDP, including professional services facilities management, system design, custom/contract programming, consulting, education, and training. Services are provided on the basis of:

    - Time and Materials - The billing rate is measured in units of time, rather than actual costs.

    - Fixed Price - A firm price is agreed upon for a defined piece of work.

    - Cost Plus Fee - The billing rate depends on actual costs plus a fixed fee.

- Professional Services Facilities Management is the management of all or a significant part of a user's data processing functions under a long-term contract (not less than one year). To qualify as professional services facilities management, the contractor must directly plan and control as well as operate

INPUT

the client's facility, where the computers are owned by the client. Simply providing resources, even though under a long-term contract, does not necessarily qualify as professional services facilities management.

SOFTWARE PRODUCTS

- This category includes the user's purchase of applications and systems packages for use on in-house computer systems. Included are lease and purchase expenditures as well as fees for work performed by the vendor to implement and maintain the package at the user's site(s). Fees for work performed by organizations other than the package vendor are counted in professional services. There are several subcategories of software products:

    - Application Products are software products which perform processing to serve user functions. They consist of:

        . Cross-industry products, which are used in multiple-user industry sectors. Examples are payroll, inventory control, and financial planning.

        . Industry-specialized products, which are used in a specific industry sector such as banking and finance, transportation, or discrete manufacturing. Examples are demand deposit accounting and airline scheduling.

    - System Products are software products which enable the computer/ communications system to perform basic functions. They consist of:

        . System operations products, which function during applications program execution to manage the computer system resource. Examples include operating systems, DBMS, communication monitors, emulators, and spoolers.

INPUT

- System utilization products, used by operations personnel to utilize the computer system more effectively. Examples include performance measurement, job accounting, computer operations scheduling, and utilities.

- System implementation products, used to prepare applications for execution by assisting in designing, programming, testing, and related functions. Examples include languages, sorts, productivity aids, data dictionaries, report writers, project control systems, and retrieval systems.

TURNKEY SYSTEMS

- A turnkey system is a combination of hardware and software integrated into a total system designed to fulfill the processing requirements of an application (or applications) for a user.

OTHER CONSIDERATIONS

- All expenditures and revenues addressed are "available" in that they are open for competition. "Captive" figures, which refer to expenditures by a user for services from a subsidiary company, such as Boeing Aircraft with Boeing Computer Services (BCS), are not included. They may be referred to when examining an individual "spin-off" vendor, such as BCS.

- When any questions arise as to the proper place to count certain user expenditures, INPUT addresses the questions from the user viewpoint and categorizes the expenditures according to the answer to the question, "What do the users perceive they are buying?"

INPUT

APPENDIX C: RELATED INPUT REPORTS

APPENDIX C: RELATED INPUT REPORTS

NAME		DATE
Computer Services Markets in the Petroleum Industry	MAS study	May 1976
Computer Services in Federal Government Energy Programs	MAS study	Feb. 1978
Financial Management and Planning Services and Software Markets	MAS study	Feb. 1979
Market Opportunities for Data Base Services	MAS study	July 1980
Power Utilities' Corporate Planning Systems	Custom study	Aug. 1979
Graphic Systems for Structural Analysis	Custom study	April 1981
Market Analysis of Automatic Bulk Terminal Systems	Custom study	Oct. 1980

INPUT

APPENDIX D: QUESTIONNAIRES

USER QUESTIONNAIRE

I.   EXPLORATION

1.   What are the major data processing applications and how is
each accomplished?

APPLICATION	HOW ACCOMPLISHED				
	SOFT-WARE VENDOR	IN-HOUSE		SERVICES VENDOR	PORTION OF TOTAL PRO-CESSING (%)
		MAIN-FRAME MODEL	TURNKEY/ MINI-MODEL		
☐ Seismic Pre Processing					
☐ Seismic Data Reduction (conventional pro-cessing)					
☐ Seismic Analysis					
- wavelet analysis					
- velocity/dig analysis					
- stratigraphic analysis					
- modeling					
☐ Mapping					
☐ Well log analysis					
☐ Data Bases					
☐ Other: _____					
_____					
_____					

Comments: _____

_____

_____

_____

INPUT

2. How much do you spend on siesmic data processing?

☐ Don't know

$_____ ☐ Annually ☐ Monthly in 1980

$_____ ☐ Annually ☐ Monthly in 1981

_____ Line miles/yr.

How much per year will this increase over the next 3-4 years?

☐ Don't know

☐ <10%/year ☐ 10-20%/yr ☐ 30-40%/yr ☐ >40%/yr

or

☐ $_____ by 198__.

3. How do you currently handle your input and output to remote locations?

Input

☐ Mail Tapes ☐ Data Transmission _____bps lines

☐ Other _____

Comments: _____

_____

_____

Output

☐ Mail results - plots

☐ Use remote graphics terminal

☐ distributed processing (remote mini)

☐ Other _____

Comments: _____

_____

_____

Are there any improvements you would like to see in the areas of input/output?

Input

_____

_____

Output

_____

_____

4. Do you have any plans to change your current method of doing seismic data reduction/analysis?

☐ No $\boxed{\text{Skip}}$ question 5.

☐ Shift in-house to _____ mainframe

                                          Vendor/Model

☐ Shift in-house to _____ minicomputer

                                          Vendor/Model

☐ Other: _____

☐ Comments: _____

_____

_____

INPUT

5. Could you outline the rationale for shifting to an in-house . . .

☐ Mainframe ☐ Minicomputer?

☐ Price performance

_____

_____

☐ Expenditure levels

_____

_____

☐ Application products

_____

_____

☐ Upward Compatibility

_____

_____

☐ Interactive CRT/Graphics terminals

_____

_____

☐ Other

_____

_____

INPU

6. Would you be interested in a remote computer services offering for seismic data processing/analysis?

☐ No

☐ If not, would a service that provided computerized training tools and "user friendly systems" to guide seismic analysis and interpretation alter your decision?

    ☐ No

    ☐ Comments: _____

_____

If yes,

☐ Services offering for

    ☐ Seismic data processing ☐ Seismic data analysis

    ☐ both

☐ Preferred method for handling Input

    ☐ Mail Tapes

    ☐ Remote data transmission _____bps lines

    ☐ Other _____

    ☐ Comments: _____

_____

☐ Preferred data reduction characteristics

    ☐ Conventional common depth point modules (Sorting, normal move out, static corrections)

    ☐ Filtering Capabilities (time domain, frequency, deconvolutions)

    ☐ F.K. filtering (frequency, wave filtering)

    ☐ Static and dynamic corrections

    ☐ Comments: _____

_____

INPUT

☐ Preferred Analysis System characteristics

    ☐ Wavelett Analysis

    ☐ Time-series Analysis

    ☐ Frequency Wavelett Analysis

    ☐ Stratigraphic Analysis

    ☐ Structural Analysis

    ☐ 3-D Processing Algorithms

    ☐ Fourier Transforms

    ☐ Migration Analysis

    ☐ Seismic Modeling

    ☐ Other _____

☐ Comments: _____

_____

☐ Preferred processing system characteristics

    ☐ Micro based graphics terminal

        ☐ Pen plotter   ☐ Yes   ☐ No

        ☐ Electrostatic plotter   ☐ Yes   ☐ No

        ☐ Color CRT   ☐ Yes   ☐ No

        ☐ Price range $_____ to _____/month

                $_____ to _____ purchase

    ☐ Remote mini with graphics work stations

        ☐ Pen plotter   ☐ Yes   ☐ No

        ☐ Electrostatic plotter   ☐ Yes   ☐ No

        ☐ Color CRT   ☐ Yes   ☐ No

        ☐ Price range $_____ to _____/month

                $_____ to _____ purchase

    ☐ Comments: _____

_____

INPUT

7. Are there any other exploration applications that you would be interested in having offered on a remote computing basis?

☐ No

☐ Mapping:

    ☐ Batch   ☐ Interactive   ☐ Interactive with linked data bases

Please comment on characteristics including expenditures:

_____

_____

_____

☐ Well log analysis:

Please comment on characteristics including expenditures:

_____

_____

_____

☐ Other

Comments: _____

_____

_____

INPUT

8. What data management and data base services do you currently use?

$\square$ None

DATA MANAGE-MENT SYSTEM (DBMS)	DATA BASE NAMES	VENDOR	APPLICATION/ USE

$\square$ On a scale of 1 to 10 where 10 is high, please rate the growing importance of data management and data base services to your organization?

Data Management _____

Data Base Services _____

$\square$ Comments: (include expenditures estimates if known)

_____

_____

_____

_____

INPUT

9.   Are there other data base services you would like to see
     offered on a remote computing services basis?

     ☐ No

     ☐ Mapping

     ☐ Land Sattelite

     ☐ Well history

     ☐ Magnetic and gravitational fields

     ☐ Seismic lines/lease boundries

     ☐ Data storage and correlation

     ☐ Other _____

     ☐ Please comment on characteristics of data base services,
       including expenditures:

     _____

     _____

     _____

10. Under what conditions is data security viewed as a concern
     when using a computer service?

     ☐ No

     ☐ Comments: _____

     _____

     _____

INPUT

III. PRODUCTION

11. What are the major applications and how is each accomplished?

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APPLICATION	HOW ACCOMPLISHED				
		IN-HOUSE			PORTION OF TOTAL
	SOFT- WARE VENDOR	MAIN- FRAME MODEL	TURNKEY/ MINI MODEL	SERVICES VENDOR	PRO- CESSING (%)
☐ Reservoir Simulation					
☐ Secondary or Enhanced Recovery					
☐ Production Accounting					
☐ Drilling Assistance					
☐ Offshore Structural Analysis					
☐ Process Simulation					
☐ Other _____					
_____					
_____					

Comments: _____

_____

_____

INPUT

12.   How much do you spend on production data processing?

$_____ ☐ Annually ☐ Monthly in 1980

$_____ ☐ Annually ☐ Monthly in 1981

How much per year do you expect this will increase over the next 3-4 years?

☐ Don't know

☐ <10%/year   ☐ 10-20%/year   ☐ 30-40%/year

☐ >40%   ☐ $_____ by 198___.

Comments (Why?)

_____

_____

_____

13.   Do you have any plans to change your current method of doing resevoir or enhanced recovery simulation?

☐ No

☐ Shift to _____ mainframes
                 Vendor/Model

☐ Shift to _____ minicomputer
                 Vendor/Model

☐ Other _____

☐ Comments: _____

_____

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INPUT

14. Could you outline the rationale for shifting to an inhouse . . .

☐ Mainframe ☐ Minicomputer

☐ Price Performance _____

_____

☐ Expenditure level _____

_____

☐ Application products _____

_____

☐ Upward Compatibility _____

_____

☐ Interactive CRT/Graphics
Terminals _____

_____

☐ Other _____

_____

INPUT

15.   Would you be interested in a remote computing service offering for reservoir simulation modeling?

☐ No

☐ Preferred modeling characteristics

    ☐ 3-D

    ☐ Multi-phase (oil, water, gas)

    ☐ Size of Model no. of Grid Blocks _____

    ☐ Other _____

    Comments: _____

    _____

☐ Preferred processing system characteristics

    ☐ Interactive or ☐ remote batch

    ☐ Micro based graphic terminals

        ☐ Color CRT ☐ Yes ☐ No

        ☐ Price Range $_____ to $_____/month

                $_____ to $_____/purchase

    ☐ Remote mini with graphics work stations

        ☐ Color CRT ☐ Yes ☐ No

        ☐ Price Range $_____ to $_____/month

                $_____ to $_____/purchase

    ☐ Comments: _____

    _____

INPUT

16.   Would you be interested in a remote computing service offering for Enhanced Recovery Modeling?

☐ No

☐ Preferred Modeling Characteristics

    ☐ 3-D

                         Rate order of importance (1 to 4)

    ☐ Injection Type (Steam_____, CO_2_____, Water_____,

            Other _____ _____)

Comments: _____

_____

☐ Preferred processing system characteristics

    ☐ Interactive or ☐ Remote Batch

    ☐ Micro based graphic terminal

        ☐ Color CRT ☐ Yes ☐ No

        ☐ Price Range $_____ to _____/month

    Remote mini with graphics work station

        ☐ Color CRT ☐ Yes ☐ No

        ☐ Price Range $_____ to _____/month

                $_____ to _____/purchase

    ☐ Comments: _____

_____

INPUT

17.   What Data Management and Data Base Services do you
        currently use?

☐ None

DATA MANAGE-MENT SYSTEM (DBMS)	DATA BASE NAMES	VENDOR	APPLICATION/ USE

☐ On a Scale of 1 to 10, where 10 is high, please rate
the growing importance of data management and data
base services to your production activity.

Data Management _____

Data Base Services _____

☐ Comments: (Include expenditure level if known)

_____

_____

_____

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INPUT

18.   Are there other data base services you would like to see offered on a remote computing services basis?

☐ No

☐ Data Storage and correlation

☐ Data Bases

TYPE OF DATA	APPLICATION/USE	EXPENDITURE LEVEL/YEAR

☐ Please comment on characteristics of data base services, including annual expenditures:

_____

_____

_____

THANK YOU

END

INPUT

VENDOR QUESTIONNAIRE

1. What products/services do you offer in energy markets?

MARKET SEGMENT	MARKET OIL COAL GAS URANIUM (INDICATE)	OFFERING NAME	DESCRIPTION	DELIVERY MODE (CHECK THOSE THAT APPLY)				
				RCS	BATCH	FM	MINI	SOFT-WARE PACK-AGE
Exploration								
Production								
Processing								
Transpor-tation								
Marketing								

INPUT

2. What is your extimate of the current market for your products/ services? Market growth?

| MARKET SEGMENT | MARKET | SIZE | | GROWTH |
		1980* ($ million)	1981 ($ million)	1982–1986 AAGR
Exploration				
Production				
Processing				
Transportation				
Marketing				

3. Who are your major competitors?

MARKET SEGMENT	COMPETITOR NAME	RELATIVE SHARE (PERCENT)	VENDOR (PERCENT)
1. Exploration	1. 2. 3.		
2. Production	1. 2. 3.		
3. Processing	1. 2. 3.		
4. Transporation	1. 2. 3.		
5. Marketing	1. 2. 3.		

INPUT

4. Do you offer or are you planning to offer:

☐   User site minicomputers?   ☐ Yes ☐ No

   Number of installations _____

   Portion of revenues from user site _____ %

   Percent of all installations _____ %

☐   Turnkey Systems?   ☐ Yes ☐ No

   Number of installations _____

   Portion of revenues from turnkey _____ %

   Percent of all installations _____ %

☐   Facilities management?   ☐ Yes ☐ No

   Number of installations _____

   Portion of revenues from FM _____ %

   Percent of all installations _____ %

Comments: _____

_____

_____

_____

5. What are the factors which would significantly impact your offer-
    ing of computer services/software products over the next 3-5
    years?

MARKET SEGMENT	FACTORS
Exploration	
Production	
Processing	
Transportation	
Marketing	

6. Please send product literature on your offering in the Energy area.

☐ Yes   ☐ No

THANK YOU!!

INPUT

EDP MANAGER INTERVIEW

Marketing ☐   Transportation ☐

1. In each of the three computer services areas (processing, software and professional services) who are your major vendors, in terms of expenditures?

	VENDOR	SERVICE/PRODUCT	% OF TOTAL EXPENDITURES IN AREA	RATING OF IMPORTANCE (1 - 10)	RANKING OF 10s
Processing Services					
Total			%		
Software Products (Get description of application)					
Total			%		
Professional Services					
Total			%		

2. Could you please rank the following characteristics in relation to choosing a vendor (0 = unimportant, 10 = very important)

Notes:

a. Technical training/support available _____ _____

b. Availability of national/international
    network   _____ _____

c. Industry knowledge   _____ _____

d. Price   _____ _____

e. Vendor's hardware/software system   _____ _____

f. Other: _____ _____ _____

INPUT

3. Who, by title, has to select and approve the selection of a vendor?

Select: _____

_____

Approve: _____

_____

4. In the three services areas (processing, software, professional services), What was the division of expenditures among the three? (Will AAGR be higher or lower than that described by the 1980-1981 rate?)

	1980	1981	AAGR 1981-1985
Processing Services	%	%	
	$	$	%
Software Products	%	%	
	$	$	%
Professional Services	%	%	
	$	$	%
Total Computer Services	= 100%	= 100%	= 100%
	$	$	%

INPUT

5. For processing services, what is the division of expenditures among the following types of processing services?

	1980	1981	AAGR 1983–1985
Remote Computing Services	%	%	
	$	$	%
Batch Services	%	%	
	$	$	%
Facilities Management	%	%	
	$	$	%

= 100%   = 100%

6. For remote computing services, what is the division of expenditures among the following types of processing services?

	1980	1981	AAGR 1983–1985
Interactive	%	%	
	$	$	%
Remote Batch	%	%	
	$	$	%
Data Base Services	%	%	
	$	$	%

= 100%   = 100%

INPUT

7. What driving factors would effect your use of outside computer services?

Increase: _____

_____

Decrease: _____

_____

8. What was the percentage split between the total cost of the previously mentioned services to the cost for in-house data processing (hardware, personnel etc.), and what do you expect it will be for this year? (Is the AAGR going to be higher or lower than that described by the 1980-1981 rate of change?)

	1980	1981	AAGR 1982-1985
Outside Computer Services	%	%	▨▨▨
	$	$	%
In-House EDP	%	%	▨▨▨
	$	$	%
Total Budget	$	$	%

INPUT

9. What major applications are supported by your in-house system which have not already been mentioned, i.e. those developed in-house?

		APPLICATION (INDICATE IF USED)	RATING OF IMPORTANCE (1 - 10)	NOTES
Transportation		Design and analysis of piping networks_____		
		Fluid flow in pipeline networks _____		
		Lease production _____		
		Crude purchasing _____		
		Processing of run tickets _____		
		Preparation of regulatory reports _____		
		Analysis of Tanker Loading _____		
		Other:_____ _____		
		Other:__·_____ _____		
Marketing		Credit Authorization_____		
		Processing of Credit Cards _____		
		Forecasting and analysis_____		
		Other:_____ _____		
		Other:_____ _____		
		Other:_____ _____		

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INPUT

10. What percent of your software (based on expenditures) is developed in-house now and what percent do you expect will be developed in-house in two years?

	1981	1983
In-house	_____ %	_____ %

11. What major applications do you expect to add within the next three years? Also, which of these will be bought and which will be developed in-house and why?

APPLICATION	DEVELOPED IN-HOUSE	BOUGHT FROM OUTSIDE	REASONS FOR GOING WITH THIS SOURCE:
_____ _____			_____ _____
_____ _____			_____ _____
_____ _____			_____ _____

INPUT

12. What new application packages and/or services would you like to see made available for your use, i.e. something which to your knowledge is not now available?

Software: _____

_____

_____

Services: _____

_____

_____

13. Are there any end users, who use outside services, which you could suggest who should be contacted regarding the above subjects and issues? ☐ YES ☐ NO ☐ All services coordinated through this office.

Name: _____

Title: _____

Location: _____

Phone Number: _____

Comments: _____

_____

THANK YOU!!

- -

INTERVIEWERS NOTES:

INPUT

EDP USER QUESTIONNAIRE

Marketing ☐   Transportation ☐

1. In each of the three computer services areas (processing, software and professional services) who are your major vendors, in terms of expenditures?

	VENDOR	SERVICE/PRODUCT	% OF TOTAL EXPENDITURES IN AREA	RATING OF IMPORTANCE (1 - 10)	RANKING OF 10s
Processing Services					
Total			%		
Software Products (Get description of application)					
Total			%		
Professional Services					
Total			%		

2. Could you please rank the following characteristics in relation to choosing a vendor (0 = unimportant, 10 = very important)

Notes:

a. Technical training/support available _____ _____

b. Availability of national/international network _____ _____

c. Industry knowledge _____ _____

d. Price _____ _____

e. Vendor's hardware/software system _____ _____

f. Other: _____ _____ _____

INPUT

3. Who, by title, has to select and approve the selection of a vendor?

Select: _____

_____

Approve: _____

_____

4. What driving factors would effect your use of outside computer services?

Increase: _____

_____

Decrease: _____

_____

INPUT

5a. In the three services areas (processing, software, professional services), What was the division of expenditures among the three? (Will AAGR be higher or lower than that described by the 1980-1981 rate?)

	1980	1981	AAGR 1981-1985
Processing Services	%	%	▨▨▨
	$	$	%
Software Products	%	%	▨▨▨
	$	$	%
Professional Services	%	%	▨▨▨
	$	$	%
Total Computer Services	= 100% $	= 100% $	= 100% %

b. What was your total EDP budget (In-house and outside) last year, what is it this year and at what rate will it grow from 1981 to 1985?

1980 _____ k,

1981 _____ k,

_____ AAGR

INPUT

6. What major applications are supported by your in-house system which have not already been mentioned, i.e. those developed in-house?

	APPLICATION (INDICATE IF USED)	RATING OF IMPORTANCE (1 - 10)	NOTES
Trans-por-tation	Design and analysis of piping networks_____		
	Fluid flow in pipeline networks _____		
	Lease production _____		
	Crude purchasing _____		
	Processing of run tickets _____		
	Preparation of regulatory reports _____		
	Analysis of Tanker Loading _____		
	Other:_____		
	Other:___·_____		
Mar-ket-ing	Credit Authorization_____		
	Processing of Credit Cards _____		
	Forecasting and analysis_____		
	Other:_____		
	Other:_____		
	Other:_____		

INPUT

7. What percent of your software (based on expenditures) is developed in-house now and what percent do you expect will be developed in-house in two years?

	1981	1983
In-house	_____ %	_____ %

8. What major applications do you expect to add within the next three years? Also, which of these will be bought and which will be developed in-house and why?

APPLICATION	DEVELOPED IN-HOUSE	BOUGHT FROM OUTSIDE	REASONS FOR GOING WITH THIS SOURCE:
_____ _____			_____ _____
_____ _____			_____ _____
_____ _____			_____ _____

INPUT

9. What new application packages and/or services would you like to see made available for your use, i.e. something which to your knowledge is not now available?

Software: _____

_____

_____

Services: _____

_____

_____

THANK YOU!!

_____

INTERVIEWERS NOTES:

INPUT