OCS Report
MMS 2001-087

2000 Assessment of Conventionally Recoverable Hydrocarbon Resources of the Gulf of Mexico and Atlantic Outer Continental Shelf as of January 1, 1999

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New Orleans
October 2001

Summary

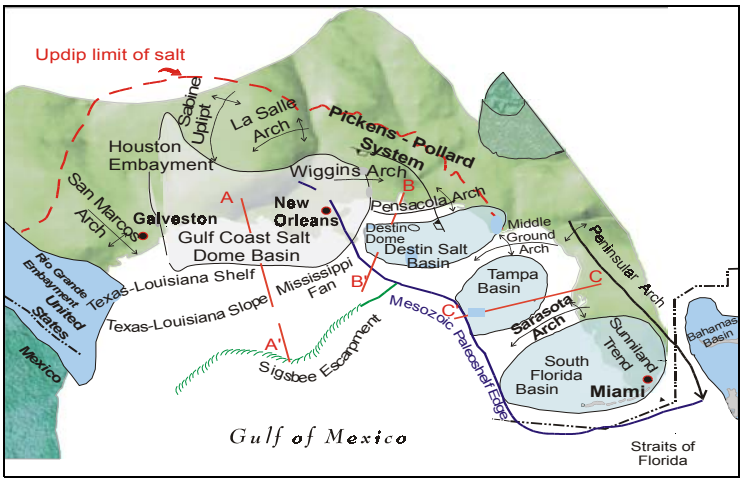

Figure 1. Physiographic map of the northern Gulf of Mexico Outer Continental Shelf.

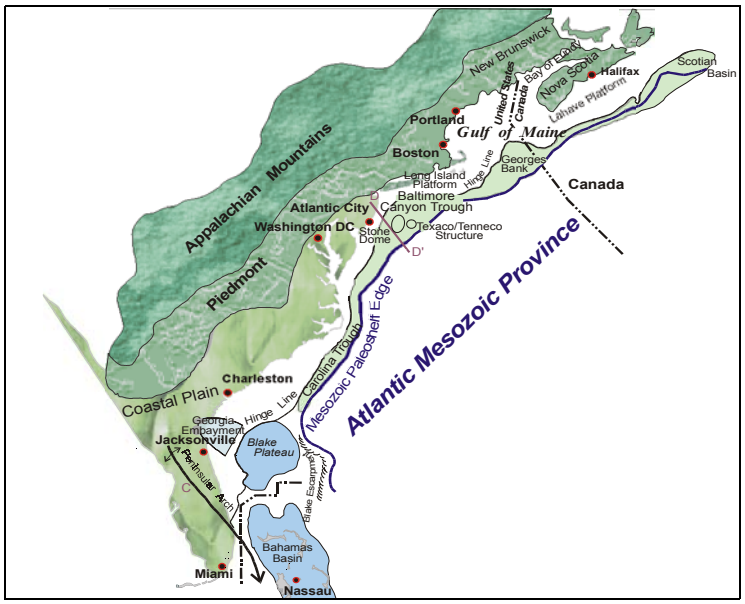

Figure 2. Physiographic map of the U.S. Atlantic Outer Continental Shelf.

Report Description

This report presents the results of the 2000 assessment of the conventionally recoverable hydrocarbon resources for the northern Gulf of Mexico and U.S. Atlantic Outer Continental Shelf (OCS) (figures 1 and 2). Conventionally recoverable resources are hydrocarbons potentially amenable to conventional production regardless of the size, accessibility, and economics of the accumulations assessed. The OCS comprises the portion of the seabed of the United States whose mineral estate is subject to Federal jurisdiction. The Minerals Management Service (MMS) and the U.S. Geological Survey have previously completed several assessments of the undiscovered conventionally recoverable oil and gas resources of the United States OCS. This 2000 assessment considered data and information available as of January 1, 1999.

Introduction

Worldwide reliance on petroleum resources will continue for decades to be the principal means to satisfy future energy demand. Petroleum resources are usually considered as finite since they do not renew at a rate remotely approaching their consumption. Since petroleum also fuels the Nation's economy, there is considerable interest in the magnitude of the resource base from which future domestic discoveries and production will occur.

Resource estimates are just that— estimates. All methods of assessing potential quantities of conventionally recoverable resources are efforts in quantifying a value that will not be reliably known until the resource is nearly depleted. Thus, there is considerable uncertainty intrinsic to any estimate. Scientists can generate estimates of conventionally recoverable resources on the basis of current geologic, engineer-

Gulf of Mexico Region Marginal Probability = 1.00	Number of Pools	Oil (Bbbl)	Gas (Tcf)	BOE (Bbbl)
Reserves				
Original proved	2369	14.266	162.711	43.218
Cumulative production	--	10.908	132.677	34.515
Remaining proved	--	3.358	30.034	8.703
Unproved	84	0.995	5.102	1.903
Appreciation (P & U)	--	7.736	68.096	19.853
Undiscovered Conventionally Recoverable Resources				
95th percentile	--	22.821	145.088	49.851
Mean	2870	37.126	191.627	71.223
5th percentile	--	56.054	246.600	97.602
Total Endowment				
95th percentile	--	45.818	380.998	114.825
Mean	5323	60.123	427.537	136.197
5th percentile	--	79.051	482.510	162.576

Table 1. Assessment results for reserves, undiscovered conventionally recoverable resources, and total endowment of the Gulf of Mexico Region.

Atlantic Region Marginal Probability = 1.00	Number of Pools	Oil (Bbbl)	Gas (Tcf)	BOE (Bbbl)
Reserves				
Original proved	0	0.000	0.000	0.000
Cumulative production	--	0.000	0.000	0.000
Remaining proved	--	0.000	0.000	0.000
Unproved	0	0.000	0.000	0.000
Appreciation (P & U)	0	0.000	0.000	0.000
Undiscovered Conventionally Recoverable Resources				
95th percentile	--	1.207	16.117	4.558
Mean	502	2.307	27.712	7.238
5th percentile	--	3.706	43.499	10.739
Total Endowment				
95th percentile	--	1.207	16.117	4.558
Mean	502	2.307	27.712	7.238
5th percentile	--	3.706	43.499	10.739

Table 2. Assessment results for reserves, undiscovered conventionally recoverable resources, and total endowment for the Atlantic Region.

ing, and economic knowledge and a consideration of future conditions. The estimates incorporate uncertainty, but they cannot account for the unforeseen or serendipity. As such, resource estimates should be used as general indicators and not predictors of absolute volumes. In spite of this inherent uncertainty, resource assessments are valuable input to developing energy policy and in corporate planning (e.g., ranking exploration opportunities, performing economic analyses, and assessing technology and capital needs).

Hydrocarbon resource assessments have been performed by geologists, statisticians, and economists for decades. For these assessments to be used effectively, a knowledge of the terminology, commodities, regions assessed, methodology, and statistical reporting conventions is essential. Much of the confusion attending the use of published petroleum resource and reserve estimates is the result of misunderstanding or inappropriately interchanging the data and terminology. An ideal basis for the inevitable comparisons among assessments does not exist.

The petroleum commodities assessed in this study are crude oil, natural gas liquids (condensate), and natural gas that exist in conventional reservoirs and are producible with conventional recovery techniques. The volumetric estimates of oil resources reported represent combined volumes of crude oil and condensate. In developing these estimates, it was necessary to make fundamental assumptions regarding future technology and economics. The inability to predict the magnitude and effect of these factors accurately introduces additional uncertainty to the resource assessment. Although not considered in this report, the continued expansion of the technologic frontiers can be reasonably assumed to partially mitigate the impacts of a lower quality remaining resource base (i.e., smaller pool sizes, less concentrated accumulations, more

GOM Region (Total of All Water Depths)				
Undiscovered Economically Recoverable Resources	**Marginal Probability**	**Oil (Bbbl)**	**Gas (Tcf)**	**BOE (Bbbl)**
$18.00/bbl and $2.11/Mcf				
Full-Cycle	1.00			
95th percentile		13.968	84.530	29.009
Mean		17.467	100.260	35.307
5th percentile		21.851	114.075	42.149
Half-Cycle	1.00			
95th percentile		14.905	90.434	30.996
Mean		18.569	105.167	37.282
5th percentile		23.073	118.912	44.232
$30.00/bbl and $3.52/Mcf				
Full-Cycle	1.00			
95th percentile		24.749	129.389	47.772
Mean		28.134	140.731	53.175
5th percentile		34.749	151.929	61.783
Half-Cycle	1.00			
95th percentile		25.171	133.790	48.977
Mean		28.811	143.986	54.431
5th percentile		35.643	155.311	63.278

Table 3. Undiscovered economically recoverable resources of the Gulf of Mexico Region.

Atlantic Region (Total of All Water Depths)				
Undiscovered Economically Recoverable Resources	**Marginal Probability**	**Oil (Bbbl)**	**Gas (Tcf)**	**BOE (Bbbl)**
$18.00/bbl and $2.11/Mcf				
Full-Cycle	1.00			
95th percentile		0.216	2.325	0.630
Mean		0.530	6.649	1.713
5th percentile		1.067	12.546	3.300
Half-Cycle	1.00			
95th percentile		0.280	3.059	0.824
Mean		0.602	7.310	1.903
5th percentile		1.178	13.280	3.541
$30.00/bbl and $3.52/Mcf				
Full-Cycle	1.00			
95th percentile		0.823	7.939	2.235
Mean		1.338	12.780	3.612
5th percentile		1.920	19.205	5.338
Half-Cycle	1.00			
95th percentile		1.044	10.100	2.842
Mean		1.570	14.875	4.216
5th percentile		2.011	21.847	5.898

Table 4. Undiscovered economically recoverable resources of the Atlantic Region.

remote locations) and less favorable economic conditions.

In this assessment, the Atlantic and Gulf of Mexico Continental Margin was divided into two regions and three provinces, which included 103 plays. Because of the inherent uncertainties associated with an assessment of undiscovered resources, probabilistic techniques were employed and the results reported as a range of values corresponding to different probabilities of occurrence. A good resource assessment model must appropriately express the effect of the various geologic, technologic, and economic forces that impact a forecast of quantities of undiscovered conventionally or economically recoverable resources. This resource assessment used the same play analysis approach as used for the 1995 assessment (Lore *et al*., 1999), which represented a major change from the procedures used by MMS for earlier assessments (Cooke, 1985; Cooke and Dellagiarino, 1990). A major strength of the current method is that it has a strong relationship between information derived from oil and gas exploration activities and the geologic model developed by the assessment team. An extensive effort was involved in defining plays, in delineating the geographic limits of each play, and in compiling data on critical geologic and reservoir engineering parameters (Hunt and Burgess, 1995; Seni *et al.*, 1997; Hentz *et al.*, 1997). These parameters were critical input in the determination of the total quantities of recoverable resources in each play. The basic assumption employed in this assessment was that the distribution of individual pool sizes for accumulations in a play is characteristically lognormal.

A significant aspect of the method used in this assessment of undiscovered resources involved the “matching” of existing discoveries with the projected pool size distributions of the geologic model. A more subjective variation of this process employing appropriately scaled ana-

GOM and Atlantic Regions Marginal Probability = 1.00	Number of Pools	Oil (Bbbl)	Gas (Tcf)	BOE (Bbbl)
Reserves				
Original proved	2,369	14.266	162.711	43.218
Cumulative production	--	10.908	132.677	34.515
Remaining proved	--	3.358	30.034	8.703
Unproved	84	0.995	5.102	1.903
Appreciation (P & U)	--	7.736	68.096	19.853
Undiscovered Conventionally Recoverable Resources				
95th percentile	--	24.520	165.587	55.512
Mean	3,372	39.433	219.338	78.461
5th percentile	--	59.047	282.935	106.617
Total Endowment				
95th percentile	--	47.517	401.497	120.486
Mean	5,825	62.430	455.248	143.435
5th percentile	--	82.044	518.845	171.591

Table 5. Assessment results for reserves, undiscovered conventionally recoverable resources, and total endowment of the combined Gulf of Mexico and Atlantic Regions.

GOM and Atlantic Regions Total (Total of All Water Depths)				
Undiscovered Economically Recoverable Resources	**Marginal Probability**	**Oil (Bbbl)**	**Gas (Tcf)**	**BOE (Bbbl)**
$18.00/bbl and $2.11/Mcf				
Full-Cycle	1.00			
95th percentile		14.264	91.944	30.624
Mean		17.936	106.756	36.932
5th percentile		22.030	123.673	44.036
Half-Cycle	1.00			
95th percentile		15.447	97.187	32.740
Mean		19.134	112.203	39.099
5th percentile		23.574	127.304	46.226
$30.00/bbl and $3.52/Mcf				
Full-Cycle	1.00			
95th percentile		25.822	141.839	51.061
Mean		29.331	153.598	56.661
5th percentile		34.807	168.857	64.853
Half-Cycle	1.00			
95th percentile		26.680	146.738	52.790
Mean		30.236	158.999	58.527
5th percentile		36.210	173.879	67.150

Table 6. Undiscovered economically recoverable resources of the combined Gulf of Mexico and Atlantic Regions.

logs was used for conceptual and frontier plays. This report presents for each play the assessment results, pool rank plots, maps, play descriptions, and a series of additional analyses including discovery histories.

Assessment Results, Gulf of Mexico

The total endowment (all conventionally recoverable hydrocarbon resources) of the Gulf of Mexico OCS as of January 1, 1999, is shown in table 1. The Gulf of Mexico OCS total endowment, which includes cumulative production, is estimated to be between 46 and 79 billion barrels of oil (Bbo) and 381 and 483 trillion cubic feet of gas (Tcfg). This is equal to 115 and 163 billion barrels of oil equivalent (BBOE). The range of estimates corresponds to a 95-percent probability (19 in 20 chance) and a 5-percent probability (1 in 20 chance) of there being more than those amounts, respectively. Please note that fractile values are not additive. The mean estimates are 60 Bbo and 428 Tcfg (136 BBOE). Nearly 23 Bbo and 236 Tcfg (65 BBOE), or approximately 48 percent, of this mean total endowment is represented by cumulative production, remaining proved reserves, unproved reserves, and reserves appreciation. Undiscovered conventionally recoverable resources (UCRR) are believed to be discoverable and producible utilizing existing and reasonably foreseeable technology. The estimates of UCRR for oil range from 23 to 56 Bbbl (billion barrels); the estimates for gas range from 145 to 247 Tcf (trillion cubic feet); and the estimates for BOE (barrels of oil equivalent) range from 50 to 98 Bbbl. The mean estimates of UCRR are 37 Bbo and 192 Tcfg (71 BBOE).

Beneath the Gulf of Mexico Continental Margin are approximately 35 to 68 Bbbl of remaining conventionally recoverable oil, with a mean of 49 Bbbl. This includes remaining reserves (proved and unproved), reserves appreciation, and UCRR.

The estimates of remaining conventionally recoverable gas range from 248 to 350 Tcf, with a mean of 295 Tcf; and the estimates of remaining conventionally recoverable BOE range from 80 to 128 Bbbl, with a mean of 102 Bbbl.

Assessment Results, Atlantic

The total endowment of the Atlantic OCS as of January 1, 1999, is shown in table 2. The Atlantic OCS total endowment is estimated to be between 1 and 4 Bbo and 16 and 43 Tcfg (5 and 11 BBOE) at the 95th and 5th percentiles, respectively. The mean estimates are 2 Bbo and 28 Tcfg (7 BBOE). No reserves are assigned to the Atlantic OCS and, therefore, undiscovered conventionally recoverable resources (UCRR) are equal to total endowment.

Economic Assessment, Gulf of Mexico

An economic analysis determined the portions of the UCRR that over the long term are anticipated to be commercially viable under a specific set of economic conditions. The basic economic analysis was performed at the prospect level with regional transportation infrastructure and costs considered at the area level. The economic evaluation was performed as both full- and half-cycle appraisals. Full-cycle analysis is measured from the point in time of a decision to explore. It considers all subsequent leasehold, geophysical, geologic, exploration, and development costs in determining the economic viability of a prospect. In a half-cycle evaluation, leasehold and exploration costs, as well as delineation costs incurred prior to the field development decision, are assumed to be sunk costs and are not considered in the discounted cash flow calculations to determine whether a field is commercially viable.

Estimates of undiscovered economically recoverable resources (UERR) are sensitive to price and technology assumptions and are primarily presented as a functional relationship to price, in the form of price-supply curves. Two specific prices from the distribution were chosen for discussion and are presented as the $18/bbl ($18.00/bbl and $2.11/Mcf) and the $30/bbl ($30.00/bbl and $3.52/Mcf) scenarios. The results of both the full- and half-cycle economic analysis for the Gulf of Mexico Region are shown in table 3.

In the full-cycle, $18/bbl scenario, the estimates of UERR for oil range from 14 to 22 Bbbl; the estimates for gas range from 85 to 114 Tcf; and the estimates for BOE range from 29 to 42 Bbbl. The mean estimates of UERR are 17 Bbo and 100 Tcfg (35 BBOE). In the $30/bbl scenario, the estimates of mean UERR increase by approximately 61 percent for oil and 40 percent for gas.

In the half-cycle, $18/bbl scenario, the estimates of UERR for oil range from 15 to 23 Bbbl; the estimates for gas range from 90 to 119 Tcf; and the estimates for BOE range from 31 to 44 Bbbl. The mean estimates of UERR are 19 Bbo and 105 Tcfg (37 BBOE). This represents an increase of 6 percent over the equivalent full-cycle analysis. In the half-cycle, $30/bbl scenario, the mean estimates of UERR increase by approximately 2 percent for oil and 2 percent for gas over the equivalent full-cycle analysis.

Approximately 47 percent of the mean undiscovered conventionally recoverable oil and 52 percent of mean undiscovered conventionally recoverable gas resources are economic in the full-cycle, $18/bbl scenario. The percentages increase to 76 percent of the oil and 73 percent of the gas in the $30/bbl full-cycle scenario. In the half-cycle analysis, these percentages are approximately 50 for oil and 55 for gas in the $18/bbl scenario and 78 and 75 percent, respectively, for oil and gas in the $30/bbl scenario.

Although useful as a comparative measure of the total quantities of hydrocarbons estimated to exist in the study area, the assessment results do not imply a rate of discovery or a likelihood of discovery and production within a specific time frame. In other words, they cannot be used directly to draw conclusions concerning the rate of conversion of these resources to reserves and ultimately production.

Economic Assessment, Atlantic

The results of both the full- and half-cycle economic analysis for the Atlantic Region are shown in table 4. In the full-cycle, $18/bbl scenario, the estimates of UERR for oil range from <1 to 1 Bbbl, the estimates for gas range from 2 to 13 Tcf, and the estimates for BOE range from <1 to 3 Bbbl. The mean estimates of UERR are 1 Bbo and 7 Tcfg (2 BBOE). In the $30/bbl scenario, the estimate of mean UERR more than doubles.

In the half-cycle, $18/bbl scenario, the estimates of UERR for oil range from <1 to 1 Bbbl; the estimates for gas range from 3 to 13 Tcf; and the estimates for BOE range from 1 to 4 Bbbl. The mean estimates of UERR are 1 Bbo and 7 Tcfg (2 BBOE). This represents an increase of 11 percent over the equivalent full-cycle analysis. In the half-cycle, $30/bbl scenario, the mean estimates of UERR increase 17 percent over the equivalent full-

cycle scenario.

Approximately 23 percent of the mean undiscovered conventionally recoverable oil and 24 percent of the mean undiscovered conventionally recoverable gas resources are economic in the full-cycle, $18/bbl scenario. The percentages increase to 58 percent of the oil and 46 percent of the gas in the $30/bbl scenario. In the half-cycle analysis, these percentages are approximately 26 for both oil and gas in the $18/bbl scenario and 68 and 54 percent, respectively, for oil and gas in the $30/bbl scenario.

Assessment results and economic analysis for the combined Gulf of Mexico and Atlantic OCS Regions are presented in tables 5 and 6, respectively.

Companion Publication

A companion publication—*Atlas of Gulf of Mexico Gas and Oil Sands as of January 1, 1999* (Bascle, *et al.*, 2001)—reports proved and unproved reserves in the Gulf of Mexico OCS and includes an extensive geologic, engineering, and production database. While some pool level reserves data is included in the 2000 Assessment, detailed reserves information is provided in the Atlas at the sand level, where all volume-weighted reservoir data has been rolled up into the common producing sand.

The Atlas also contains GIS capabilities that enable users to query, retrieve, and display tabular data in map form. Data are linked at the sand, field, and play levels.

Together, these two publications allows others to use their own techniques in performing a resource assessment or to evaluate the economic viability of drilling prospects.

Introduction

An essential ingredient in performing the resource management mission responsibilities of the Department of the Interior is a sound knowledge of the mineral resource base. This knowledge provides an understanding of the characteristics and distribution of the resource, establishing a solid basis for decisions related to resource management issues. With this as the primary objective, the MMS periodically performs an assessment of the undiscovered conventionally recoverable oil and gas resources of the United States Outer Continental Shelf (OCS). This report presents the results of the 2000 assessment of the conventionally recoverable hydrocarbon resources of the Gulf of Mexico and Atlantic OCS. This latest assessment reflects data and information available as of January 1, 1999, thus incorporating data and information not available at the time of the January 1, 1995 MMS assessment (Lore *et al.*, 1999). It also provides a more detailed presentation of the results previously summarized on the MMS website (Hunt and Dickerson, 2001).

Objectives

The principal purpose of this report is to present estimates of the total endowment of conventionally recoverable oil and gas that may be present beneath the Gulf of Mexico and Atlantic Continental Margin. Secondary objectives are to describe the geologic and mathematical methodologies employed in the assessment, present an economic analysis of the undiscovered conventionally recoverable resources of the area, and provide a historical perspective in which to review the results. We are also providing sufficient geologic, reservoir engineering, and production data here, in conjunction with a separate gas and oil atlas (Bascle *et al*., 2001), to allow others to use their own techniques to perform a resource assessment or evaluate the economic viability of the postulated resources.

Reliance on Petroleum

Energy is the lifeblood of the world's economy. Since displacing coal early in the last century, crude oil has been the world's primary source of energy. The United States is currently experiencing a dramatic increase in the use of natural gas, mainly as the environmentally preferred fuel for the generation of electricity. In 1998, oil and gas resources comprised 63 percent of the world's total energy consumption, up from 60 percent in 1994. Worldwide reliance on petroleum resources as the principal fuel to satisfy future energy demand is likely to continue for decades. However, petroleum resources are usually considered as finite since they do not renew at a rate remotely approaching their consumption. Since these minerals also power the Nation's economy, there is considerable interest in the magnitude of the resource base from which future domestic discoveries and production will occur. The Gulf of Mexico OCS, which currently contributes 13 and 25 percent, respectively, of the United States domestic oil and gas production, is obviously a critical component of any deliberations concerning future domestic petroleum supplies.

Resource Estimates

A reasonable knowledge concerning the potential quantities of remaining conventionally recoverable oil and gas resources is required by governments for strategic planning and formulating domestic land use, energy, and economic policies. Financial institutions and large corporations use resource estimates for long-term planning and making decisions concerning investment options. Exploration companies use assessments to design exploration strategies and target expenditures. Petroleum industry trade associations use resource assessments to gauge trends and the relative health of the industry.

Uncertainty is inherent in estimating quantities of hydrocarbon resources prior to actual drilling. Imperfect knowledge is associated with almost every facet of the assessment process. It is vital to recognize that estimates are just that— *estimates*. Dreyfus and Ashby (1989) noted that resource assessments are performed at widely varying levels of detail and precision.

At one end of the spectrum lie estimates of proved reserves. These assessments rely primarily upon detailed investigations incorporating relatively abundant subsurface geologic and geophysical data, as well as actual reservoir performance information associated with the particular reservoir. At the other end of the spectrum is the appraisal of undiscovered resources that might exist in areas of regional, national or even global scope. In dealing with the same type of data as reserve estimates, the scope is extended to a generalized inference of the probable quantities

of undiscovered hydrocarbon resources that may exist in broad areas.

The various estimates presented in this report encompass this spectrum and should be viewed as indicators and not predictors of the petroleum potential of the plays, provinces, and regions. It is also important to realize that the undiscovered conventionally recoverable resources estimated may not be found or, in fact, produced. It is, however, implied that these resources have some chance of existing, being discovered, and possibly produced.

Pools and Plays

Hydrocarbon plays, comprising pools that share common factors influencing the accumulation of hydrocarbons, were the basic building blocks for this assessment. The results were subsequently aggregated to the province and region levels.

The assessment methodology incorporated existing data and information available from exploration and development activities, knowledge of particular plays, and assumptions regarding technology and costs. For each play a geologic description, sand characteristics, discovery history, reserves, and cumulative production are provided. Additionally, the play's resource potential is portrayed as a pool rank plot, identifying both discovered and undiscovered pools. Undiscovered pools are shown as bars that are indicative of their range of probable sizes.

An economic analysis was performed under two scenarios, with and without a consideration of exploration costs, to determine quantities of hydrocarbon resources that may be commercial under given conditions. The results are presented as ranges of values with associated probabilities of occurrence.

This report presents play, province, region, planning area, and margin level data and information.

Definition of Resource Terms

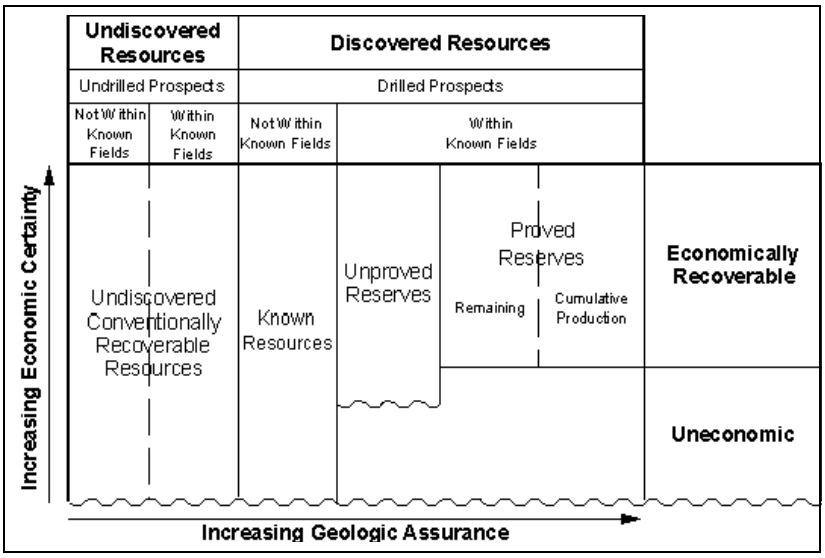

Figure 1. MMS classification scheme for conventionally recoverable hydrocarbon resources (U.S. Bureau of Mines and U.S. Geological Survey, 1980).

The terminology associated with resource assessments is involved, but it must be understood so that the results can be correctly interpreted and applied. A set of precise definitions regarding resource assessment terminology that is universally accepted does not exist. The lexicon used in this report conforms with past assessments and general industry usage. The MMS scheme of classifying conventionally recoverable hydrocarbons is modified from the McKelvey diagram (U.S. Bureau of Mines and U.S. Geological Survey, 1980) (figure 1). The scheme is dynamic with hydrocarbon resources migrating from one category to another over time. Resource availability is expressed in terms of the degree of certainty about the existence of the resource and the feasibility of its economic recovery. As such, resource estimates should be used as general indicators and not predictors of absolute volumes. The overall movement of petroleum resources is to the right as accumulations are discovered and upward as development and production ensue. The degree of uncertainty as to the existence of resources decreases to the right in the diagram. The degree of economic viability decreases downward and also implies a decreasing certainty of technologic recoverability.

The initial concept to be grasped is that of recoverable resources. Resource assessments that are intended to be of more than scientific interest are generally limited to accumulations that are believed to be amenable to discovery and production employing conventional techniques under reasonably foreseeable technological and economic conditions. This distinction eliminates from consideration significant portions of the resource base that may be developable sometime after the next 25 or 30 years. Other key terms used in this report are included in the glossary, and the definitions presented both here and in the glossary should be viewed as general explanations rather than strict technical definitions of the terms.

***A) Conventionally recoverable*:** Producible by natural pressure, pumping, or secondary recovery methods such as gas or water injection.

***B) Marginal probability of hydrocarbons (MP_{hc})*:** An estimate, expressed as a decimal fraction, of the chance that an oil or natural gas accumulation exists in the area under consideration. The area under consideration is typically a geologic entity, such as a pool, prospect, play, basin, or province; or a large geographic area such as a planning area or region. All estimates presented in this report reflect the probability that an area may be devoid of hydrocarbons or, in the case of estimates of economically recoverable resources, that commercial accumulations may not be present.

***C) Cumulative production*:** The sum of all produced volumes of hydrocarbons prior to a specified point in time.

***D) Resources*:** Concentrations in the earth's crust of naturally occurring liquid or gaseous hydrocarbons that can conceivably be discovered and recovered. Normal use encompasses both discovered and undiscovered resources.

***d1) Recoverable resources*:** The volume of hydrocar-

bons that is potentially recoverable, regardless of the size, accessibility, recovery technique, or economics of the postulated accumulations.

***d1i) Conventionally recoverable resources*:** The volume of hydrocarbons that may be produced from a wellbore as a consequence of natural pressure, artificial lift, pressure maintenance (gas or water injection), or other secondary recovery methods. They do not include quantities of hydrocarbon resources that could be recovered by enhanced recovery techniques, gas in geopressured brines, natural gas hydrates (clathrates), or oil and gas that may be present in insufficient quantities or quality (low permeability "tight" reservoirs) to be produced via conventional recovery techniques.

***d1i') Remaining conventionally recoverable resources*:** The volume of conventionally recoverable resources that has not yet been produced and includes remaining proved reserves, unproved reserves, reserves appreciation, and undiscovered conventionally recoverable resources.

***d1ii) Economically recoverable resources*:** The volume of conventionally recoverable resources that is potentially recoverable at a profit after considering the costs of production and the product prices.

***d2) Undiscovered resources*:** Resources postulated, on the basis of geologic knowledge and theory, to exist outside of known fields or accumulations. Included also are resources from undiscovered pools within known fields to the extent that they occur within separate plays.

***d2i) Undiscovered conventionally recoverable resources (UCRR)*:** Resources in undiscovered accumulations analogous to those in existing fields producible with current recovery technology and efficiency, but without any consideration of economic viability. These accumulations are of sufficient size and quality to be amenable to conventional primary and secondary recovery techniques. Undiscovered conventionally recoverable resources are primarily located outside of known fields.

***d2ii) Undiscovered economically recoverable resources (UERR)*:** The portion of the undiscovered conventionally recoverable resources that is economically recoverable under imposed economic and technologic conditions.

E) Reserves: The quantities of hydrocarbon resources anticipated to be recovered from known accumulations from a given date forward. All reserve estimates involve some degree of uncertainty.

***e1) Proved reserves*:** The quantities of hydrocarbons estimated with reasonable certainty to be commercially recoverable from known accumulations and under current economic conditions, operating methods, and government regulations. Current economic conditions include prices and costs prevailing at the time of the estimate. Estimates of proved reserves equal cumulative production plus remaining proved reserves and do not include reserves appreciation.

***e1i) Remaining proved reserves*:** The quantities of proved reserves currently estimated to be recoverable. Estimates of remaining proved reserves equal proved reserves minus cumulative production.

***e2) Unproved reserves*:** Quantities of hydrocarbon reserves that are assessed on the basis of geologic and engineering information similar to that used in developing estimates of proved reserves, but technical, contractual, economic, or regulatory uncertainty precludes such reserves being classified as proved.

***e3) Reserves appreciation*:** The observed incremental increase through time in the estimates of reserves (proved and unproved [P & U]) of an oil and/or gas field. It is that part of the known resources over and above proved and unproved reserves that will be added to existing fields through extension, revision, improved recovery, and the addition of new reservoirs. Also referred to as reserves growth or field growth.

***e4) Total reserves*:** All hydrocarbon resources within known fields that can be profitably produced using current technology under

existing economic conditions. Estimates of total reserves equal cumulative production plus remaining proved reserves plus unproved reserves plus reserves appreciation.

***F) Total endowment*:** All conventionally recoverable hydrocarbon resources of an area. Estimates of total endowment equal undiscovered conventionally recoverable resources plus cumulative production plus remaining proved reserves plus unproved reserves plus reserves appreciation.