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Oil and Gas Resources of the West Siberian Basin, Russia

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Preface

Oil and Gas Resources of the West Siberian Basin, Russia is part of the Energy Information Administration's (EIA's) Foreign Energy Supply Assessment Program (FESAP). The primary objective of this study is to assess the oil and gas potential of the West Siberian Basin of Russia. The study does not analyze the costs or technology necessary to achieve the estimates of the ultimate recoverable oil and gas.

This is the second report on an oil and gas province in the former Soviet Union. The first, *Oil and Gas Resources of the Fergana Basin (Uzbekistan, Tadzhikistan, and Kyrgyzstan)*, was published in January 1995.

Russia's West Siberian Basin contains sufficient oil and natural gas to affect world petroleum markets. The basin supplies approximately 70 percent of the oil and 90 percent of the gas production for Russia. Decreases in produced volumes from the basin would require that the demand for petroleum in Russia be met from other sources. Likewise, increases in production would increase the amount of oil or gas for export into international markets.

This study uses reservoir data to estimate recoverable oil and gas quantities which were aggregated to the field level. Field totals were summed to a basin total for discovered fields. An estimate of undiscovered oil and gas, from work of the United States Geological Survey (USGS), was added to give a total basin resource volume. Recent production decline points out Russia's need to continue development of its discovered recoverable oil and gas. Continued exploration is required to discover additional oil and gas that remains undiscovered in the basin.

The estimates of recoverable oil and gas for the regions of the basin, the individual fields, and the geologic intervals are intended as a guide to organizations such as oil and gas operating companies, financial institutions, and government agencies. In addition to the estimates of maximum recovery, the reported and estimated reservoir parameters are a valuable reference source. The appendices contain the estimates of ultimate recovery by field and frequency distributions of the reservoir data. Additionally, a computer diskette contains the reported and estimated parameters for each productive reservoir.

Several independent petroleum engineers and geologists with experience in West Siberia have reviewed the analysis and contributed many useful suggestions which have been incorporated in the report. Retired and current staff of the USGS also assisted in reviewing this report. The assistance of all of these professionals is gratefully acknowledged. Special thanks is given to Dr. James W. Clarke and Dr. James A. Peterson, USGS retired, who contributed Appendix A, Petroleum Geology in its entirety.

Publication of this report is in keeping with responsibilities given the Energy Information Administration (EIA) in Public Law 95-91/Section 205(a) and Section 657(2)a for estimating foreign energy supply information. General information about this publication may be obtained from Joan Heinkel, Director of the Reserves and Natural Gas Division, (202) 586-6090, or John Wood, Director of the Dallas Field Office, (214) 720-6150. Specific information regarding the content or preparation of this report may be obtained from Floyd Wiesepape, (214) 720-6166, fax (214) 720-6155, or
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Contents

Page

Tables

Figures

Executive Summary

This analysis, prepared in cooperation with the U. S. Geological Survey (USGS), is part of the Energy Information Administration's (EIA's) Foreign Energy Supply Assessment Program (FESAP). The purpose of the program is to review the potential of major oil and gas provinces around the world. This report aggregates calculated reservoir-level results to field and then to basin level. The production projections establish a possible range of potential.

By area and resources, the West Siberian Basin is the largest oil and gas producing province in the Russian Federation of the former Soviet Union. Approximately 70 percent of the oil and 90 percent of the gas produced in Russia come from the West Siberian Basin. Petroleum consumption in Russia in 1995 of approximately 1.07 billion barrels of oil and 14.5 trillion cubic feet of natural gas was exceeded by production from the basin of approximately 1.5 billion barrels and 21 trillion cubic feet per year. The United States consumption of petroleum in 1995 was 6.5 billion barrels with production of 2.4 billion barrels of oil and 18.8 trillion cubic feet of gas. Production from the basin supplies Russia, other parts of the former Soviet Union, and Europe as well as other parts of the world. World supplies would have to be redirected to maintain a balance of supply if oil and gas production were not available from the basin.

Discoveries in the basin total 634 oil fields and 147 gas fields. Individual reservoir data are available in 70 percent of the fields. The data represents over 1500 reservoirs or approximately three productive reservoirs per field that has data reported. The decline of oil production from the producing fields from 3.1 to 1.5 billion barrels per year (8.5 to 4.1 million barrels per day) between 1988 and 1994 and a slight decline from 22.6 to 21.9 trillion cubic feet per year (61.9 to 60.0 billion cubic feet per day) of gas between 1991 and 1993 cause concern about the potential of the basin as a long term supplier of oil and gas. However, the sum of the estimated ultimate recovery (EUR) from discovered fields by EIA and undiscovered resources estimated by the USGS indicate that significant potential remains in the West Siberian Basin (Table ES1).

Remaining oil and condensate EUR are 65.5 billion barrels. Remaining EUR of undeveloped fields and undiscovered resources of oil and condensate total 101.4 billion barrels. Production projections for oil based on maintaining the current rate or returning to the previous peak producing rate indicate that sufficient oil volume exists to maintain those rates for 35 to 50 years. Recent production decline and maximum estimates of ultimate recovery cause this producing time to be optimistic and longer than the production time estimated for gas. However, to accomplish this ultimate recovery requires significant development of new fields, continued maintenance and development of producing fields, and the application of advanced technology. Continued development will require significant amounts of money and technology advancements. Economic factors are not included in this analysis.

The potential also exists for significant natural gas production. The EUR of developed reserves are 551 trillion cubic feet with 341 trillion cubic feet in undeveloped fields. Undiscovered resources are 1084 trillion cubic feet. The development of the remaining potential could arrest the current decline and maintain production at the current rate for another 32 years. The length of time that the peak rate could be maintained is less than the estimates of time that a peak oil rate could be maintained because the recent gas rate decline has not been as severe as the decline of the oil rate. The gas producing fields are located in the northern portion of the basin, north of the Arctic Circle, and additional development potential exists offshore in the Kara Sea. High development costs and logistical problems can be expected to delay the development of some of the possible and undiscovered gas resources.

Significant condensate production potential exists in the basin. Ultimate recovery was estimated where data were available. Five billion barrels of discovered condensate and four billion barrels in the undiscovered category represent a minimum potential for the basin and are reported as a portion of the EUR. Condensate production was not separated from crude oil production.

The analysis of the oil and gas resources of the West Siberian basin provides a view of the potential of a major resource in Russia which has global implications in a world economy. The included basic data also provide a source of information for additional study in more detail for areas, fields or geologic intervals of interest.

Table ES1. Estimated Crude Oil, Condensate, and Natural Gas Resources of the West Siberian Basin, as of Year End 1994 (Oil) and 1993 (Gas)

Resource Description	Oil and Condensate Billion Barrels		Natural Gas Trillion Cubic Feet	
Cumulative Production		**49.3**		**214**
Developed Fields				
Remaining Estimated Ultimate Recovery	**65.8**		**551**	
Discovered Undeveloped Fields				
Estimated Ultimate Recovery		**51.0**		**341**
Undiscovered Resources				
(USGS, Mean Value)		**50.4**		**1084**
Basin Total Resources		**216.5**		**2190**

Source: Energy Information Administration, Office of Oil and Gas.

1. Overview of the West Siberian Basin

Background

The Energy Information Administration (EIA) in cooperation with the U. S. Geological Survey (USGS), has assessed the resources, reserves, and production potential of 14 major oil and gas producing regions outside the United States. This series of assessments was done under EIA's Foreign Energy Supply Assessment Program (FESAP). The basic approach used is to combine historical drilling, discovery, and production data with EIA estimates of ultimate recovery and USGS generated undiscovered resource estimates. Field-level data for discovered oil and gas were used for the previous assessments. Supply projections through depletion were typically formulated for the country or major producing region.

EIA has prepared an assessment of oil and gas resources of one province in the former Soviet Union (FSU). A report on the oil and gas resources of the Fergana Basin[1] in the republics of Uzbekistan, Tajikistan, and Kyrgyzstan was published in January 1995.

Geographic Setting

In terms of the geographic area and recoverable oil and gas, the largest oil and gas producing province in the FSU is the West Siberian Basin in the Russian Federation (Russia). Not only is it the largest in the FSU but it also is one of the largest in the world, from about 52° N. to 73° N. latitude and about 60° E. to 90° E. longitude (**Figure 1**).. The basin covers an area of approximately 1.3 million square miles, more than twice the size of the entire state of Alaska. The basin extends eastward from the Ural Mountains to the Yenisey River and northward from the Kazakh Uplands and the Altai and Sayan Mountains into the Kara Sea, a distance of roughly 1,500 miles. A comparison of similar latitudes to North America would place the West Siberian basin from Vancouver Island (off the northwest coast of the state of Washington) north to latitudes in the Beaufort Sea, off northern Alaska.

Topographically, the basin forms a nearly perfect plain, with an imperceptible slope to the north. This is the world's largest area of unbroken flat terrain. It is characterized by waterlogged soils, shallow lakes, and extensive swamps. Winters last seven to nine months with mean temperatures ranging from about +5° to -20° F. (degrees Fahrenheit).

Geology

Structurally, the West Siberian Basin is a broad, relatively gentle downwarp filled with 10,000 to 33,000 feet of post-Paleozoic marine, near shore marine, and continental clastic sedimentary rocks. The underlying basement is composed of Precambrian and Paleozoic fold systems with large areas of partly metamorphosed Paleozoic carbonate and clastic rocks and numerous areas of Paleozoic granite and igneous bodies. In the central part of the Basin, the basement is cut by an extensive, northerly-oriented Triassic rift system. Oil source rocks are mainly marine Jurassic and Lower Cretaceous bituminous shales. Trapping is structural and stratigraphic. The petroleum geology of the West Siberian Basin is discussed by Peterson and Clarke in their report titled "West Siberian Oil-Gas Province"(**Appendix A**).

Production History

The initial discovery in the basin, the Berezovo field, was made in 1953. It is a gas field in the northern Urals region. Production was not established until 1963 because of its remote location. The first major oil discovery was the Samotlor field in 1961. It is one of the largest oil fields in the world with an estimated ultimate oil recovery of 24.7 billion barrels. Samotlor production began in 1964.

Development of oil production in the 1970s was followed by development of gas resources in the northern portion of the Basin in the 1980s. In recent years, basin production has exceeded reserves replacement. Oil production has declined since 1988, and gas production began to decline in 1991.

Figure 1. Location of the West Siberian Basin in Russia

Source: Earth Science Associates, *Arlington, TX.*

Oil and condensate production in Russia has declined from a peak of 4.2 billion barrels in 1988 (11.5 million barrels per day) to 2.2 billion barrels in 1994 (6.0 million barrels per day). Production has stabilized with 1996 oil production approximately the same as in 1994. West Siberian Basin oil production has dropped from a peak of 3.1 to 1.5 billion barrels (8.5 to 4.1 million barrels per day) during the same time. Peak gas production in Russia occurred in 1991 at 22.6 trillion cubic feet (62.2 billion cubic feet per day) and had declined to 21.9 trillion cubic feet (60.0 billion cubic feet per day) in 1993 with approximately 20.3 to 20.1 trillion cubic feet (55.6 to 55.2 billion cubic feet per day) from the West Siberian Basin.

Economic Significance

Approximately 70 percent of the oil and 90 percent of the gas produced in Russia come from the West Siberian Basin. As Russia increasingly participates in the global economy, the importance of its oil and gas resources will increase. Russia exports a significant amount of oil and gas to Europe and the republics of the FSU. Hard currency-generating exports to non-FSU countries have increased over the last several years as delinquent payments from FSU republics increased. A significant amount of Russia's oil and gas is consumed within Russia. Russia is the world's second largest consumer[2] of natural gas and forth largest consumer of petroleum liquids behind the United States, Japan, and China. In 1995, oil and gas consumption was 1.07 billion barrels of petroleum liquids and 14.51 trillion cubic feet of natural gas. In comparison, the United States consumed 6.47 billion barrels of petroleum liquids and 21.65 trillion cubic feet of natural gas in 1995. The Russian petroleum industry supplies the consumption requirements of Russia plus the oil and gas for export. Further decline of Russian production could cause changes in the world petroleum markets as well as effect the economy and development of Russia. An assessment of the oil and gas resources and the potential for development of those resources in the West Siberian Basin is provided herein.

Largest Fields

Several of the largest oil and gas fields in the world have been found in the basin. The five largest oil fields in this analysis represent approximately 30 percent of the discovered oil resources in the basin. The estimated ultimate recoverable oil from the largest oil field, Samotlor, is estimated as 24.7 billion barrels. Cumulative production through 1993 is 17.9 billion barrels. The five largest gas fields contain 60 percent of the discovered nonassociated gas resources of the basin. The Urengoy field is the largest gas field in the basin with estimated total recovery of 269.6 trillion cubic feet and cumulative production of 108.5 trillion cubic feet through 1993.

2. Analysis Discussion

Basic Methods and Categories

The database constructed for this study contains information on 1538 separate reservoirs, an average of approximately three reservoirs per field that has reservoir data reported. Some reservoir designations represent various subdivisions of geologic intervals while others represent the entire geologic interval. Each reservoir with reported data was assumed to contain producible hydrocarbons unless noted as non-productive in the data source. The locations of fields within the basin and the location of fields that produce from selected common geologic intervals are shown in **Appendix B.**

The method used to estimate a recovery of oil and gas from each field involved the calculation of reservoir volumes within the individual fields. Known reservoir data were used to approximate any unknown information. Recovery was calculated for each reservoir indicated to be hydrocarbon bearing. The primary phase (gas or oil) was assumed to fill the entire reservoir; therefore, gas-oil contacts within individual reservoirs were not considered.

Volumetric methods used in the determination of reserves tend to produce optimistic estimates. Some of the estimates reflect data from initial discoveries or exploration prospects. Even though the method has limitations, it was chosen because sufficient field or reservoir performance data were not available to estimate the potential of the entire basin. Production history was considered unreliable for estimating recoverable oil and gas because recent performance may be the result of operational problems rather than natural depletion.

A recovery factor is applied to a volumetric estimate of original oil or gas in place in each reservoir within a field. The resulting quantity is defined as estimated ultimate recovery. The Russian terminology would classify the volumes calculated in this analysis as $A + B + C_1$, with some volume in the C_2 category. "A" reserves are considered developed producing; "B" are drilled and tested but not producing; "C_1" are partially evaluated, undeveloped, nonproducing; and "C_2" reserves have not been delineated by drilling. The field area data of this report may include areas that have not been delineated by drilling; therefore, some C_2 reserves are likely in this report. The USGS estimate of undiscovered resources would be classified as $C_3 + D_1$ in the Russian system.

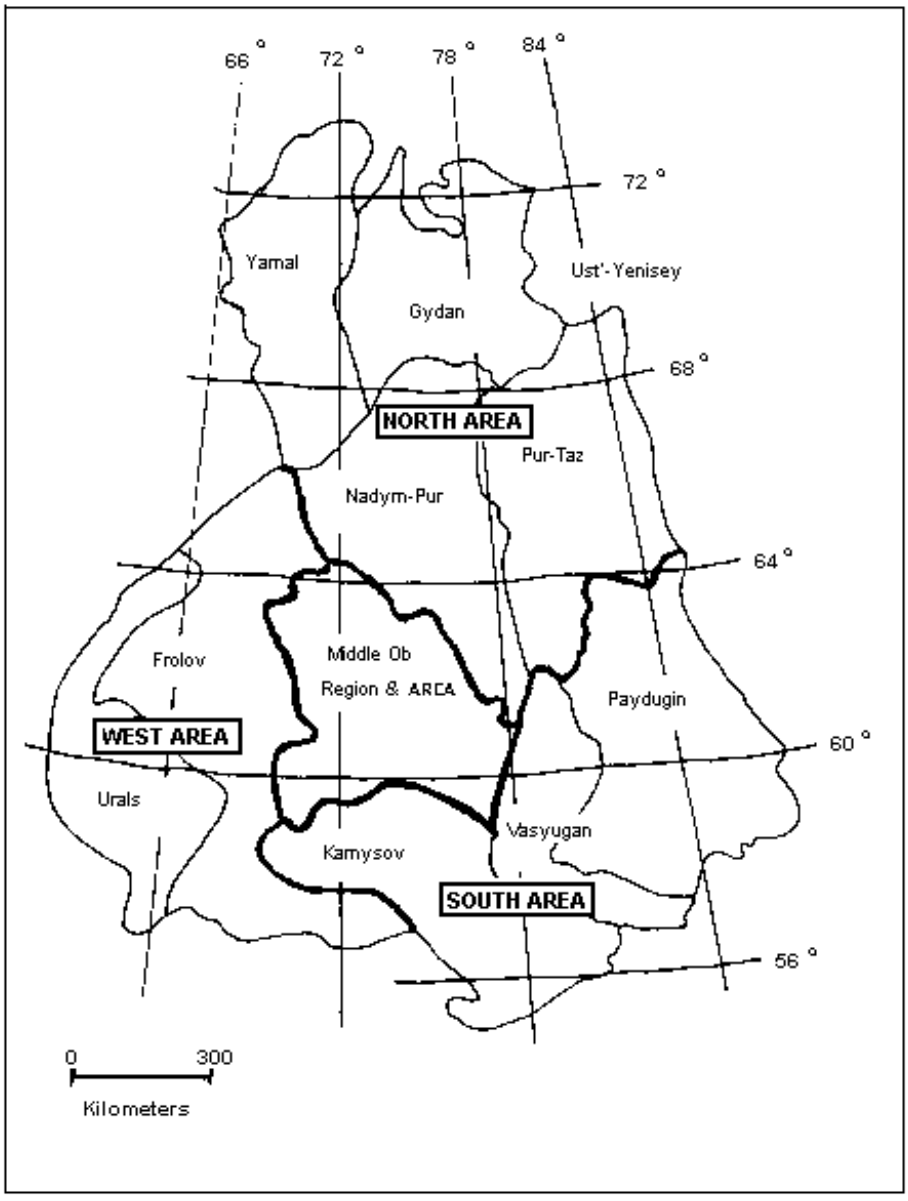
The estimated ultimate recovery (EUR) calculated in this analysis is not defined by performance, economic limits of production, or costs of development. Therefore, a comparison to U. S. Reserve classifications can not be made. Additional field studies would be necessary to evaluate operational methods and expenses and capital requirements for development.

Performance and economic evaluations could then be used to determine the amount of proved and probable reserves are in the producing fields. Additional analysis would also be necessary to classify undeveloped estimated ultimate recoverable oil or gas as probable or possible.

Basin Subdivisions

Regional boundaries within the Basin were described by Maksimov[3] and others (**Figure 2**). The areal subdivision of the basin used in this study follows the method adopted by Maximov and Peterson and Clarke.[4] The ten Regions identified can be combined into four Areas having common characteristics (**Table 1**). Common geologic intervals within the Areas were combined for data analysis (**Table 2**). The linkage of geologic age with geologic interval and the areal subdivisions is shown as **Table 3**.

Figure 2. Map of the Oil and Gas Regions and Areas of the West Siberian Basin



Source: Oil and Gas Fields of the U.S.S.R., Edited by S. P. Maksimov.

Table 1. Regions Within Areas of the West Siberian Basin

Area	Region
North	Yamal
	Gydan
	Nadym-Pur
	Pur-Taz
West	Frolov
	Near Urals
South	Kaymysov
	Vasyugan
	Paydugin
Middle Ob	Middle Ob

Source: Department of the Interior, U. S. Geologic Survey.

Table 2. Geologic Intervals Combined Within Productive Areas of the West Siberian Basin for Data Analysis

Combined Geologic Intervals	Productive Areas
Upper Cretaceous	All Areas
Albian - Aptian (North)	North
Albian - Aptian (South)	Middle Ob, West, & South
Neocomian (North)	North
Neocomian (South)	Middle Ob, West, & South
Jurassic (North)	North
Jurassic (South)	South
Jurassic (West)	West
Jurassic (Ob)	Middle Ob
Triassic-Paleozoic	All Areas

Source: Energy Information Administration, Office of Oil and Gas.

Production by Area

The northern portion of the basin produces primarily nonassociated gas and gas condensate from Upper Cretaceous. More than 90 percent of the discovered nonassociated gas in the basin is located in this area. The volume of discovered oil in the North Area ranks second to the Middle Ob Area.

The Middle Ob Region, in the central portion of the basin, is considered a single area. It is the major oil producing area of the basin. All but one field in the Middle Ob Area are considered primarily oil fields.

The West Area is productive in the Lower Cretaceous and Jurassic intervals. The West Area is generally gas productive in its northern portion and oil productive in its southern portion. Production in the South Area is predominantly oil from Jurassic intervals with some production from Lower Cretaceous intervals.

The number of fields in each of the four Areas is about evenly distributed, from 18 percent in the South Area to 34 percent in the Middle Ob Area. The locations of less than 2 percent of the fields are unknown. The database includes 634 oil and 147 gas fields for a total of 781 fields in the basin. Seven fields of the Ust-Yenisey Region, which adjoins the Gydan Region along the northeastern edge of the basin, are included in the Gydan Region. Other sources may give a different count for the number of fields because of name changes, combining of fields within areas, or different translations of field names. Field locations are shown in **Figure 3** with gas fields in red and oil fields in green.

Table 3. Stratigraphic Chart Linking Geologic Age with Pay Zone Identifiers, by Area and Region, West Siberian Basin (Maksimov reference)

SERIES	AGE	NORTH BASIN AREA: Pay Zones, Yamal and Gydan Regions	NORTH BASIN AREA: Pay Zones, Nadum-Pur and Pur-Taz Regions	WEST BASIN AREA: Pay Zones, Frolov and Near-Ural Regions	SOUTH BASIN AREA: Pay Zones, Kaymysov, Vasyugan, and Paydugin Regions	MIDDLE OB BASIN AREA: Pay Zones, Middle Ob Region
UPPER CRETACEOUS	Maastrichtian					
	Campanian					
	Santonian					
	Coniacian					
	Turonian		Gazolinian			
	Cenomanian	PK1-PK6	PK0-PK6		PK1, PK11	PK1
LOWER CRETACEOUS	Albian	TP1-TP8	PK15 TP10, TP-11	PK2, PK21	PK12, PK14, PK15, PK18	PK21
	Aptian	TP12-TP14	PK16-PK21			AV1
	Barremian	TP15-TP18	AV1-AV3			AV1, AV2, AV3 , AS4-AS6, B19-B22
	Hauterivan	TP18-TP24 TP25-TP27, NP2-NP4	AV6-AV8, AU7-AU11 AV-8, BV4-BV6, BP9, BS0-BS8, BT3, BT4, BU0-BU6, BN4 BV5-BV7, SD4	N1, N2	A10	AV2-AV8, AS7-AS12, B3, BV0 BV0-BV4, BS1-BS6 BV4-BV7, BS-8
	Valanginian	BU16, NP10, NP11	BV8-BV13, BP6-BP15, BS9-BS12, BT7-BT12, BU7-BU16, BN9-BN16, SD8 BV14-BV16, BP16-BP20, BS16,		B5, B7-B9, B12-B14, BV9	B6, B10, BV7-BV12, BS8-BS12
	Berriasian	Achimov	BT16-BT18, BU16, Achimov BV18-BV20, BP18, BP19, Achimov	B16-B20	B16-B20 B16-B20	BS16-BS18 BV18-BV20, BS18-BS22
UPPER JURASSIC	Volgian		Yu0	P0-P3, Yul-YulV P0-P3, Yul-YulV	Yu0, Yu1, Yu1(1), Yu1(3-4)	Yu0
	Kimmeridgian			P1(F), P0-P3(&P3F), Yul-YulV	Yu1, Yu1(1), Yu1(3-4)	
	Oxfordian		Yu1	P0-P3(&P3F), Yul-YulV	Yu1, Yu1(1), Yu1(3-4), Yu2	Yu1(1)
MIDDLE JURASSIC	Callovian	Yu1(1)	Yu1, Yu1(1), Yu1(2)	P0-P3(&P3F), Yu1-Yu7(&Yu2F), Yu11, Yu12, Yul-YulV	Yu1, Yu1(1-4), Yu2 Yu1, Yu2, Yu4, Yu7-Yu9, M	Yu1, Yu1(1-3), Yu2
	Bathonian	Yu2	Yu2	P0-P3, Yu1-Yu7(&Yu2F), Yu11, Yu12, Yul-YulV	Yu1, Yu2, Yu4, Yu7-Yu9	Yu2
	Bajocian	NP5-NP9	Yu3		Yu1-Yu9	
	Aalenian	NP5-NP9				
LOWER JURASSIC	Toarcian					
	Pliensbachian	Yu2, Yu7	Yu2	Yu1-Yu3, Yu6, Yu7, Yu11, Yu12, Yul-YulV	Yu1, Yu2, Yu6	
	Sinemurian			(Yu1 listed as Lower-Upper Jurassic in only two fields)		
	Hettangian					
		F		YulV	M (undifferented Paleozoic) M3 & M11 (Up. & Mid. Devonian) M23 (Lower Devonian) S2 (Upper Silurian)	M (undifferentiated Paleozoic)
PALEOZOIC SYSTEM						

Notes: Apparent Russan alpha-numeric use for pay zone identifiers is to alpha-abbreviate names of formations, formation groups, series, or systems, then separate into numeric pay zones, analagous to formations and members.

Pay zones listed in between-age rows indicate age ranges (such as TP10 as Aptian-Albian age). The numbered pay zones increase with age (depth).

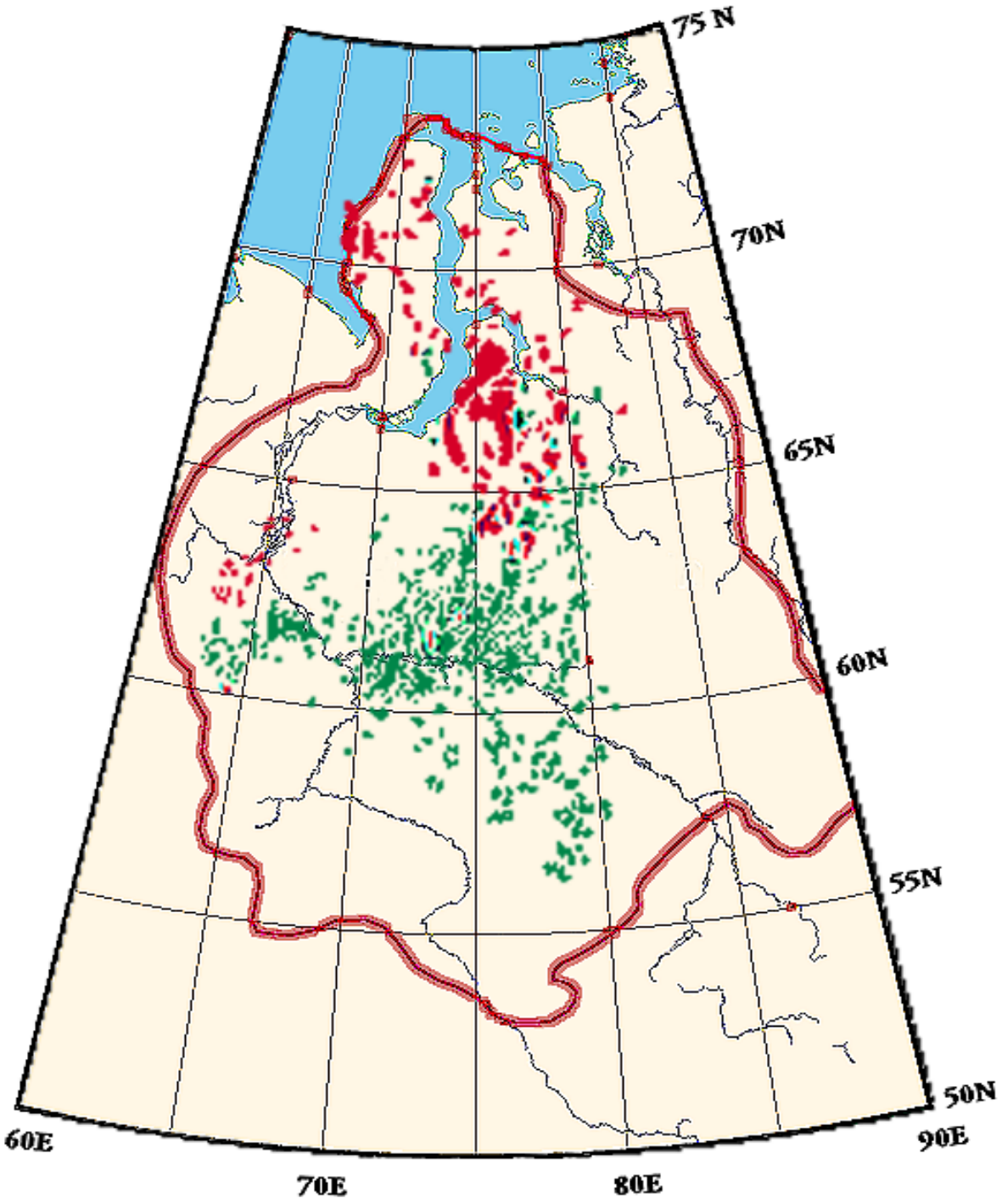
For Jurassic pay zones, the numbers in parentheses indicate further separations into sub-pay zones, again, increasing with age (depth). Other sub-pay zone designations are not listed, here.

Gazolinian and Achimov formations are not abbreviated and not differentiated into numerical pay zones, here. Most Jurassic (Yu) pay zones are not differentiated beyond series combinations (such as Lower-Middle Jurassic.

Partial abbreviations, various geologic units: M = "crust" (weathered paleosurface?); P = ? (P0-P3 in the Near-Ural is equivalent to Yu2 in other Regions; PK = Pokur formation; Yu = Jurassic System; Yu0 = Bazhenov Shale formation; Yu11-Yu12 = Sherkalin member (by many investigators).

Source: Extracted from reservoir-level listings in *Oil and Gas Fields of the USSR -- Volumn II,* edited by S.P. Maksimov, 1987.

Figure 3. Location of Oil and Gas Fields in the West Siberian Basin.



Source: Earth Science Associates, *Arlington, TX*.

3. Data Description

Available Data

Reservoir data were acquired from several published sources. Agreement was found between the data sources, suggesting a single original source. Where differences were noted, the most recent information was used. Differences in translation and nomenclature and additional development between reporting dates of data account for some data differences. Multiple discoveries combined into single fields as development progressed and fields combined under Regional geologic province names may also account for some duplication of information. Primary data sources are listed below.

> Oil and Gas Fields of the U.S.S.R. (In Russian), edited by S. P. Maksimov, 1987.
>
> *Gas and Condensate Fields - Reference Book* (in Russian), by I. P. Zhabrev, 1983.
>
> *Atlas of Key Hydrocarbon Basins of the Former Soviet Union,* Compiled by K. L. Talley, 1993.
>
> Field and reservoir data from Petroconsultants S.A., Geneva, Switzerland, August 1995.
>
> Conversation with G. Ulmishek, USGS, Denver, CO, 1997.

The West Siberian Basin's fields can be divided into three groups according to the available data. Most of the fields had very little data missing so few assumptions or data constructions were needed to develop an estimate of recoverable oil and gas. These fields represent 94 percent of the estimated discovered oil volume and 98 percent of the calculated discovered gas volume of the basin.

The second group had significant data missing for some fields but the available data were sufficient to apply correlations to estimate missing data. Little information was known about the third group of fields. Low confidence in the calculated oil or gas volume of these few fields resulted. Less than 0.02 percent of the estimated ultimate recovery falls in this low-confidence category.

Most of the reported reservoir parameter data were represented as reservoir averages. Ranges of data were reported for reservoirs within some fields. When a range of data was reported, an average value was used to represent the reservoir. Often, data used to represent a field was taken only from the discovery well. Calculated reserves were reported in data sources for some fields but were used only to compare with values calculated here.

As an indicator of data availability, the amount of available area, gross pay, net pay, porosity, and permeability data were calculated as a percentage of the number of reservoirs in each geologic interval (**Table 4**).

Estimated Data

Estimates of some reservoir data were necessary for all fields to accomplish volumetric calculations. The available data were sufficient to make reasonable engineering estimates of missing information. Except for reservoir temperature and pressure, those estimates were made within geologic intervals over common analogous areas. Graphical displays of data were used to visually evaluate the consistency or variations in the data. Details of the methods used in estimating data are reported in **Appendix B**.

A single linear function of depth was used to estimate unknown pressures in all Regions of the basin. A linear equation was developed for each of the four Areas of the basin to calculate reservoir temperature as a function of depth.

All other properties were determined within geographic boundaries described by Maksimov and combinations of geologic intervals described by Peterson and Clarke. Much of the data were reported for subdivisions of the major geologic intervals. Missing information was determined by averaging and analyzing data within major geologic intervals. Distributions of the data within the areal and geologic subdivisions of the basin were graphed and analyzed to evaluate consistency and to choose the best value to represent the combination of location with geologic interval.

Data Correlations

Reservoir fluid volume factors were determined using correlations programed for personal computer spreadsheet software[5]. The West Siberian Basin oil and gas characteristics presented no special problems in the determination of fluid properties. The oil is a medium to high API gravity and does not contain sufficient hydrogen sulfide or other impurities that would affect the use of correlations to determine fluid properties. The nonassociated gas is primarily methane without significant inert impurities or intermediate components. Correlations can be used to calculate solution gas-oil ratios and bubble point pressures that match available data and reservoir performance.

Some volumetric calculations could be in error using the reported field productive areas. Reported areas may be from seismic interpretations or exploration mapping. Many fields are not completely developed; therefore, areas are not accurately defined. Area data were reported as the total field areal extent, the area of the largest reservoir, or the area of each individual reservoir. Area data were not reported for some fields. A method, described in **Appendix B**, assigned an area to each individual reservoir in a field for the calculation of initial oil or gas in place.

More data for gross pay thickness were available than for net pay thickness data. A net-to-gross ratio was calculated when both net and gross data were known. The average net-to-gross ratio of a Region was used to estimate net pay when gross pay was reported. The net pay values that could not be calculated from gross pay were assumed to be equal to the average net pay of the Region.

Very little water saturation data were available. A correlation developed by Schlumberger[6] was used to calculate irreducible water saturation for each reservoir for which an average permeability was reported. The distribution of calculated water saturation was plotted to examine the results. The calculated water saturation for some combinations of parameters was outside the normal range of saturations anticipated for productive reservoirs. To screen out these values, the mode of the calculated saturations was used in the volumetric estimates of original oil and gas in place.

Porosity was the reservoir parameter most often available among those reservoir parameters used to calculate oil or gas in place. Missing porosity data were estimated from distribution graphs using the method described in **Appendix B**.

Table 4. Percentage of Reservoirs with Data Available within Major Geologic Intervals of the West Siberian Basin

Geologic Interval	Area	Gross Pay	Net Pay	Porosity	Permeability
Upper Cretaceous (All Areas)	92	98	57	74	68
Albian - Aptian (N)	89	100	24	52	39
Albian - Aptian (S)	79	91	30	76	73
Neocomian (N)	88	95	28	71	65
Neocomian (S)	77	95	42	80	77
Jurassic (N)	100	100	56	80	76
Jurassic (S)	95	99	68	99	95
Jurassic (W)	90	97	43	95	90
Jurassic (Middle Ob)	85	95	55	79	77
Triassic - Paleozoic (All Areas)	94	80	43	100	80

Note: N, S, W, and Middle Ob refer to the four Basin areas of **Table 2.**
Source: Energy Information Administration, Office of Oil and Gas.

4. Ultimate Recovery Determination

Methodology

Estimated ultimate recovery was determined for each reservoir within the discovered fields using the procedures described in **Appendix C.** The EUR represents the maximum expected recovery of oil or gas from a productive reservoir without regard for economic limitations. The methodology used can be applied to all fields in a consistent manner. The basic method requires a volumetric determination of original oil or gas in place. A recovery efficiency is then applied to determine the recoverable oil. For gas, an abandonment pressure is assumed for estimating the recovery efficiency. Recovery estimates are summed to produce a total EUR for each field. The average recovery efficiencies are reported for each Region of the basin in **Table 5.** Results are also tabulated by field producing status for oil and gas (**Tables 6 and 7**).

Table 5. Average Reservoir Recovery by Regions of the West Siberian Basin as a Percent of Original Oil or Gas in Place

Region	Primary Oil Recovery	Total Oil Recovery	NA Gas Recovery
Yamal	19.3	38.6	79.7
Gydan	16.8	33.6	78.2
Nadym-Pur	19.5	39.0	78.5
Pur-Taz	18.8	37.6	79.1
Frolov	15.3	30.6	77.8
Near Urals	18.3	36.3	61.4
Kaymysov	17.2	35.2	78.2
Vasyugan	18.8	37.6	79.3
Paydugin	19.2	38.4	79.5
Middle Ob	17.5	35.0	79.6
Average	18.1	36.2	77.1

Note: NA Gas is nonassociated gas.
Source: Energy Information Administration, Office of Oil and Gas.

Oil Recovery

Recovery from oil reservoirs was estimated for primary depletion and improved recovery efficiency. The total recovery was the sum of the estimated primary recovery with improved recovery volumes added based on the assumptions listed below.

Primary Recovery

Primary recovery averaged 18.1 percent of the original oil in place across the basin. Primary recovery is the sum of the recovery from the initial pressure to the bubble point pressure as calculated by fluid expansion and the recovery below the bubble point pressure calculated using a statistical correlation from the American Petroleum Institute (API).[7] This correlation is provided in **Appendix C.** Although the validity of this correlation is questionable, the results are within an expected range for the properties of the basin. The correlation provides a method that can be applied to account for reservoir property changes within the basin and to obtain consistent results across the basin.

Improved Recovery

Improved recovery assumed that all oil reservoirs would be subjected to improved recovery techniques (such as waterflooding) except those reservoirs below the Jurassic section or with permeabilities less than 10 millidarcys. Oil reservoirs within predominantly gas fields and reservoirs in the Bazhenov shale formation were also excluded. API statistical correlations for water drive recovery that assume full development and continuity within the reservoir, calculated an average ultimate recovery of 54.5 percent of the original oil in place. This calculated recovery was assumed not to be representative of recovery from an improved recovery project. Field recovery was reduced because of geographic and environmental limitations. Reservoir stratification and discontinuities were also assumed to reduce the recovery efficiency. The incremental improved oil recovery was reduced to a value equal to the calculated primary recovery in reservoirs that would be subject to an improved recovery process.

Recovery Efficiency

The average total oil recovery efficiency, including potential improved recovery, from fields in the basin was 36.2 percent of the original oil in place.

Producing Fields

The fields that are currently producing have an estimated original recoverable oil and condensate volume of approximately 115.1 billion barrels. No improved recovery oil was included for fields currently producing under primary depletion. Cumulative oil and condensate production through 1994 was 49.3 billion barrels leaving 65.8 billion barrels to be produced from fields that are currently producing.

Nonproducing Fields (Undeveloped)

The discovered fields that are not on production contain an estimated 51.0 billion barrels of recoverable oil and condensate. This value includes 20.6 billion barrels of oil added for potential improved oil recovery. Primary oil recoverable from discovered, nonproducing fields is estimated to be 30.4 billion barrels.

Discovered Fields

Total discovered ultimate recoverable oil and condensate in the basin are about 166.1 billion barrels. Subtracting cumulative production of 49.3 billion barrels of oil and condensate results in remaining reserves of all classes of 116.8 billion barrels. Assuming only primary recovery from nonproducing fields reduces the volume to 96.2 billion barrels. This volume includes five billion barrels of condensate to be produced with nonassociated gas. No probability of attaining the calculated recovery (risk) was applied to any of the estimates of discovered reserves. Therefore the range of recovery from discovered fields is 96.2 to 116.8 billion barrels.

Undiscovered Resources

Undiscovered resources are the mean value of the USGS[8] assessment of undiscovered oil and condensate totaling 52.4 billion barrels. Two billion barrels discovered since the estimate was made in 1993, which are included in the current database of discovered oil, have been subtracted from the estimate of undiscovered resources.

Remaining Resources

Adding the undiscovered resources to the discovered EUR yields a maximum remaining future potential for the basin of between 146.6 and 167.2 billion barrels of oil and condensate to be discovered, developed, and produced. The original resources of the basin were estimated to be 216.5 billion barrels of oil and condensate.

Gas Recovery

Estimated ultimate recovery for gas reservoirs was calculated from an initial pressure to an abandonment pressure of 0.1 psi per foot of depth to the reservoir. This does not represent an economic limit but serves as a consistent lower pressure limit applied across the basin. Calculated recoveries range from 61.4 percent to 79.9 percent of the initial gas in place **(Table 7)**.

Producing Fields

Fields that are producing contained estimated ultimate recoverable gas of 765 trillion cubic feet of gas. Of this total, nonassociated gas fields account for 711 trillion cubic feet and associated-dissolved gas from oil reservoirs accounts for 54 trillion cubic feet. The remaining estimated gas reserves of fields that are currently producing are 551 trillion cubic feet after subtracting 214 trillion cubic feet of produced gas.

Nonproducing Fields (Undeveloped)

Discovered, undeveloped reservoirs contain 341 trillion cubic feet of recoverable gas to be developed and produced. Of this volume, 322 trillion cubic feet are in nonassociated gas reservoirs and 19 trillion cubic feet are associated-dissolved gas in undeveloped oil fields.

Discovered Fields

The total discovered EUR gas, including 73 trillion cubic feet of associated-dissolved (AD) gas from oil reservoirs and 1,033 trillion cubic feet of nonassociated (NA) or gas well gas, are 1,106 trillion cubic feet. Subtracting cumulative gas production of 214 trillion cubic feet through 1993 from the total leaves 892 trillion cubic feet to be recovered from discovered reservoirs. The volume does not include gas from the Leningradskoye and Rusanovskoye fields in the Kara Sea. Other sources estimate recovery potential of between 85 and 282 trillion cubic feet from these two fields. Sufficient information was not available to make an independent estimate of these offshore discoveries; they are included only as a comment.

Undiscovered Resources

A statistical mean value of undiscovered nonassociated gas resources of 1,090 trillion cubic feet was estimated by the USGS as of 1993. The current data base includes six trillion cubic feet of gas discovered after 1993. The remaining undiscovered resources therefore are 1,084 trillion cubic feet.

Remaining Resources

Future gas potential in the basin is 1,975 trillion cubic feet, the sum of the remaining recoverable discovered gas and the USGS mean estimate of undiscovered gas. The original gas resource potential of the basin is estimated to be 2,189 trillion cubic feet. No probability of occurrence or risk was applied to the estimates of the discovered gas volume.

Condensate Recovery

Ultimate condensate recovery was calculated for those gas fields where the liquid content of the produced gas was reported. A volume of five billion barrels from the fields that are on production was calculated. The USGS estimate of undiscovered resources includes four billion barrels of condensate. Reported production of oil includes condensate; therefore, the estimated volume of condensate was added to the oil volume in this analysis.

Table 6. Estimated Oil and Condensate Resources in the West Siberian Basin, End of 1994 (Billion Barrels)

Resource Description	Total Recovery	Remaining Recovery
Discovered		
Producing Fields		
Primary Producing Fields	13.8	-
Improved Recovery Producing Fields	96.3	-
Condensate	5.0	-
Subtotal	115.1	65.8
Nonproducing Fields		
Primary Recovery	30.4	-
Potential Improved Recovery	20.6	-
Subtotal	51.0	
Total Discovered	166.1	116.8
Undiscovered		
Oil	46.4	-
Condensate	4.0	-
Total Undiscovered	50.4	50.4
Total Basin Resources	216.5	167.2
Cumulative Production	-49.3	

Note: Original USGS estimates of undiscovered oil and condensate were 52.4 billion barrels. The database of discovered fields includes two billion barrels discovered since the USGS estimate.

Sources: Discovered - Energy Information Administration, Office of Oil and Gas
Undiscovered - U. S. Geological Survey, "Estimated Petroleum Resources in the Former Soviet Union," G. Ulmishek and C. Masters, Open-File Report 93-316, March 1993, Denver, Colorado.

Table 7. Estimated Natural Gas Resources in the West Siberian Basin, End of 1993 (Trillion Cubic Feet)

Resource Description	Total Recovery	Remaining Recovery
Discovered		
Producing Fields		
Nonassociated	711	-
Associated-Dissolved	54	-
Subtotal	765	551
Nonproducing Fields		
Nonassociated	322	-
Associated-Dissolved	19	-
Subtotal	341	
Total Discovered	1,106	892
Undiscovered	1,084	-
Total Basin	2,189	1,975
Cumulative Production	-214	

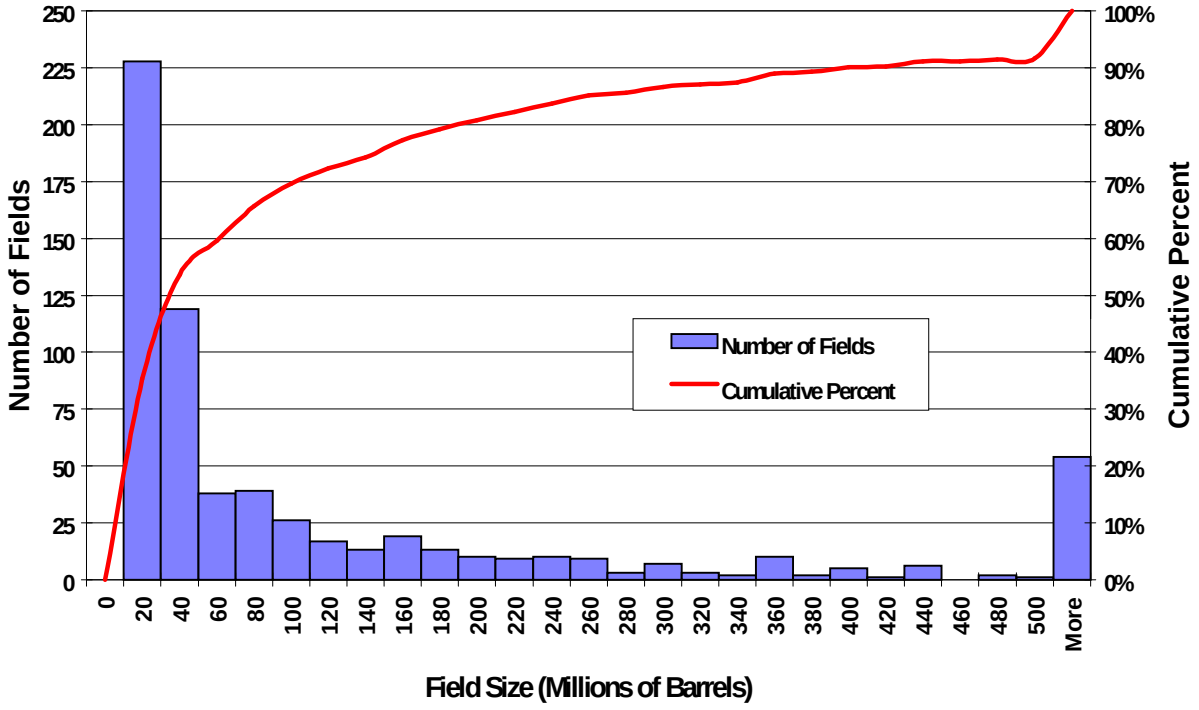
Note: Original USGS estimate of undiscovered gas was 1090 trillion cubic feet. Discovered database includes 6 trillion cubic feet discovered since estimate.

Source: Discovered - Energy Information Administration, Office of Oil and Gas, Undiscovered - U. S. Geological Survey, "Estimated Petroleum Resources in the Former Soviet Union," G. Ulmishek and C. Masters, Open-File Report 93-316, March 1993, Denver, Colorado.

Field Size Distribution

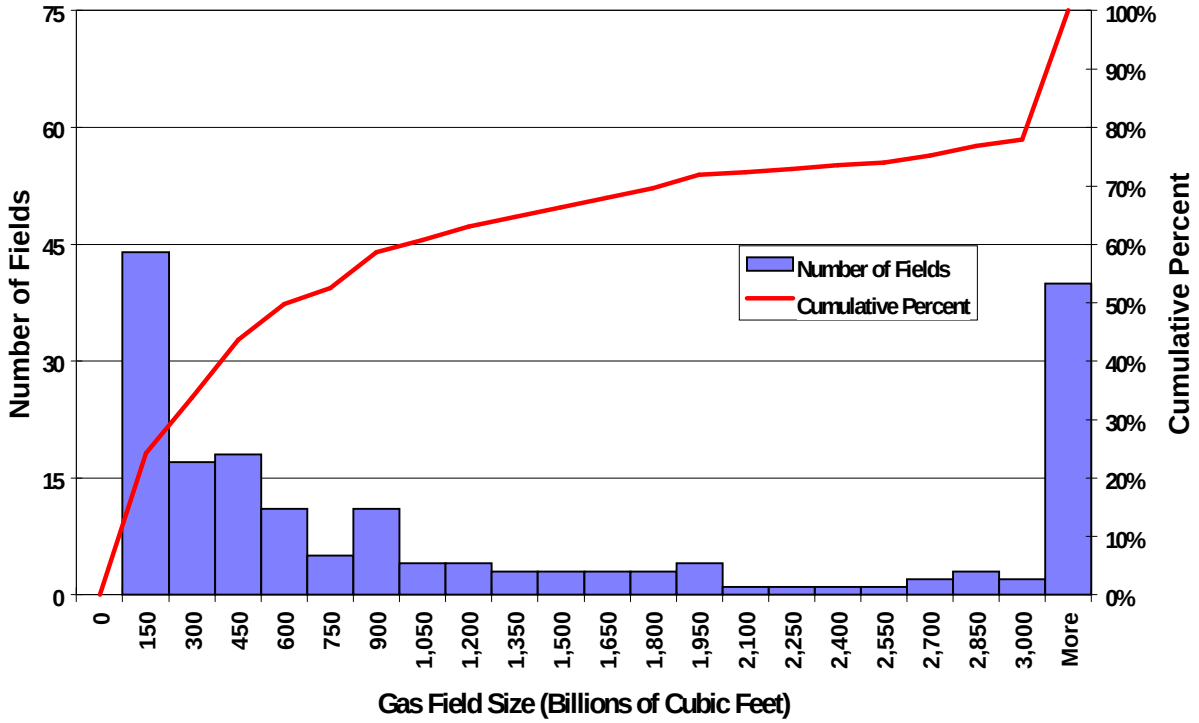
The average field size in the basin is 248 million barrels for oil fields and 5.3 trillion cubic feet for nonassociated gas fields. The giant fields of the basin cause the average to be much larger than the mode of the field size distribution. Giant fields, defined as those that contain more than 500 million barrels of recoverable oil or the equivalent in gas (roughly 3 trillion cubic feet). Although the potential exist to discover additional giant fields, many smaller fields that are included in this analysis may not be developed for economic reasons. The field size distributions (**Figures 4 and 5**) show a mode of approximately 25 million barrels or 400 billion cubic feet of recoverable oil or gas.

Figure 4. Crude Oil Field Size Distribution for Discovered Fields, West Siberian Basin.



Source: Energy Information Administration, Office of Oil and Gas.

Figure 5. Gas Field Size Distribution for Discovered Fields, West Siberian Basin.



Source: Energy Information Administration, Office of Oil and Gas.

Geographic Distribution

The estimated recovery for each Region in the basin is tabulated in **Table 8**. Totals for each Area are also presented. The field summaries tabulated in **Appendix D** are sorted alphabetically. Also included are tabulations of the field data by Regions of the basin. The information includes field location, discovery date, production status, and primary product. The complete data base and the calculated results for each reservoir are available on a computer diskette in a self-extracting spreadsheet file. To obtain a copy, contact the **EIA Dallas Field Office at (214) 720-6150.**

Table 8. Discovered Oil and Gas by Region and Area, West Siberian Basin (Million Barrels Oil and Condensate; Billion Cubic Feet Gas)

Region	Number of Fields		Ultimate Recovery		Ultimate Recovery	
Area	Oil	Gas	Oil	AD Gas	NA Gas	Condensate
Yamal	0	27	141	35	194,998	590
Gydan	2	22	282	221	71,419	52
Nadym-Pur	58	29	28,170	23,022	581,721	2,742
Pur-Taz	34	20	11,973	5,908	152,278	1,057
North Area	94	98	40,566	28,965	1,000,416	4,441
Frolov	59	7	10,505	3,045	1,286	16
Near Urals	65	25	2,733	1,080	6,119	67
West Area	124	32	13,238	4,125	7,405	83
Kaymysov	73	3	4,812	4,489	3,663	78
Vasyugan	61	6	3,919	2,155	14,153	334
Paydugin	6	4	349	92	840	21
South Area	140	13	9,080	6,736	18,656	433
Middle Ob	263	2	98,227	33,160	6,720	61
Unknown	13	2	26	13	30	0
Total Basin	634	147	161,137	73,220	1,033,227	5,017

Note: AD Gas is associated-dissolved gas and NA Gas is nonassociated gas.
Source: Energy Information Administration, Office of Oil and Gas.

5. Production Projections

Future Discoveries

In 1993, the USGS mean estimate of the undiscovered oil and gas resources of the West Siberian basin were 52.4 billion barrels of oil and condensate and 1,090 trillion cubic feet of gas. Condensate included was four billion barrels. Most of this additional supply will likely be found in stratigraphic traps and structures smaller than those currently known. Some new production will come from less productive and deeper reservoirs. Adding these amounts (adjusted for discoveries after 1993) to the estimated amounts discovered provides the resources for the basin of 216 billion barrels of oil and condensate and 2,189 trillion cubic feet of gas. Subtracting production leaves 167 billion barrels and 1,975 trillion cubic feet to be produced, developed, and discovered.

To project a schedule of the future discoveries, a modified method of Dr. M. King Hubbert[9] was used, utilizing a modified logistic function developed by the EIA.[10] EUR discovered oil and gas plotted at the date of discovery with an end point equal to the total basin resources are fit[11] with the logistic function (**Figures 6 and 7**). The function obtained by the curve fit was then used to schedule future discoveries for the amount of the basin resources. The total basin recovery used in the calculation was the sum of the EIA estimate of discovered fields and the USGS estimate of undiscovered resources.

Future Production

Theory suggests that production should follow discoveries with an appropriate time lag for development. Production in the West Siberian basin has not followed this model because of the remote arctic environment and unique problems associated with Russian development practices (full field delineation before beginning production development). Another method, described in **Appendix C**, was therefore developed to project future production. A declining ratio of the remaining EUR divided by the annual production (R/P ratio) was used to schedule production based on the discovery schedule developed using the logistic function.

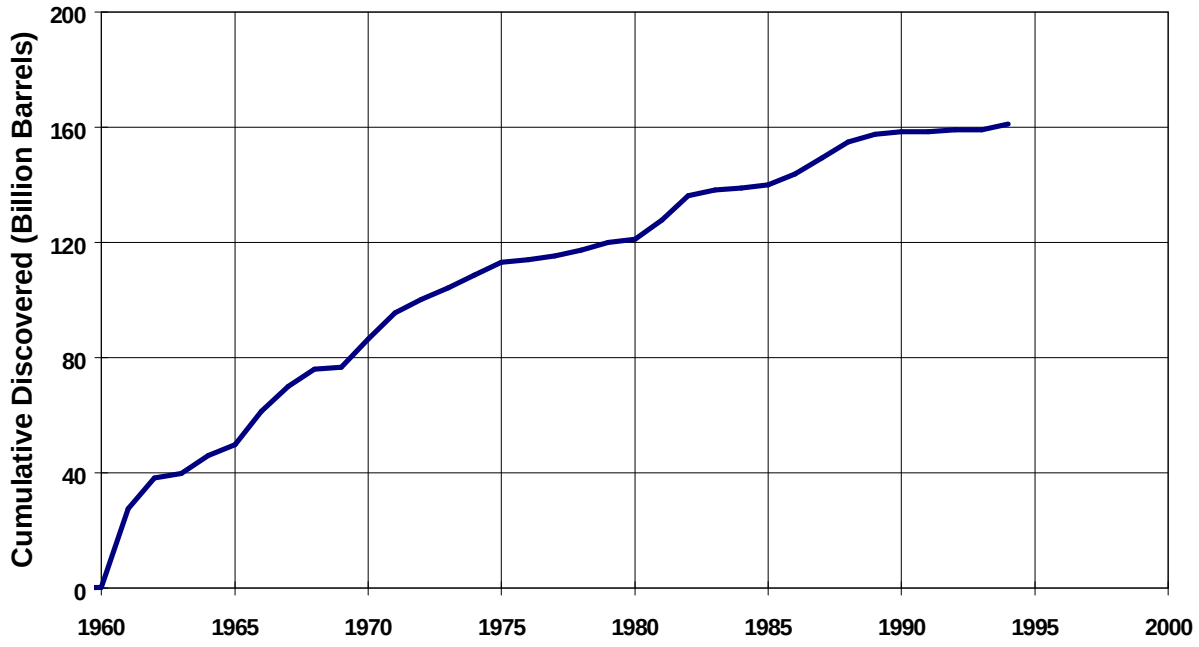
Oil and Condensate

The oil resources in the basin should support production greater than the production rate that existed before the decline that began in 1988 (from 3.1 to 1.5 billion barrels per year or 8.5 to 4.1 million barrels per day in 1994). A theoretical peak annual production rate of 4.1 billion barrels per year (11.2 million barrels per day) was calculated to be possible in the years 2006 to 2009 before a decline begins (**Figure 8**). Three forecast cases were projected to show the range of production potential beginning at the 1994 annual rate of 1.46 billion barrels (**Figures 9 and 10**).

The most severe case *(Continued Decline Case)* assumes that production continues to decline at the recent rate of 16 percent per year to 100 million barrels (MMbbls) in the year 2010. Remaining recovery would be less than 10 billion barrels. This is less than, but approximates, the remaining estimated primary recovery of 15 billion barrels in the fields that are currently producing. As depletion occurs, the decline of the producing rate could decrease or become hyperbolic, extending the producing life, and approaching the 15 billion barrel estimate.

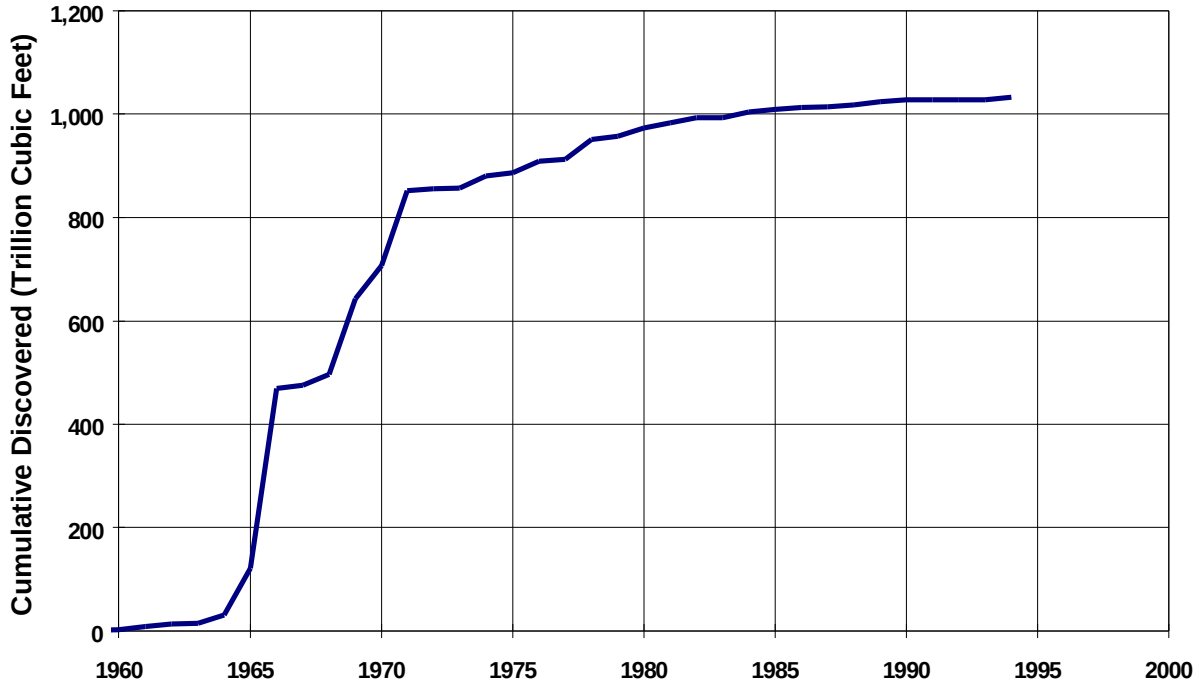
A second case *(No New Discoveries Case)* assumes that oil production can be stabilized at the current rate for a period of time and will then decline at the theoretical rate to a recovery of the remaining 96.2 billion barrels from discovered fields. Only primary recovery of 30.4 billion barrels from nonproducing fields was considered. No additional discoveries would occur. In this case, the current rate of approximately 1.46 billion barrels per year (4.0 million barrels per day) could be maintained until the year 2051 before the decline begins.

Figure 6. Cumulative Discovered Crude Oil, West Siberian Basin



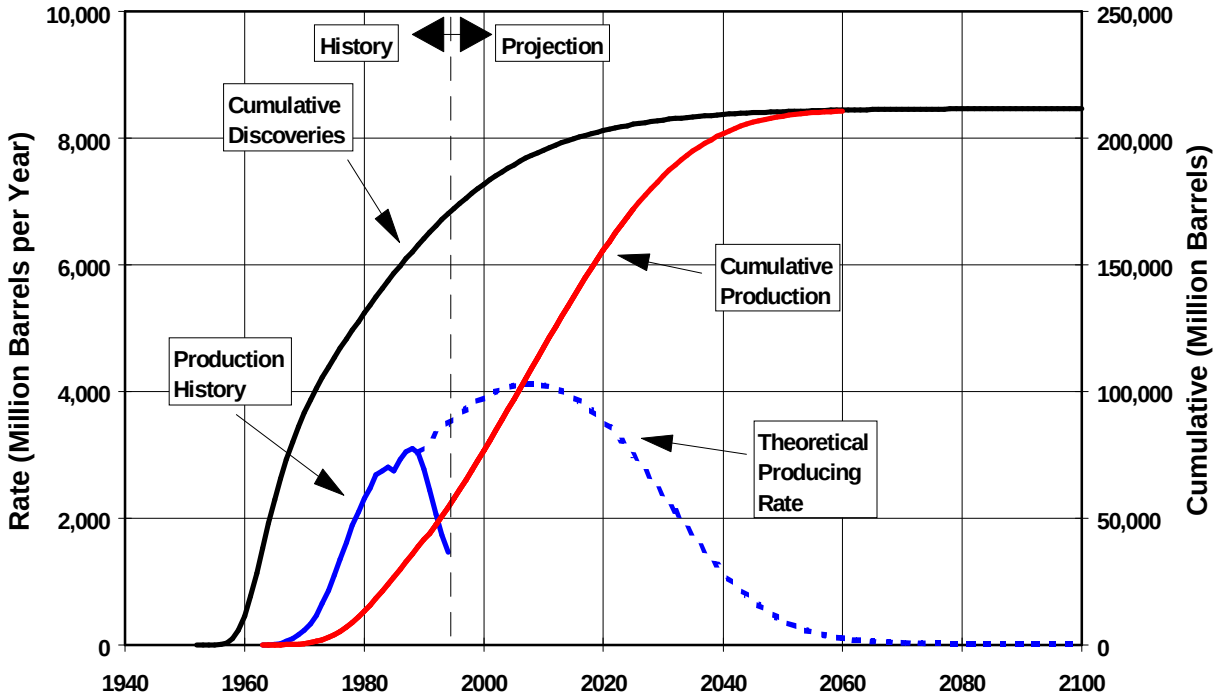
Source: Energy Information Administration, Office of Oil and Gas

Figure 7. Cumulative Discovered Natural Gas, West Siberian Basin



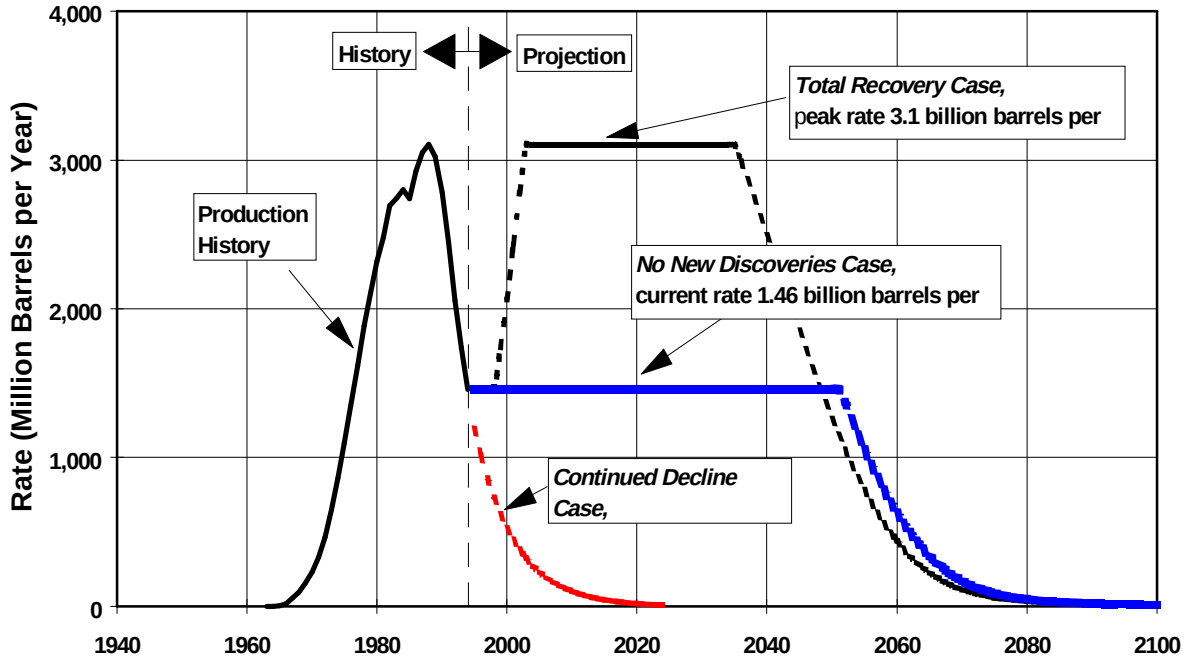
Source: Energy Information Administration, Office of Oil and Gas.

Figure 8. Total Oil and Condensate Discoveries and Theoretical Production, West Siberian Basin



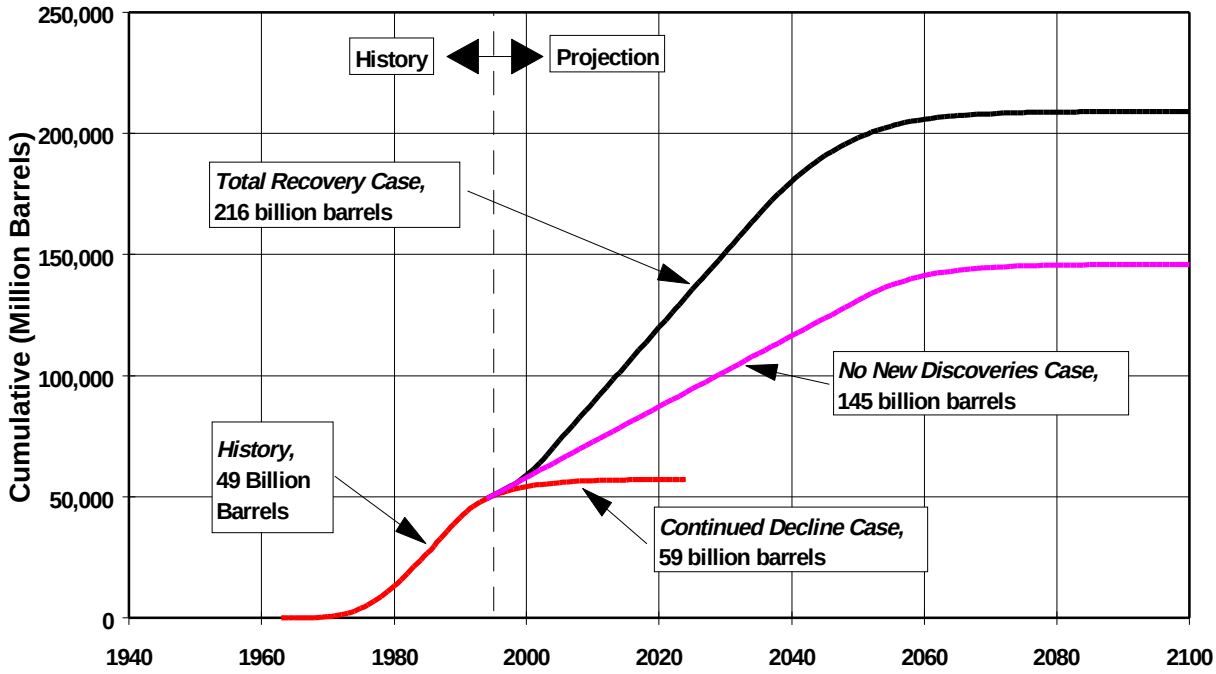
Source: Energy Information Administration, Office of Oil and Gas.

Figure 9. Projected Oil Production, West Siberian Basin



Source: Energy Information Administration, Office of Oil and Gas.

Figure 10. Projected Cumulative Oil and Condensate Production, West Siberian Basin



Source: Energy Information Administration, Office of Oil and Gas.

The third case *(Total Recovery Case)* assumes exploration and development return to higher levels and cause production to increase to the historical peak rate of 3.1 billion barrels (8.5 million barrels per day) produced in 1988. To reach this peak rate, it is assumed that the current oil production rate would be maintained through the year 1998 and production would then increase over the next five years to the peak rate. Production is then maintained at 3.1 billion barrels per year until the cumulative production plus the amount produced on decline from 3.1 billion barrels per year is equal to the remaining recoverable resource of 167.2 billion barrels. The result is total recovery of 216.5 billion barrels from the basin.

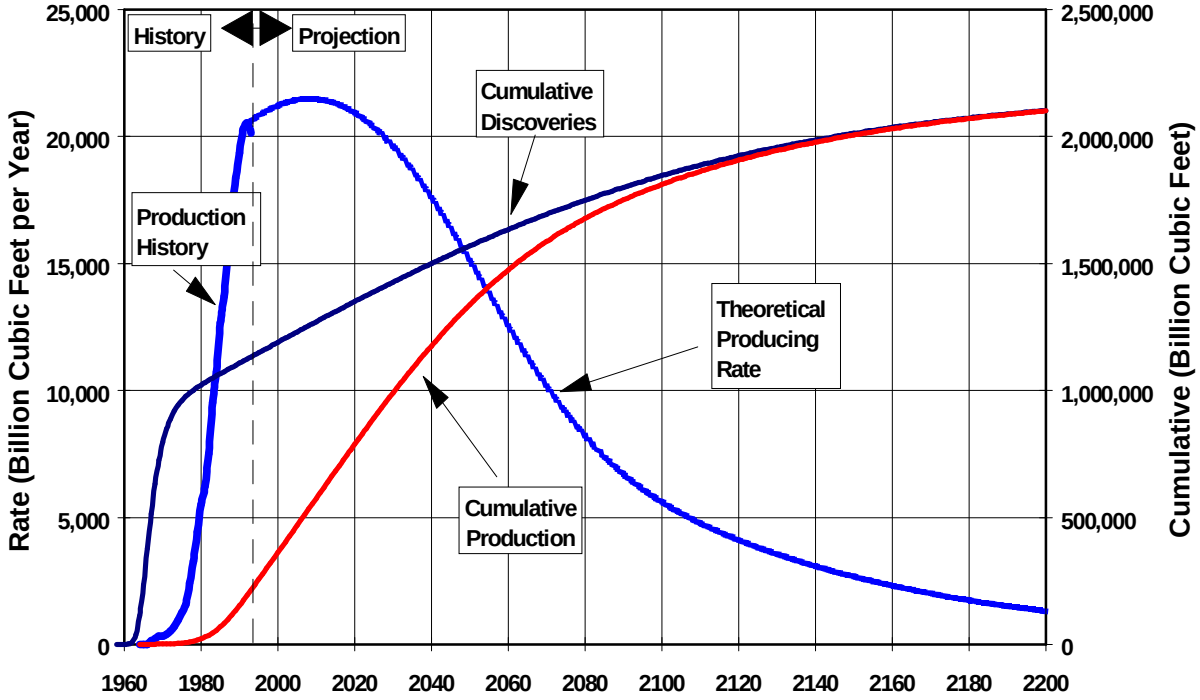
Gas

Total recoverable gas was estimated to be about 2,189 trillion cubic feet with peak production of approximately 24 trillion cubic feet per year (65.8 billion cubic feet per day) in the years 2012 to 2019 (**Figure 11**). Estimates of gas volume development and production were calculated by using the same method as for oil. The estimates are from the cumulative discoveries curve calculated by using the logistic function and production is based on an assumed decline of the R/P ratio. Gas production has declined since 1992, probably as a result of reduced development activity influenced by the changes that have occurred in Russia since the breakup of the Soviet Union.

Two projections were made to examine potential gas production from the basin. One case *(No New Discoveries Case)* assumed no additional discoveries and remaining potential of 892 trillion cubic feet, the remaining EUR of the discovered fields. Production was declined at the rate of the theoretical production schedule to depletion in approximately 75 years.

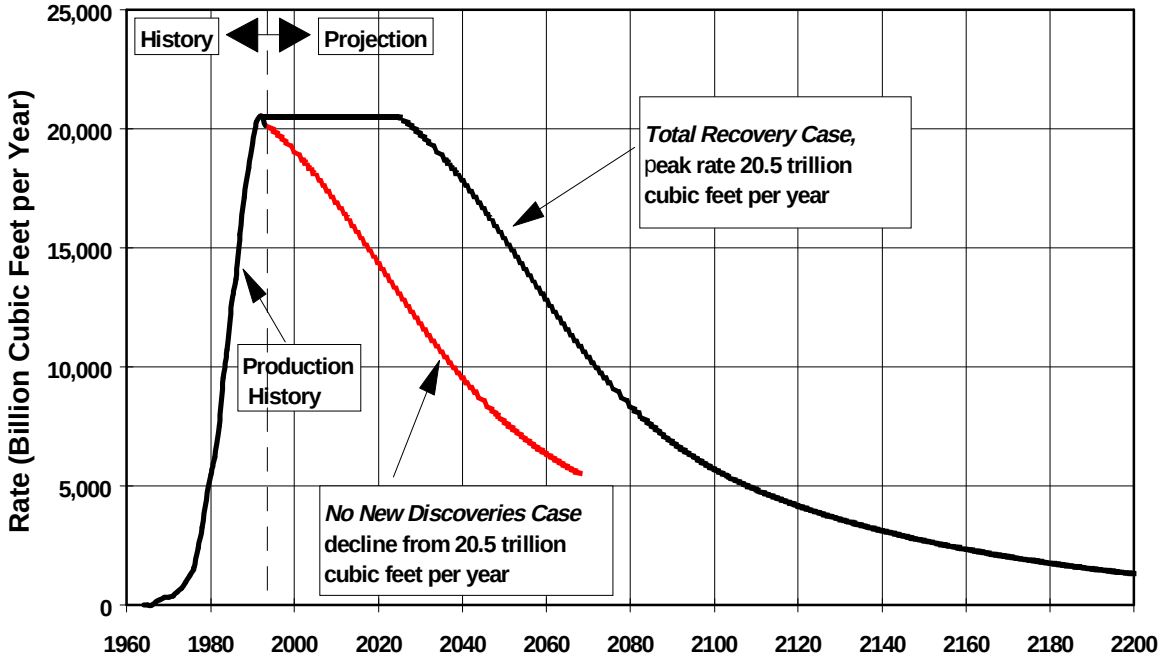
The second case (*Total recovery Case)* assumed full development of the basin's estimated remaining producible gas of 1,975 trillion cubic feet. The peak historical rate of 20.5 trillion cubic feet per year (56.2 billion cubic feet per day), attained in 1992, was maintained until the cumulative production plus the production from the decline portion of the theoretical projection equaled the total gas resource of the basin of 2,189 trillion cubic feet. In this case, the peak rate could be maintained for 32 years before decline begins (**Figures 12 and 13**).

Figure 11. Ultimate Gas Discoveries and Theoretical Production, West Siberian Basin



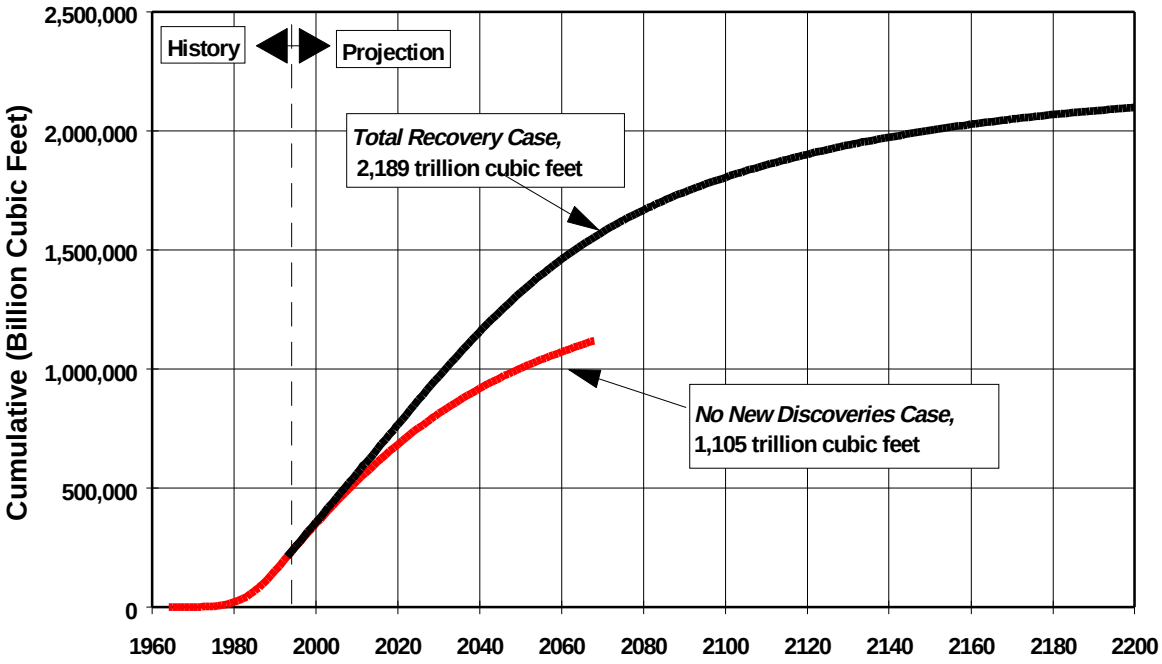
Source: Energy information Administration, Office of Oil and Gas.

Figure 12. Projected Gas Production, West Siberian Basin



Source: Energy Information Administration, Office of Oil and Gas.

Figure 13. Projected Gas Cumulative Production, West Siberian Basin



Source: Energy Information Administration, Office of Oil and Gas.

6. Summary

The largest oil and gas producing province by area and resources in the former Soviet Union is in western Siberia. The West Siberian Basin is also one of the largest in the world. The geographic location of the basin north of 52 degrees north latitude and the topography of gently sloping lowlands of permafrost and extensive swamps cause significant operational problems.

Oil production from the basin has declined from approximately 3.1 billion barrels in 1988 to 1.5 billion barrels in 1994 (8.5 to 4.1 million barrels per day), and gas production has declined from 22.6 trillion cubic feet of gas in 1991 to 21.9 trillion cubic feet in 1993 (61.9 to 60.0 billion cubic feet per day). Cumulative production was 49.3 billion barrels of oil through 1994 and 214 trillion cubic feet of gas through 1993. Production data by individual field are not complete or reliable; therefore, oil and gas recoveries were calculated by volumetric methods.

A database was constructed containing all available information necessary to calculate reserves volumetrically for 634 oil fields and 147 gas fields with over 1,500 separate reservoirs. Missing data were imputed based on information from similar or nearby geologic intervals. The estimated ultimate recovery (EUR) was calculated for each reservoir identified as productive and summed to a field totals. The EUR can not be compared to U.S. Reserves that are defined as economically recoverable since economic parameters were not considered in this analysis. The EUR therefore, represents a maximum potential for the basin. To achieve this potential would require full development of all identified fields and the application of the latest available technology. Undiscovered resources were estimated by the USGS. The undiscovered volume was added to the estimated ultimate recoverable volumes of individual fields to yield a total basin resource.

Of the 166.1 billion barrels of oil and condensate discovered through 1994, 115.1 billion barrels are in producing fields and 51.0 billion barrels are in fields to be developed. Subtracting the 49.3 billion barrels of production from the EUR of the producing fields yields remaining EUR of 65.8 billion barrels of oil and condensate. Estimated ultimate recovery in undeveloped fields ranges from 30.4 billion barrels of primary oil to 51.0 billion barrels of oil including improved recovery potential.

The mean estimate of the undiscovered oil and condensate is reported as 50.4 billion barrels by the USGS. Estimate of ultimate basin resources is 216.5 billion barrels of oil and condensate with between 146.6 and 167.2 billion barrels remaining to be discovered, developed, and produced after 1994.

The natural gas discovered through 1993 was 1,106 trillion cubic feet. Producing fields contained 765 trillion cubic feet of EUR with nonproducing fields containing 341 trillion cubic feet of EUR to be developed. Remaining recoverable gas is 551 trillion cubic feet in producing fields after subtracting 214 trillion cubic feet of cumulative production. Adding 341 trillion cubic feet in discovered, undeveloped fields sums to 892 trillion cubic feet of remaining, discovered EUR gas. The mean estimate of undiscovered gas resources reported by the USGS is 1,084 trillion cubic feet. The basin's total original gas resources are therefore 2,189 trillion cubic feet with 1,975 trillion cubic feet remaining to be discovered, developed, and produced after 1993.

The average field size in the basin is 248 million barrels of oil or 5.3 trillion cubic feet of gas. The averages are influenced by the very large fields in the basin. The most likely field size is 25 million barrels of oil or 400 billion cubic feet of gas. Economic conditions will influence the development of the smaller fields.

Discovered oil volumes are sufficient to maintain the current production rate of approximately 1.5 billion barrels per year (4.1 million barrels per day) for over 50 years before production begins to decline. If developed, total resources of the basin are sufficient to maintain the historical peak rate of 3.1 billion barrels per year (8.5 million barrels per day) for over 35 years before decline begins. Gas production could be maintained for over 30 years at approximately 21 trillion cubic feet per year supported by the remaining gas resources of the basin.

These production projections are limited scenarios with many variables not considered. However, this analysis

shows the potential of the West Siberian Basin as a significant future producer of oil and gas if maintenance and development of the resources continues. The production decline of the past several years is the result of reduced development and maintenance indicating that only a fraction of the potential resources would be recovered if development and exploration in the basin were to cease.

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