Seventh Biennial Report to Congress: Estimates of Natural Gas and Oil Reserves, Reserves Growth, and Undiscovered Resources on the U.S. Outer Continental Shelf and in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama

Energy Policy Act of 2005 – Section 965(c)

Prepared by

Bureau of Ocean Energy Management
Office of Strategic Resources

For the United States Congress
Year 2022

U.S. Department of the Interior
Bureau of Ocean Energy Management

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Preface

This report on estimated oil and gas reserves and resources off the coasts of Texas, Louisiana, Mississippi, and Alabama is required by section 965(c) of the Energy Policy Act of 2005. Specifically, the Secretary of the Interior has been directed to, in consultation with other appropriate Federal agencies, submit to Congress a report on the latest estimates of natural gas and oil reserves, reserves growth, and undiscovered resources in State waters and on the U.S. Outer Continental Shelf (OCS) off the coasts of Texas, Louisiana, Mississippi, and Alabama.

The Department of the Interior's (DOI) Bureau of Ocean Energy Management (BOEM) coordinated with appropriate Federal agencies in preparing this report. The Department of Energy's Energy Information Administration (EIA) supplied BOEM with the oil and gas reserves estimates and recent production information for fields within the State waters of Texas, Louisiana, Mississippi, and Alabama. The DOI's United States Geological Survey (USGS) provided BOEM with estimates of undiscovered, conventionally recoverable oil and gas resources for the same areas. Estimates of both discovered and undiscovered oil and gas resources within the U.S. OCS offshore Texas, Louisiana, Mississippi, and Alabama are based on assessments developed by BOEM.

Based on existing offshore administrative boundaries[1] (see figure 1), the cumulative production, reserves, contingent resources, and undiscovered resources that exist on U.S. OCS blocks within the geographic area identified by BOEM as the Western Gulf of Mexico Planning Area were allocated to the State of Texas. Cumulative production, reserves, contingent resources, and undiscovered resources that exist on U.S. OCS blocks in the Central Gulf of Mexico Planning Area, were allocated to the States of Louisiana, Mississippi, and Alabama, as appropriate, based on the existing offshore administrative boundaries.

[1] BOEM has developed offshore administrative lines from each adjoining coastal state. BOEM undertook this task in light of the increasing number and type of both traditional and non-traditional energy, alternative energy-related, and other activities on the U.S. OCS. BOEM has used, to the extent practicable, the updated National Baseline (or Supreme Court fixed baselines where they exist) to derive offshore administrative boundaries in compliance with accepted cartographic practice. The use of state administrative boundaries in this report is for allocation of oil and gas resources only and is not meant to imply distribution of U.S. OCS or State water revenues.

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Executive Summary

This report summarizes the results of BOEM's compilation of the technically recoverable resources for State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama and from the adjacent U.S. OCS in the Gulf of Mexico (GOM). Technically recoverable resources are hydrocarbons potentially amenable to conventional production regardless of the size, accessibility, and economics of the accumulations assessed. The U.S. OCS comprises the portion of the submerged seabed and subsoil whose mineral estate is subject to Federal jurisdiction under the OCS Lands Act (see figure 1). No new government-sponsored geological or geophysical data acquisition was undertaken for this inventory.

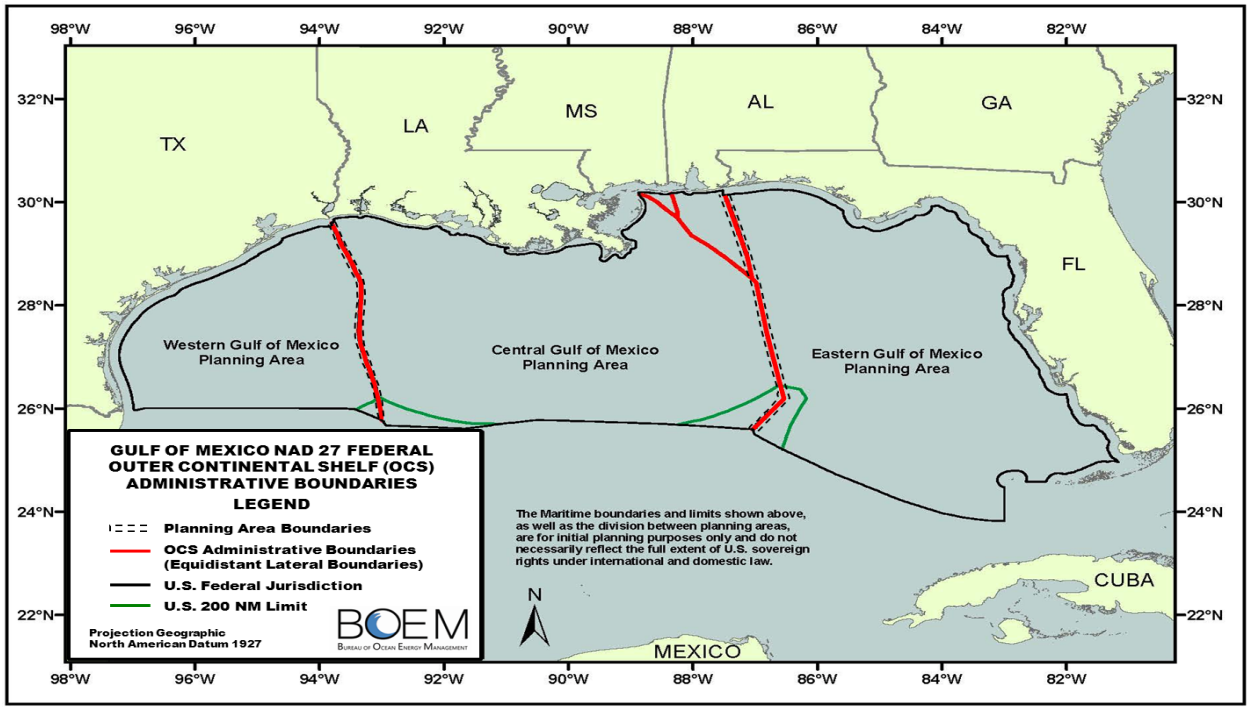

Figure 1: Gulf of Mexico OCS Administrative Boundaries

The petroleum commodities assessed in this report are crude oil, natural gas liquids (condensates), and natural gas that exist in conventional reservoirs producible with typical traditional recovery techniques. The terms "natural gas" and "gas" are used interchangeably in this report. The volumetric estimates of oil resources reported represent combined volumes of crude oil and condensate. Although not considered in this report quantitatively, the continued expansion of the technological frontiers can reasonably be expected to impact recoverable hydrocarbon volumes. Additionally, this report provides a supply-side estimate of undiscovered and discovered resources and does not explicitly consider changes to demand or future commodity prices.

All resource estimates are subject to continuing revision as undiscovered resources are converted to reserves and reserves to production, and as improvements in data and assessment methods occur. The assessment results do not imply a rate of discovery or a likelihood of discovery and production within a specific time frame. However, uncertainty surrounding the estimates decreases as the asset progresses through this cycle, and the true resource volumes are only known once an accumulation is depleted. Resource estimates should be viewed from the perspective of the data, information, and methodology available at the time the assessment was performed.

Resource estimates are highly dependent on the current knowledge base. In general, risk and uncertainty in estimates of undiscovered oil and natural gas are greatest for frontier areas that have had little or no previous exploratory efforts. For other areas that have been extensively explored and are in a mature development stage, many of the risks have been reduced or eliminated, and the degree of uncertainty in possible outcomes narrows considerably. As a result, resource potential can be evaluated with much more confidence in non-frontier areas. However, even in some mature producing areas, such as the GOM shelf, considerable uncertainty remains regarding the petroleum potential at deeper subsurface depths.

The results of this assessment are presented in tables 1(a) and 1(b) and in section IV of this report. The total endowment of technically recoverable oil and gas in State waters and on the U.S. OCS comprises known resources—i.e., cumulative production and estimates of remaining proved reserves, contingent resources, and reserves appreciation—plus estimates of Undiscovered Technically Recoverable Resources (UTRR). The estimate of the total hydrocarbon endowment in State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama (table 1(a)) is 3.46 billion barrels of oil (Bbo) and 61.63 trillion cubic feet of gas (Tcf), for a total of 14.43 billion barrels of oil equivalent (BBOE).[2] The total endowment in the U.S. OCS offshore of these same States is 63.54 Bbo and 272.38 Tcf, for a total of 112.01 BBOE (table 1(b)).

[2] Gas volumes are converted to barrels of oil equivalent using a factor of 5.62 (i.e., 5,620 cubic feet of gas per barrel of oil).

Table 1(a): Total Endowment of Technically Recoverable Oil and Gas Resources in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama, 2022

State	Resources in Known Fields		Undiscovered Technically Recoverable Resources (mean estimate)	Total Endowment
	Cumulative Production (through 2020)	Reserves (2020)		
OIL (Billion Barrels)				
Texas	0.07	0.00	0.41	0.48
Louisiana	1.88	0.01	0.97	2.86
Mississippi	0.00	0.00	0.07	0.07
Alabama	0.00	0.00	0.05	0.05
Total Oil in State Waters off the Coasts of TX, LA, MS, and AL	1.95	0.01	1.50	3.46
NATURAL GAS (Trillion Cubic Feet)				
Texas	4.95	0.00	11.31	16.26
Louisiana	14.60	0.04	22.06	36.70
Mississippi	0.00	0.00	2.89	2.89
Alabama	4.01	0.72	1.05	5.78
Total Gas in State Waters off the Coasts of TX, LA, MS, and AL	23.56	0.76	37.31	61.63
Barrels of Oil Equivalent (BOE; Billion Barrels)				
Texas	0.95	0.00	2.42	3.38
Louisiana	4.48	0.02	4.90	9.39
Mississippi	0.00	0.00	0.58	0.58
Alabama	0.71	0.13	0.24	1.08
Total BOE in State Waters off the Coasts of TX, LA, MS, and AL	6.14	0.15	8.14	14.43

Table 1(b): Total Endowment of Technically Recoverable Oil and Gas Resources in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama, 2022

State	Resources in Known Fields				Undiscovered Technically Recoverable Resources (mean estimate; updated 2021)	Total Endowment
	Cumulative Production (through end of 2019)	Reserves (end of 2019)	Contingent Resources (end of 2019)	Reserves Appreciation (end of 2019)		
OIL (Billion Barrels)						
Texas	1.18	0.07	0.52	0.68	6.05	8.51
Louisiana	20.77	4.57	3.22	7.56	18.06	54.18
Mississippi	<0.001	<0.001	<0.001	<0.001	0.16	0.16
Alabama	0.17	<0.01	0.02	0.08	0.42	0.68
Total Oil in the U.S. OCS off the Coasts of TX, LA, MS, and AL	22.12	4.65	3.75	8.32	24.70	63.54
NATURAL GAS (Trillion Cubic Feet)						
Texas	35.15	0.20	1.42	5.72	11.39	53.88
Louisiana	152.02	5.82	7.37	17.01	28.54	210.76
Mississippi	0.62	0.02	0.01	0.20	0.33	1.18
Alabama	3.09	0.06	0.15	0.95	2.31	6.56
Total Gas in the U.S. OCS off the Coasts of TX, LA, MS, and AL	190.88	6.10	8.94	23.88	42.58	272.38
Barrels of Oil Equivalent (BOE; Billion Barrels)						
Texas	7.44	0.11	0.77	1.70	8.08	18.10
Louisiana	47.82	5.61	4.53	10.58	23.14	91.68
Mississippi	0.11	<0.01	0.00	0.04	0.22	0.37
Alabama	0.72	0.01	0.04	0.24	0.83	1.85
Total BOE in the U.S. OCS off the Coasts of TX, LA, MS, and AL	56.09	5.74	5.35	12.57	32.27	112.01

Of the total endowment in State waters offshore Texas, Louisiana, Mississippi, and Alabama, about 1.96 Bbo and 24.32 Tcf (6.29 BBOE total), or approximately 44 percent of the total endowment on a BOE basis, is represented by discovered resources in known fields (the total of cumulative production and remaining reserves).

- Cumulative production in State waters through 2020 was 1.95 Bbo and 23.56 Tcf (6.14 BBOE); cumulative production represents 43 percent of the estimated total endowment.
- Estimates of the reserves remaining to be produced total 0.01 Bbo and 0.76 Tcf (0.15 BBOE).
    - The estimated reserves (as of year-end 2020) in fields within State waters are approximately 93 percent natural gas and 7 percent oil and condensate.
    - BOEM did not attribute additional growth or appreciation to reserves in known discoveries for State waters.

The UTRR mean estimate in State waters totals 1.50 Bbo and 37.31 Tcf (8.14 BBOE). Of this total BOE estimate, 18 percent is oil and condensate, and 82 percent is natural gas.

In the U.S. OCS offshore Texas, Louisiana, Mississippi, and Alabama, approximately 38.84 Bbo and 229.80 Tcf, or 79.74 BBOE total (71 percent of the total endowment), is represented by resources in known fields—the total of cumulative production, remaining proved and contingent resources, and reserves appreciation.

- Cumulative production in the U.S. OCS offshore Texas, Louisiana, Mississippi, and Alabama through 2019 was 22.12 Bbo and 190.88 Tcf (56.09 BBOE total); cumulative production represents 50 percent of the estimated total endowment.
- Estimates of the discovered resources remaining to be produced (reserves, contingent resources, and reserves appreciation) total 16.72 Bbo and 38.92 Tcf (23.66 BBOE total). Of this total discovered resource remaining, approximately 71 percent is oil and condensate, and 29 percent is natural gas.
    - BOEM estimates that reserves remaining within the over 1300 fields discovered through 2019 total 4.65 Bbo and 6.10 Tcf (5.74 total BBOE).
    - The estimated contingent resources total 3.75 Bbo and 8.94 Tcf (5.35 BBOE).
    - An additional volume of reserves growth or appreciation—the projected increase in current estimates of reserves within existing fields based on historical trends—totaling 8.32 Bbo and 23.88 Tcf (12.57 BBOE) is also forecast to be recoverable from existing offshore fields. This growth occurs primarily from the in-field discovery of new reservoirs and an increase in the estimate of the recoverable portion of in-place hydrocarbons within known reservoirs, due to future advances in technology and an increased understanding of reservoir performance.

The UTRR mean estimate in the U.S. OCS offshore Texas, Louisiana, Mississippi, and Alabama is 24.70 Bbo and 42.58 Tcf (32.27 BBOE). Of this total BOE, approximately 77 percent is oil and condensate, and 23 percent is natural gas.

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I. Introduction

The U.S. OCS and State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama[3] contain significant quantities of both discovered and undiscovered oil and natural gas resources. Section 965(c) of the Energy Policy Act of 2005 ("EPACT") directed the Secretary of the Interior, in consultation with other appropriate Federal agencies, to submit to Congress a biennial report on the latest estimates of natural gas and oil reserves, reserves growth, and undiscovered resources in the U.S. OCS and State waters offshore Texas, Louisiana, Mississippi, and Alabama. This is the seventh biennial report to Congress to satisfy the requirements in section 965(c).

The report is organized as follows:

Section II provides background discussion on oil and gas resource assessments, classification schema, and terminology.

Section III presents the methodology and data sources used to generate estimates of oil and gas resources.

Section IV discusses results from the oil and gas resource inventory.

Section V presents conclusions that can be drawn from the results of the resource inventory.

II. Background

Oil and natural gas resources are currently major contributors to the world's energy supply, and the demand for petroleum is likely to continue for decades (EIA, 2021). However, as the world transitions to other sources of renewable and clean energy to meet climate goals, the reliance on fossil fuels will likely decrease. Notwithstanding the accelerated pace of renewable energy projects on the U.S. OCS, including the recent identification of two wind energy areas in the GOM, this report does not focus on the shifting demand for energy, nor does it predict the future contribution of hydrocarbons to the global energy market. Rather, as required by EPACT, this report provides an inventory of past oil and gas production as well as future supply from both discovered and undiscovered oil and gas resources.

Geologists, statisticians, and economists have been performing resource assessments for decades to provide insights regarding the future of petroleum supply. The demands for and uses of these assessments have evolved an increasingly complex quantitative techniques and procedures to meet the challenge. Generally, the evolution has been from deterministic to stochastic methods, incorporating uncertainty and risk analyses. Scientific disciplines involved in the assessment process have evolved in parallel with the methodology, from primarily geology in the early

[3] The boundaries between the U.S. OCS and State waters in the GOM vary by State, as follows: Texas = 9 nautical miles (nm), Louisiana = 3 nm, Mississippi = 3 nm, and Alabama = 3 nm.

assessments to a complex multi-disciplinary array of geology, geophysics, petroleum engineering, economics, and statistics.

1. Purposes of Resource Assessments: Resource assessments are performed at various scales and for many purposes. Local assessments are developed at the prospect or field level to generate the subsurface characterization necessary for fair market value analysis and the quantification of discovered resources. Regional assessments may be developed to understand the distribution of geologic resources across contiguous areas that comprise a common suite of petroleum system elements. Regional assessments can be aggregated into larger national-level assessments to support the quantitative programmatic analysis that often accompanies broad policy and programmatic decisions.

Large corporations and financial institutions use resource estimates for long-term planning, in their analysis of investment options, and as a guide in analyzing the future demand for oil and gas resources. Exploration companies use resource assessments to design exploration strategies and target expenditures. Increasingly, resource estimates are used by the Federal Government, Congress, and the public to provide objective statements of how much oil and natural gas could be available for future domestic consumption.

This report includes an accounting of historical production, an inventory of discovered resources, and the results of regional, play-based assessments of undiscovered resources off the coasts of Texas, Louisiana, Mississippi, and Alabama. The assessments consist of a thorough investigation of the petroleum geology and an identification of appropriate domestic and international analogs, coupled with a probabilistic methodology to estimate the remaining hydrocarbon potential.

2. Terminology and Classification Schema: The following are important terms related to the analysis presented in this report. The definitions presented here should be viewed as general explanations, rather than strict technical definitions of the terms.

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

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

Undiscovered Technically Recoverable Resources (UTRR): 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.

Reserves: Those quantities of hydrocarbon resources anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria: They must be discovered, recoverable, commercial, and remaining (as of a given date) based on the development project(s) applied. Reserves are further sub-classified based on economic certainty.

Proved Reserves: The quantities of hydrocarbons estimated, with reasonable certainty, to be commercially recoverable from known accumulations 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 do not include reserves appreciation.

Contingent Resources: The quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects, but which are not currently considered to be commercially recoverable due to one or more contingencies.

Reserves Appreciation: The observed incremental increase through time in the estimates of reserves of a field containing oil, natural gas, or both. 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. This is commonly referred to as reserves growth or field growth.

Cumulative Production: The sum of all produced volumes of hydrocarbons prior to a specified point in time.

Estimated Ultimate Recovery (EUR): All hydrocarbon resources within known fields that can be profitably produced using current technology under existing economic conditions. Estimates of EUR equal the sum of cumulative production, reserves, and reserves appreciation.

Total Endowment: All conventionally recoverable hydrocarbon resources of an area. Estimates of total endowment equal the sum of undiscovered resources, cumulative production, reserves, contingent resources, and reserves appreciation.

The BOEM resource classification framework for the U.S. OCS is shown in figure 2. At the point in time a discovery is made, the identified accumulation of hydrocarbons is classified as a Contingent Resource until the time a development project is identified. When an operator makes a formal commitment to develop and produce the accumulation, it is classified as Reserves Justified for Development. During the period when infrastructure is being constructed and installed, the accumulation is classified as Undeveloped Reserves. After the equipment is in place, the accumulation is classified as Developed Non-Producing Reserves, and when production of the accumulation has begun, the status becomes Developed Producing Reserves. If an accumulation goes off production, for a year or more, for any reason, the classification changes back to Developed Non-Producing. All hydrocarbons produced and sold are included in

the Cumulative Production category. Should a project be abandoned, at any phase of development, any estimates of remaining hydrocarbon volumes could be re-classified to Contingent Resources.

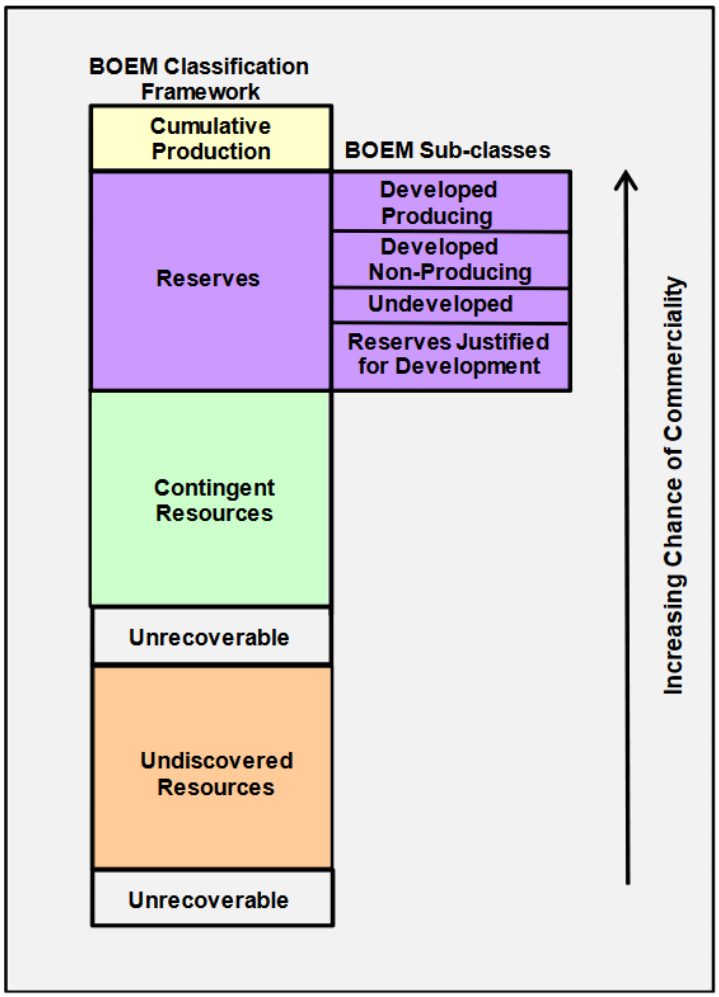


Figure 2: BOEM Resource Classification Schema

The resource classifications used in this report have been modified from the Society of Petroleum Engineers, World Petroleum Congress, American Association of Petroleum Geologists and Society of Petroleum Evaluation Engineers, 2007, *Petroleum Resource Management System* where necessary to conform to the requirements of BOEM's Reserves Inventory Program.

3. Commodities Assessed: The petroleum commodities assessed in this inventory are crude oil, natural gas liquids (condensate), and natural gas that exist in conventional reservoirs and are producible through conventional recovery techniques. Crude oil exists in a liquid state in the subsurface and at the surface; it may be described on the basis of its American Petroleum Industry (API) gravity as "light" (i.e., approximately 20° to 50° API) or "heavy" (i.e., generally

less than 20° API). Condensate is a very high-gravity (i.e., generally greater than 50° API) liquid; it may exist in a dissolved gaseous state in the subsurface but liquefy at the surface. Crude oil with a gravity greater than 10° API and condensate can be removed from the subsurface with conventional extraction techniques and have been assessed for this inventory.

Natural gas is a gaseous hydrocarbon resource, which may consist of associated or non-associated gas; the terms natural gas and gas are used interchangeably in this report. Associated gas exists in spatial contact with crude oil; it may exist in the subsurface as undissolved gas within a gas cap or as gas that is dissolved in crude oil (solution gas). Non-associated gas exists spatially independent of crude oil. Gas resources that can be removed from the subsurface with conventional extraction techniques have been assessed for this inventory.

Crude oil and condensate are reported jointly as oil; associated and non-associated gas are reported as gas. Oil volumes are reported as stock tank barrels and gas as standard cubic feet. Oil-equivalent gas is a volume of gas (associated or non-associated) expressed in terms of its energy equivalence to oil (i.e., 5,620 cubic feet of gas per barrel of oil) and is reported in barrels. The combined volume of oil and oil-equivalent gas resources is referred to as barrels of oil equivalent (BOE) and is reported in barrels.

This report encompasses only a portion of all the oil and natural gas resources believed to exist on the GOM continental margin. This assessment does not include hydrocarbon resources that could be recovered from known and future accumulations by enhanced recovery techniques, gas in geopressured brines, natural gas hydrates, or oil and natural gas that may be present in insufficient quantities or qualities (low permeability "tight" reservoirs) to be produced by conventional recovery techniques. These unconventional resources are not widely produced from the U.S. OCS or State waters.

4. Limitations of Resource Assessments: Resource assessments are an attempt to quantify something that cannot be accurately known until the resource has been essentially depleted, as imperfect knowledge is associated with almost every facet of the assessment process. 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 geological and geophysical data, as well as actual reservoir engineering 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. While 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 over broad areas.

All resource estimates are subject to continuing revision as undiscovered resources are converted to reserves and reserves to production and as improvements in data and assessment methods occur. Though uncertainty surrounding the estimates decreases as the asset progresses through this cycle, the assessment results do not imply a rate of discovery or a likelihood of discovery and production within a specific timeframe. In other words, resource assessments should not be

used directly to draw conclusions concerning the rate of conversion of these undiscovered resources to reserves and ultimately production.

In spite of the inherent uncertainty and limitations of resource assessments, they provide value by informing the development of energy policy and corporate planning—e.g., for ranking exploration opportunities, as a basis for economic analyses, and assessments of technology and capital needs.

5. Role of Geologic Risk and Uncertainty in Resource Assessments: Exploration for hydrocarbons includes a quantifiable probability that oil and gas resources may not be found, or that they may not exist in the quantities predicted; this is often referred to as geologic risk. Risk and uncertainty are integral parts of every resource assessment, with nearly every component of the assessment process incorporating a consideration of uncertainty. The accumulation of petroleum in significant quantities requires the juxtaposition of many complex geologic events: the accumulation of organic matter in a source rock; the maturation of this organic matter into petroleum; the presence of a reservoir rock with sufficient thickness, porosity, and permeability; the migration of the petroleum into a trap with adequate size and seals; and the preservation of the petroleum in the trap. Prior to drilling, the actual existence of these geologic conditions is known with varying levels of uncertainty.

In general, risk and uncertainty in estimates of undiscovered oil and natural gas are greatest for frontier areas that have had little or no past exploration. For areas that have been extensively explored and are in a mature development stage, many of the risks have been reduced or eliminated and the degree of uncertainty in possible outcomes narrowed considerably. As a result, resource potential can be evaluated with much more confidence. However, even in some mature producing areas, such as the GOM shelf, considerable uncertainty remains about the petroleum potential at greater subsurface depths.

Geoscientists can estimate the quantity of undiscovered resources based on the present state of geological and engineering knowledge, modified by a consideration of future technological advancement. However, the percentage of that quantity that may actually be discovered and produced ultimately includes economic considerations. Uncertainties about future crude oil and natural gas prices and the costs of exploration and development (including the impacts of technology advances on costs), and changes to demand and consumption due to advancing clean energy solutions, will have an impact on all economic resource estimates. In terms of the commercial viability of an accumulation, there is substantial uncertainty concerning total costs, future demand and consumption patterns, and future market prices, resulting in additional economic risk and uncertainty for a project.

6. Role of Technology and Economics in Resource Assessment: In developing the estimates of discovered and undiscovered technically recoverable hydrocarbon resources, it is necessary to make fundamental assumptions regarding future technology and economics.

Assessment teams typically estimate the quantity of technically recoverable resources on the basis of the present state of geologic and engineering knowledge, modified by a subjective consideration of future technologic advancement. In addition, the quantity of resources that may

actually be produced is dependent in large part upon the economics of finding costs and commodity prices. New capital-intensive exploration and development technologies require higher product prices for implementation. Typically, as these high-cost technologies are more widely employed, costs decrease, resulting in even more widespread use of these techniques. On the other hand, new modest-cost exploitation technologies that increase recoveries or decrease finding, development, or operating costs can markedly increase estimates of technically recoverable resources without requiring an increase in product prices. A decrease in price can be moderated or offset by the implementation of a technology that reduces unit costs or vice versa. Rogner (1997) concluded that "over the last century technology has probably had a more profound and lasting impact on prices than prices have had on technology."

Generally, the effects of price and technology can be considered interchangeable within the context of a resource assessment. There is a technologic and economic limit to the amount of in-place oil and natural gas resources that can be physically recovered from a reservoir. Within conventional reservoirs, approximately 30 to 40 percent of the in-place oil and 65 to 80 percent of the in-place natural gas resources are typically recovered through primary and secondary recovery mechanisms. Three principal factors affect the amount of oil or gas that can be recovered from a known reservoir: rock properties, technology, and economics. While industry cannot change the properties of the rock, it can develop new techniques to recover more oil from the rock, thus adding to the resource base. For example, recent technological advances, such as horizontal wells and multi-lateral completions, enable the recovery of a higher percentage of the in-place resources from a field.

Additional technologic and economic constraints are applicable to the circumstances under which exploration and development activities can occur, including ultra-deep water or ultra-deep drilling. Advanced technology now provides for the exploitation of resources in these operating environments that were not previously economically viable.

One of the most recent technologies to make significant advances has enabled the production of high pressure/high temperature reservoirs. In 2019, the first production from the deepwater Upper Jurassic Norphlet Formation marked the first high-temperature development in deep water. Also in 2019, Chevron sanctioned the first deepwater high-pressure development for its Lower Tertiary Anchor Field in approximately 5,180 feet of water using technologies capable of handling up to 20,000 pounds per square inch of pressure.

Another important aspect of the role of technology in a resource assessment is the opportunity to rethink fundamental approaches to developing exploration play methods through the deployment of new technology. Scientific advances aided by new technologies have affected the ability to identify previously unknown potential exploration plays. An example of this was the introduction of new seismic data acquisition techniques, which when combined with high-end computing technology and new data processing algorithms, resulted in the ability for geoscientists to generate accurate imaging of the subsurface below the salt structures that dominate a large portion of the GOM OCS.

Understanding the natural evolution in technological progress is critical to fully comprehending resource assessments. It is a reasonable assumption that continued expansion of the technological

frontiers can partially mitigate the impacts of a lower quality resource base and less favorable economic conditions. Because they significantly affect the cost/price relationship, many forecasters choose to model the impacts of technological advancements primarily as a reduction in the future cost of finding and producing domestic oil and natural gas resources. BOEM resource assessments capture this effect in the price (cost) supply curves, which present estimates of the volumes of economically recoverable resources at various product prices.

III. Methodology and Data Sources

1. U.S. OCS:

A. Data Sources: All U.S. OCS analysis in this report, with the exception of production data, is developed and maintained by BOEM. Oil and gas production data on the U.S. OCS are maintained by DOI's Bureau of Safety and Environmental Enforcement and incorporated by BOEM into assessments of undiscovered and discovered resources. The foundational subsurface data includes both published information and proprietary geologic, geophysical, and engineering data collected by industry from operations performed under permits or mineral leases and obtained by BOEM.

Based on existing offshore administrative boundaries (see figure 1), the cumulative production, reserves, contingent resources, and undiscovered resources that exist within the geographic area identified by BOEM as the Western Gulf of Mexico Planning Area were allocated to the State of Texas. Cumulative production, proved reserves, contingent resources, and undiscovered resources that exist on U.S. OCS blocks in the Central Gulf of Mexico Planning Area were also allocated based on existing offshore administrative boundaries to the States of Louisiana, Mississippi, and Alabama, as appropriate.

B. Reserves and Production: Reserve data for the U.S. OCS off the coasts of Texas, Louisiana, Mississippi, and Alabama are derived from BOEM-internal databases, using a cutoff date of December 31, 2019. A summary of reserves and production data is available in OCS Report BOEM 2021-052, "Estimated Oil and Gas Reserves Gulf of Mexico OCS Region December 31, 2019".

Note that cumulative oil and gas production data for the U.S. OCS are available through the end of 2021 (23.36 Bbo, 192.59 Tcf, 57.63 BBOE total), but are not included in the summary tables 1(b) and 2(b) as reserves and contingent resources data are only available through end of 2019. The BOEM reserves database is currently undergoing an upgrade to enable reporting of probabilistic reserve estimates, which BOEM considers to be an improvement over the existing deterministic database. The delivery of the probabilistic reserves database is expected by the end of calendar year 2023. Production data must be reported using the same date cutoff as reserves data (tables 1(b) and 2(b)), since all increases in production have an equal decrease in reserves.

C. Reserves Appreciation: Cumulative production plus total estimated future production (from reserves) equals the estimate of the ultimate recovery (EUR) from a field. Predicting a field's true EUR requires an estimate of its future reserves growth or appreciation. During the initial

years after discovery, reserve estimates typically increase rapidly. The rate of growth then tends to level off at a much smaller annual rate of increase. Appreciation is the result of numerous factors that occur as a field is developed and produced, most importantly:

- consistently conservative standard industry practices for reporting proved reserves;
- an increased understanding of the petroleum reservoir;
- physical expansion of the field through the discovery of new reservoirs or the extension of existing reservoirs; and
- improved recoveries due to experience with actual field performance, the implementation of new technology, or changes in the cost-price relationships.

As part of the BOEM national resource assessment process identified in the "Report to Congress: Comprehensive Inventory of U.S. Outer Continental Shelf Oil and Natural Gas Resources", February 2006 (Minerals Management Service, 2006), the initial reserves estimate for each active and expired field in the GOM is grown at the geologic play level 50 years from the field's geologic play discovery date using a reserves growth function. The growth functions are developed using the BOEM database of U.S. OCS fields with reserves and were calculated by dividing the estimate of reserves for all fields of the same age by the estimate of reserves for the same fields in the previous year. Growth factors represent the ratio of the size of a field several years after discovery to the initial estimate of its size in the year of discovery. The assumptions central to this analysis are:

- the amount of growth in any year is proportional to the size of the field;
- this proportionality varies inversely with the age of the field;
- the age of the field is a reasonable proxy for the degree to which the factors causing appreciation have occurred; and
- the factors causing future appreciation will result in patterns and magnitudes of growth similar to those observed in the past.

D. Undiscovered Resources: Estimates of UTRR are based on BOEM's "Assessment of Undiscovered Oil and Gas Resources of the Nation's Outer Continental Shelf, 2021" (BOEM Fact Sheet 2021-09).[4] A complete description of the methodology that BOEM uses to assess undiscovered resources is available in OCS reports BOEM 2021-071[5] and 2021-082.[6] Mean estimates of UTRR were allocated to the States of Texas, Louisiana, Mississippi, and Alabama using the methods described above.

2. State Waters:

A. Data Sources: The data for the State water component of this assessment comes from two sources within the Federal Government. The USGS provided to BOEM the most recent results of

[4] Available at https://www.boem.gov/sites/default/files/documents/oil-gas-energy/resource-evaluation/2021%20Fact%20Sheet_0.pdf
[5] Full report is available here "2021 National Assessment of Undiscovered Oil and Gas Resources of the U.S. Outer Continental Shelf"
[6] Full report is available here "2021 Assessment of Technically and Economically Recoverable Oil and Natural Gas Resources of the Gulf of Mexico Outer Continental Shelf "

an assessment of the potential volume of undiscovered conventionally recoverable oil and gas resources within State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama. The EIA provided to BOEM estimates of reserves and annual production that are collected from operators of fields located within State waters.

B. Reserves and Production: EIA maintains a historical database of reserve estimates and production data for oil and gas fields located in State waters. This database consists of operator-reported reserves estimates and production submitted on Form EIA-23L. EIA provided BOEM with annual production for natural gas and oil, and reserve estimates for fields located in State waters for the period from 1985-2019. Estimates for the volume of cumulative production prior to 1985 were taken from *Federal Offshore Statistics: 1995* (MMS, 1997).

EIA's survey information is primarily collected under the authority of the Federal Energy Administration Act of 1974 (Pub. L. No. 93-275, 15 U.S.C. 761 et seq.) and the DOE Organization Act (Pub. L. No. 95-91, 42 U.S.C. 7101 et seq.). EIA and BOEM developed a data sharing agreement to share information in the possession of the EIA under 15 U.S.C. 771(f), which provides that EIA shall disclose certain data to "other Federal Government departments, agencies, and officials for official use upon request."

C. Reserves Appreciation: BOEM incorporates the State water reserve data as it was received from EIA with no adjustments for appreciation or growth.

D. Undiscovered Resources: USGS prepares estimates of undiscovered conventionally recoverable oil and gas resources of the onshore United States and within State waters adjacent to each State. Undiscovered conventionally recoverable resources are equivalent to BOEM's UTRR. The USGS allocated the resource estimates to the individual State waters offshore Texas, Louisiana, Mississippi, and Alabama from the larger resource estimates conducted as part of its Gulf Coast petroleum assessment. The USGS used a variety of data and information to conduct geologically-based assessments of more than 80 assessment units and plays, more than 40 of which extended offshore into State waters. USGS makes available publications detailing and explaining the conventional assessment methodologies (Schmoker and Klett, 2005; Charpentier and Klett, 2005), which have been subjected to rigorous peer reviews by non-Federal panels.

IV. Results

The results in this section are summarized by State and aggregated to a total GOM estimate for both State waters (table 2(a)) and the U.S. OCS (table 2(b)). Additionally, results are described and shown graphically for both State waters and the U.S. OCS for the categories of cumulative production (figures 3 (a) and (b)), reserves (figures 4(a) and (b)), and undiscovered resources (figures 7(a) and (b)). Contingent resources (figure 5) and reserves appreciation (figures 6) are only shown graphically for the U.S. OCS. Finally, the total endowment by product type and by State is shown for both State waters and the U.S. OCS (figures 8(a) and (b)).

Table 2(a): Total Endowment of Technically Recoverable Oil and Gas Resources in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama, 2022

State	Resources in Known Fields		Undiscovered Technically Recoverable Resources (mean estimate)	Total Endowment
	Cumulative Production (through 2020)	Reserves (2020)		
OIL (Billion Barrels)				
Texas	0.07	0.00	0.41	0.48
Louisiana	1.88	0.01	0.97	2.86
Mississippi	0.00	0.00	0.07	0.07
Alabama	0.00	0.00	0.05	0.05
Total Oil in State Waters off the Coasts of TX, LA, MS, and AL	1.95	0.01	1.50	3.46
NATURAL GAS (Trillion Cubic Feet)				
Texas	4.95	0.00	11.31	16.26
Louisiana	14.60	0.04	22.06	36.70
Mississippi	0.00	0.00	2.89	2.89
Alabama	4.01	0.72	1.05	5.78
Total Gas in State Waters off the Coasts of TX, LA, MS, and AL	23.56	0.76	37.31	61.63
Barrels of Oil Equivalent (BOE; Billion Barrels)				
Texas	0.95	0.00	2.42	3.38
Louisiana	4.48	0.02	4.90	9.39
Mississippi	0.00	0.00	0.58	0.58
Alabama	0.71	0.13	0.24	1.08
Total BOE in State Waters off the Coasts of TX, LA, MS, and AL	6.14	0.15	8.14	14.43

Table 2(b): Total Endowment of Technically Recoverable Oil and Gas Resources in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama, 2022

State	Resources in Known Fields				Undiscovered Technically Recoverable Resources (mean estimate; updated 2021)	Total Endowment
	Cumulative Production (through end of 2019)	Reserves (end of 2019)	Contingent Resources (end of 2019)	Reserves Appreciation (end of 2019)		
OIL (Billion Barrels)						
Texas	1.18	0.07	0.52	0.68	6.05	8.51
Louisiana	20.77	4.57	3.22	7.56	18.06	54.18
Mississippi	<0.001	<0.001	<0.001	<0.001	0.16	0.16
Alabama	0.17	<0.01	0.02	0.08	0.42	0.68
Total Oil in the U.S. OCS off the Coasts of TX, LA, MS, and AL	22.12	4.65	3.75	8.32	24.70	63.54
NATURAL GAS (Trillion Cubic Feet)						
Texas	35.15	0.20	1.42	5.72	11.39	53.88
Louisiana	152.02	5.82	7.37	17.01	28.54	210.76
Mississippi	0.62	0.02	0.01	0.20	0.33	1.18
Alabama	3.09	0.06	0.15	0.95	2.31	6.56
Total Gas in the U.S. OCS off the Coasts of TX, LA, MS, and AL	190.88	6.10	8.94	23.88	42.58	272.38
Barrels of Oil Equivalent (BOE; Billion Barrels)						
Texas	7.44	0.11	0.77	1.70	8.08	18.10
Louisiana	47.82	5.61	4.53	10.58	23.14	91.68
Mississippi	0.11	<0.01	0.00	0.04	0.22	0.37
Alabama	0.72	0.01	0.04	0.24	0.83	1.85
Total BOE in the U.S. OCS off the Coasts of TX, LA, MS, and AL	56.09	5.74	5.35	12.57	32.27	112.01

1. ***Cumulative Production***: Cumulative production is a measured quantity that can be accurately determined and reported. The uncertainty associated with these estimates is less than with comparable estimates of volumes of reserves and considerably less than estimates of undiscovered resources. Cumulative production through 2020 from State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama includes 1.95 Bbo and 23.56 Tcf (6.14 BBOE total) as shown in figure 3(a) and table 2(a). Cumulative production through 2019[7] from the U.S. OCS includes 22.12 Bbo and 190.88 Tcf (56.09 BBOE total; figure 3(b) and table 2(b)).

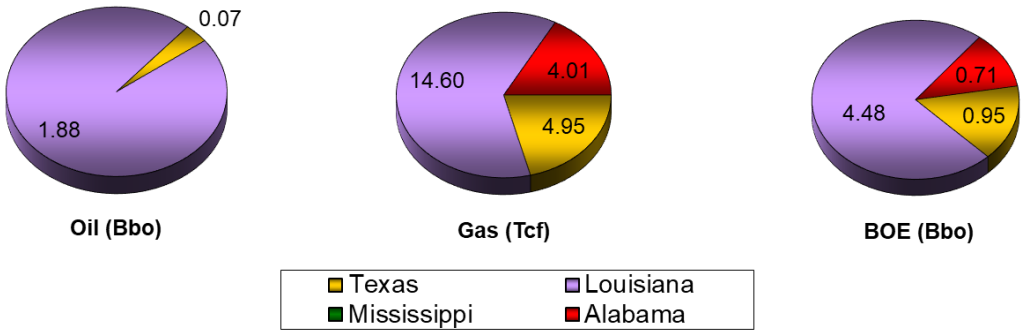


Figure 3(a): Distribution of Cumulative Production in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

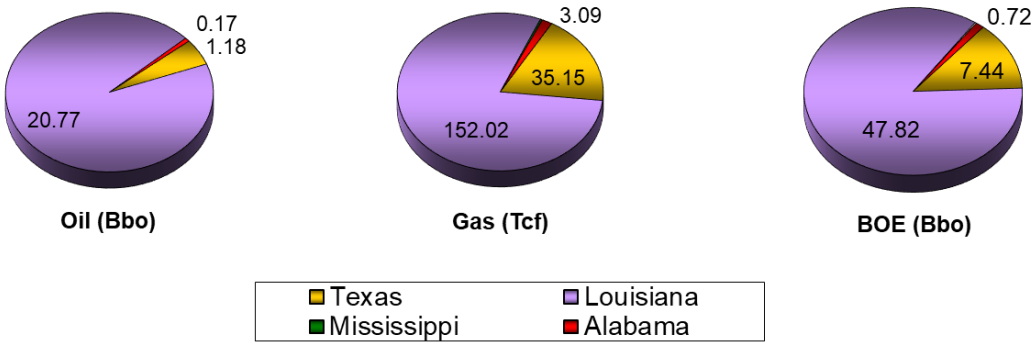


Figure 3(b): Distribution of Cumulative Production in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

[7] As noted earlier, oil and gas production data for the U.S. OCS are available through calendar year 2021 but are not aggregated into the total endowment as U.S. OCS reserves data are only available through calendar year 2019.

2. ***Reserves***: Reserves are frequently estimated at different stages during the exploration and development cycle of a hydrocarbon accumulation, i.e., after exploration and delineation drilling, during development drilling, after some production and, finally, after production has been well-established. Different methods of estimating the volume of reserves are appropriate at each stage. Reserve estimating procedures generally progress from volumetric to performance-based techniques as oil and gas fields mature. The relative uncertainty associated with these estimates decreases as more subsurface information and production history become available. Table 2(a) and figure 4(a) show that the total reserves remaining in State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama are estimated to be 0.01 Bbo and 0.76 Tcf (0.15 BBOE). Table 2(b) and figure 4(b) show that the total reserves remaining in the over 1300 fields in the OCS off the coasts of Texas, Louisiana, Mississippi, and Alabama are estimated to be 4.65 Bbo and 6.10 Tcf (5.74 BBOE total).

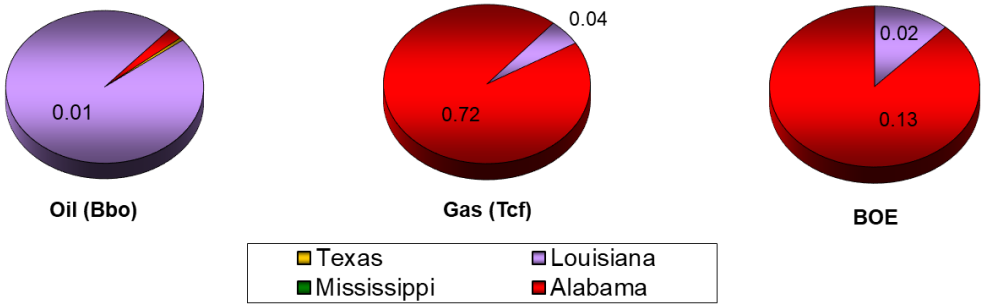


Figure 4(a): Distribution of Reserves in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

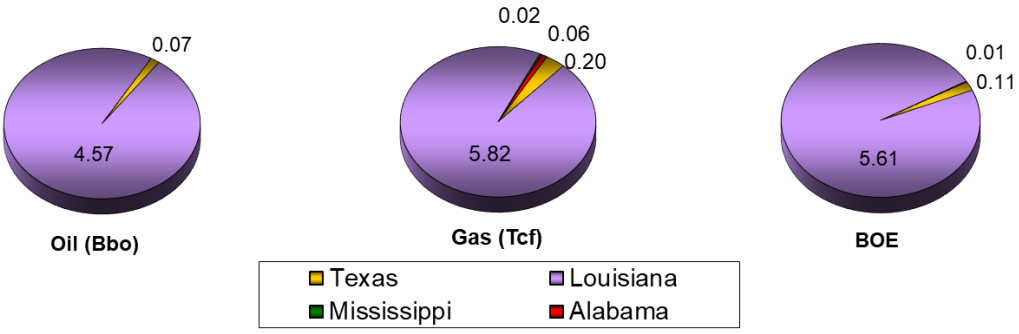


Figure 4(b): Distribution of Reserves in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

3. ***Contingent Resources:*** The contingent resources remaining in the over 1300 fields in the OCS off the coasts of Texas, Louisiana, Mississippi, and Alabama are estimated to be 3.75 Bbo and 8.94 Tcf (5.35 BBOE total) (table 2(b) and figure 5). Contingent resources are not available for reporting in State waters.

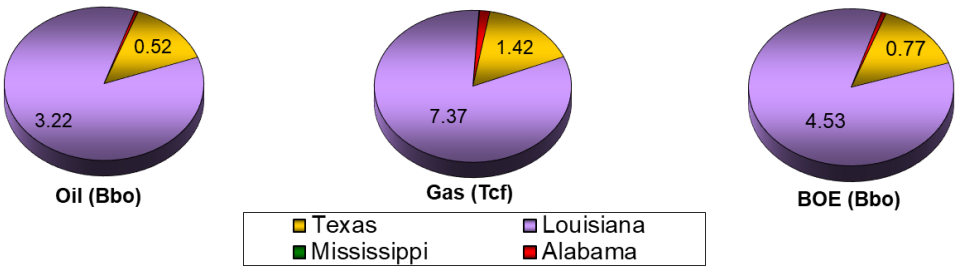


Figure 5: Distribution of Contingent Resources in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

4. ***Reserves Appreciation***: Reserves appreciation in the OCS routinely exceeds new field discoveries and contributes the bulk of annual additions to proved reserves; it is an important consideration in any analysis of future oil and natural gas supplies. Future reserves appreciation within the existing active fields in the OCS off the coasts of Texas, Louisiana, Mississippi, and Alabama is estimated at 8.32 Bbo and 23.88 Tcf (12.57 BBOE total) (table 2(b) and figure 6). Reserves appreciation data are not available for oil and gas fields in State waters.

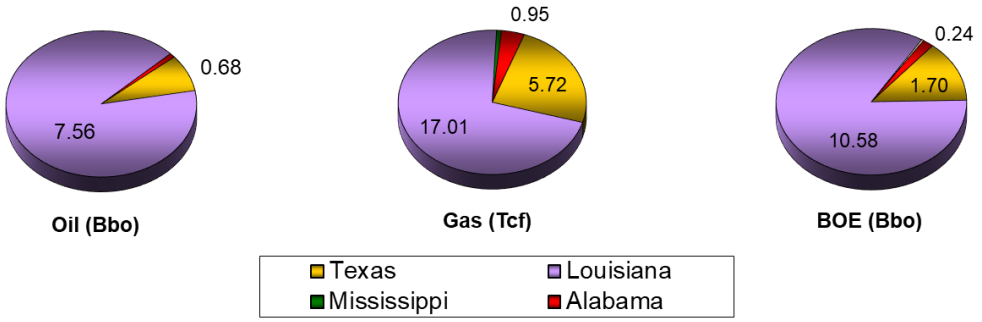


Figure 6: Distribution of Reserves Appreciation in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

5. ***Undiscovered Resources***: Estimates of the undiscovered resources for State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama have a mean of 1.50 Bbo and 37.31 Tcf (8.14 BBOE total) (figure 7(a) and table 2(a)). Similarly, estimates for the OCS have a mean of 24.70 Bbo and 42.58 Tcf (32.27 BBOE total) (figure 7(b) and table 2(b)).

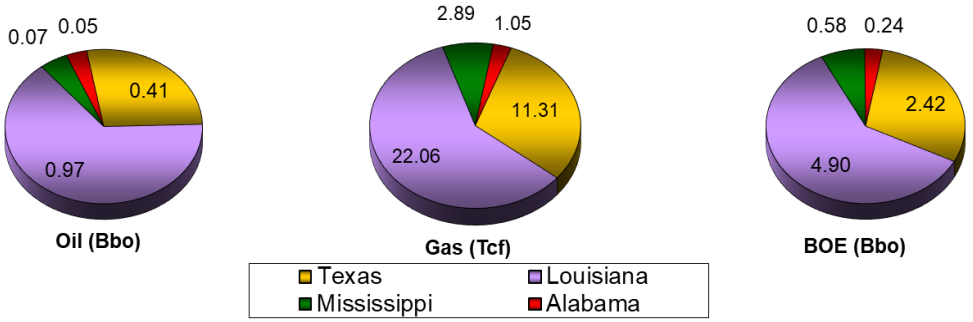


Figure 7(a): Distribution of Undiscovered Resources in the State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

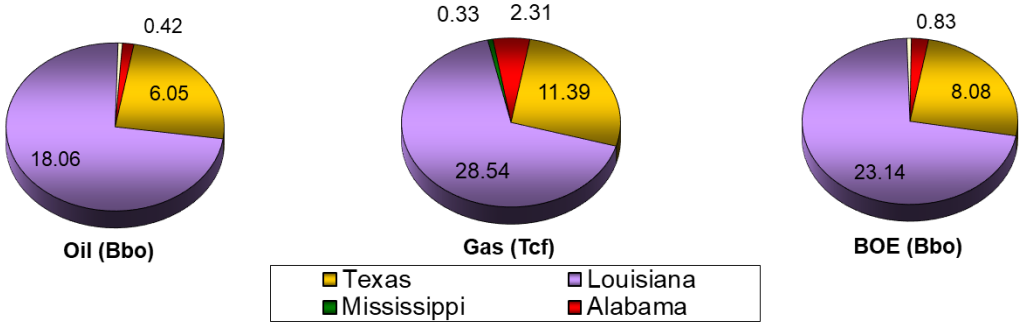


Figure 7(b): Distribution of UTRR in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type and State

6. ***Total Endowment***: The total hydrocarbon endowment for State waters off the coasts of Texas, Louisiana, Mississippi, and Alabama is 3.46 Bbo and 61.63 Tcf (14.43 total BBOE) (figure 8(a) and table 2(a)). Approximately 43 percent of the total BOE endowment has already been produced.

   The total hydrocarbon endowment for the OCS off the coasts of Texas, Louisiana, Mississippi, and Alabama is 63.54 Bbo and 272.38 Tcf (112.01 BBOE total) (figure 8(b) and table 2(b)). Approximately 50 percent of the total BOE endowment has already been produced. An additional 21 percent is contained within the various reserves categories, the source of near and midterm production.

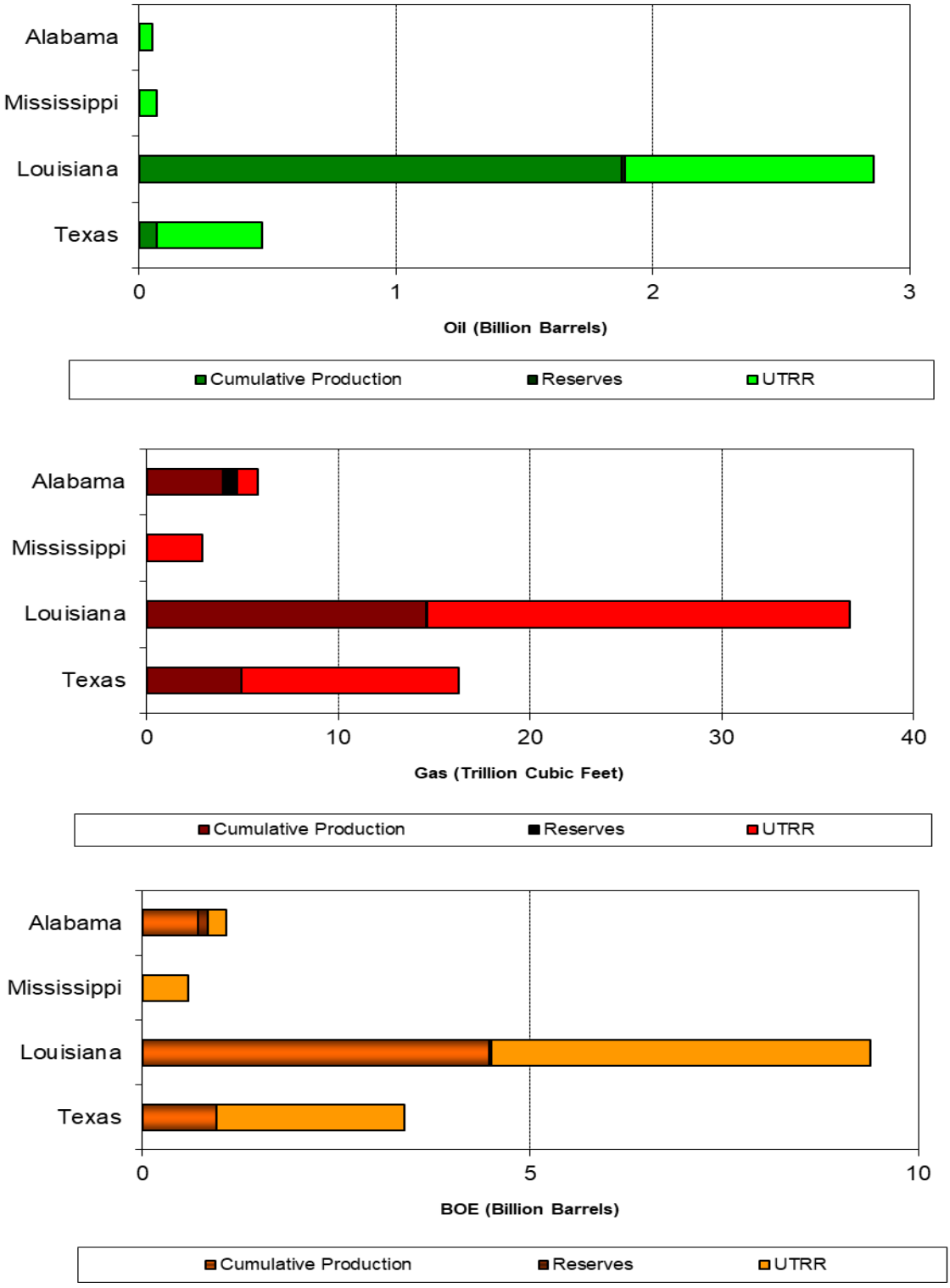
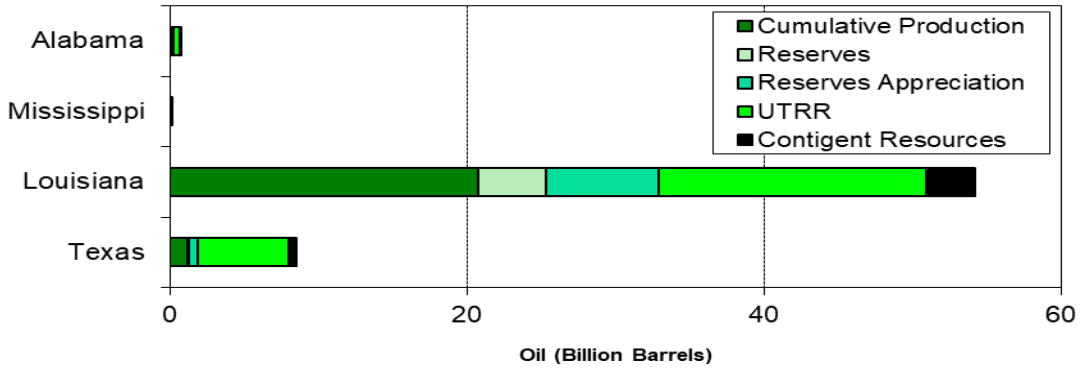
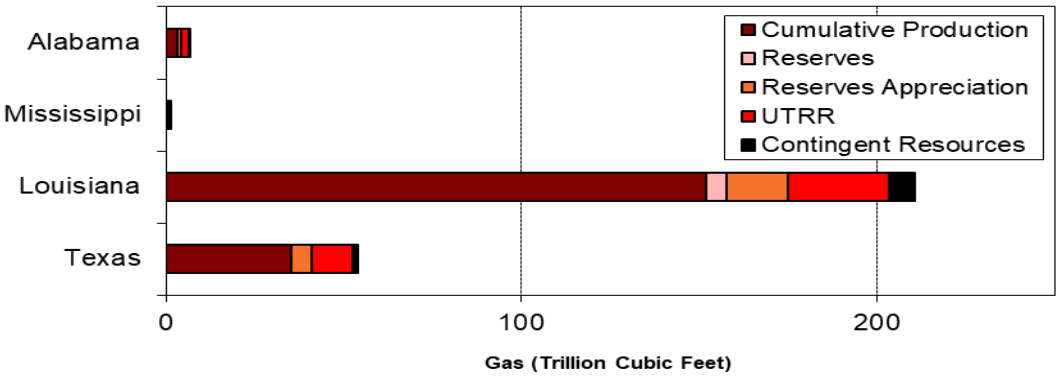


Figure 8(a): Distribution of Total Hydrocarbon Endowment in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type, State, and Resource Category





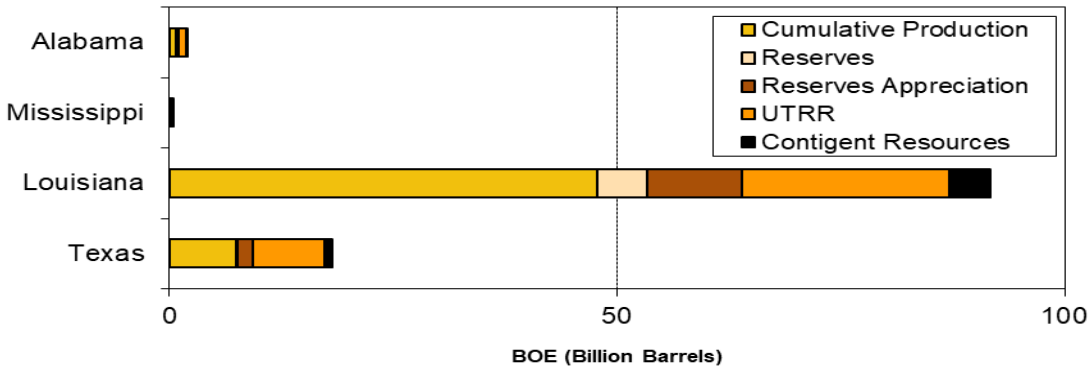


Figure 8(b): Distribution of Total Hydrocarbon Endowment in the U.S. OCS off the Coasts of Texas, Louisiana, Mississippi, and Alabama by Type, State, and Resource Category

V. Conclusions

This report finds that total hydrocarbon endowment, which includes cumulative production, discovered reserves, and undiscovered resources, in the State waters offshore Texas, Louisiana, Mississippi, and Alabama, is 3.46 Bbo and 61.63 Tcf (14.43 BBOE total). For the U.S. OCS, the total hydrocarbon endowment (including cumulative production, discovered reserves plus reserves growth, contingent resources, and undiscovered resources) is 63.54 Bbo and 272.38 Tcf (112.01 BBOE total).

Of the total endowment in State waters, approximately 43 percent has been produced and 56 percent remains undiscovered. Just over 1 percent remains as discovered reserves in known fields. Over 75 percent of the total endowment in State waters are natural gas resources.

Of the total endowment in the U.S. OCS offshore Texas, Louisiana, Mississippi, and Alabama, approximately 50 percent has been produced and 21 percent is discovered remaining resources (the aggregation of reserves plus growth and contingent resources). Approximately 29 percent of the total endowment on the OCS remains undiscovered. Unlike the gas-rich province of the State waters, oil resources comprise about 57 percent of the total endowment on the OCS, including a large oil component that remains undiscovered.

Appendices

Appendix A: Glossary
Appendix B: Abbreviations, Acronyms, and Symbols
Appendix C: References

Appendix A: Glossary

The glossary defines relevant terms generally rather than in a strictly technical manner.

American Petroleum Industry (API) Gravity: An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API. The higher the API gravity, the lighter the fluid.

Appreciation: Analogous to reserves appreciation. See "reserves."

Assessment: The estimation of potential amounts of technically recoverable hydrocarbon resources.

Associated Gas: See "gas, natural."

Barrel: A volumetric unit of measure for crude oil equivalent to 42 U.S. gallons.

Barrel of Oil-Equivalent (BOE): The sum of gas resources, expressed in terms of their energy equivalence to oil, plus the oil volume. The conversion factor of 5,620 standard cubic feet of gas equals 1 BOE is based on the average heating values of domestic hydrocarbons.

Condensate: Hydrocarbons associated with saturated gas that are present in the gaseous state at reservoir conditions but are produced as liquid hydrocarbons at the surface.

Contingent Resources: The quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects but which are not currently considered to be commercially recoverable due to one or more contingencies.

Conventionally Recoverable: Producible by natural pressure, pumping, or secondary recovery methods, such as gas or water injection.

Cumulative Production: The sum of all produced volumes of hydrocarbons prior to a specified point in time.

Deterministic: A process in which future states can be forecast exactly from knowledge of the present state and rules governing the process. It contains no random or uncertain components.

Development: Activities following exploration, including the installation of production facilities and the drilling and completion of wells for production.

Dissolved Gas: See "gas, natural."

Economic Analysis: An assessment performed in order to estimate the portion of the undiscovered conventionally recoverable resources in an area that is expected to be commercially viable in the long term under a specific set of economic conditions.

Economic Risk: See “risk.”

Estimated Ultimate Recovery (EUR): See “reserves.”

Exploration: The process of searching for minerals prior to development. Exploration activities include geophysical surveys, drilling to locate hydrocarbon reservoirs, and drilling of delineation wells to determine the extent and quality of an existing discovery prior to a development decision.

Field: A producible accumulation of hydrocarbons consisting of a single pool or multiple pools related to the same geologic structure or stratigraphic condition. In general, usage of this term refers to a commercial accumulation.

Gas, Natural: A mixture of gaseous hydrocarbons (typically methane with lesser amounts of ethane, propane, butane, pentane, and possibly some nonhydrocarbon gases).

Associated Gas: Natural gas that occurs in crude oil reservoirs as free gas (gas cap).

Dissolved Gas: Natural gas that occurs as gas in solution within crude oil reservoirs.

Non-associated Gas: Natural gas that occurs in reservoirs not in contact with significant quantities of crude oil.

Geologic risk: See “risk.”

Growth Factor: A function used to calculate an estimate of a field’s size at a future date. Growth factors reflect technology, market, and economic conditions existing over the period spanned by the estimates.

Hydrocarbons: Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbons include crude oil and natural gas. As used in this report, the term is synonymous with petroleum.

Mean: A statistical measure of central tendency; the arithmetic average or expected value, calculated by summing all values and dividing by the number of values.

Model: A geologic hypothesis expressed in mathematical form.

Non-associated Gas: See “gas, natural.”

Oil, Crude: A mixture of hydrocarbons that exists naturally in the liquid phase in subsurface reservoirs.

Outer Continental Shelf (OCS): The continental margin, including the shelf, slope, and rise, beyond the line that marks the boundary of State ownership; that part of the seabed under Federal jurisdiction.

Petroleum: A collective term for oil, gas, and condensate.

Play: A group of known or postulated pools that share common geologic, geographic, and temporal properties, such as history of hydrocarbon generation, migration, reservoir development, and entrapment.

Probability: A means of expressing an outcome on a numerical scale that ranges from impossibility to absolute certainty; the chance that a specified event will occur.

Recoverable Resources: See "resources."

Reserves: Those quantities of hydrocarbon resources anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria: They must be discovered, recoverable, commercial, and remaining (as of a given date) based on the development project(s) applied. Reserves are further sub-classified based on economic certainty.

Proved Reserves: The quantities of hydrocarbons estimated, with reasonable certainty, to be commercially recoverable from known accumulations 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 do not include reserves appreciation.

Reserves Appreciation: The observed incremental increase through time in the estimates of reserves of an oil 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.

Estimated Ultimate Recovery (EUR): All hydrocarbon resources within known fields that can be profitably produced using current technology under existing economic conditions. Estimates of EUR equal the sum of cumulative production, reserves, and reserves appreciation.

Reservoir: A subsurface, porous, permeable rock body in which an isolated accumulation of oil or gas is stored.

Resource Assessment: The estimation of potential amounts of recoverable resources. The focus is normally on conventionally or technically recoverable hydrocarbons.

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.

Recoverable Resources: The volume of hydrocarbons that is potentially recoverable, regardless of the size, accessibility, recovery technique, or economics of the postulated accumulations.

Technically 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, or oil and gas that may be present in insufficient quantities or quality (low permeability "tight" reservoirs) to be produced via conventional recovery techniques.

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.

Undiscovered Technically Recoverable Resources (UTRR): 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.

Risk: The chance or probability that a particular event will not occur.

Economic Risk: The chance that no commercial accumulation of hydrocarbons will exist in the area under consideration (e.g., prospect, play, or area). The chance that an area may not contain hydrocarbons, or the volume present may be noncommercial is incorporated in the economic risk.

Geologic Risk: The chance that technically recoverable volumes of hydrocarbons will not exist in the area under consideration (e.g., prospect, play, basin or area). The commercial viability of an accumulation is not a consideration.

Stochastic: A process in which each observation possesses a random variable.

Subjective Judgment: A technique utilized to assign probabilities of occurrence to possible events when all of the possible outcomes of an event are not known and when the

frequency of recognized outcomes cannot be estimated with certainty; often referred to as expert opinion.

Total Endowment: All conventionally recoverable hydrocarbon resources of an area. Estimates of total endowment equal the sum of undiscovered resources, cumulative production, reserves, contingent resources, and reserves appreciation.

Uncertainty: Imprecision in estimating the value (or range of values) for a variable.

Undiscovered Resources: See "Recoverable Resources."

Undiscovered Technically Recoverable Resources (UTRR): See "Recoverable Resources."

Appendix B: Acronyms and Units

API	American Petroleum Institute
BOEM	Bureau of Ocean Energy Management
DOE	Department of Energy
DOI	Department of the Interior
EIA	Energy Information Administration
EUR	Estimated Ultimate Recovery
GOM	Gulf of Mexico
MMS	Minerals Management Service
OCS	Outer Continental Shelf
PA	Planning Area
UTRR	Undiscovered Technically Recoverable Resources
U.S.	United States
USGS	U.S. Geological Survey

Bbo	Billion Barrels of Oil
BBOE	Billion Barrels of Oil Equivalent
BOE	Barrel of Oil Equivalent
Tcf	Trillion Cubic Feet

Appendix C: References

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United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

MAR - 2 2023

The Honorable Kevin McCarthy
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

I am enclosing the "Seventh Biennial Report to Congress: Estimates of Natural Gas and Oil Reserves, Reserves Growth, and Undiscovered Resources on the U.S. Outer Continental Shelf and in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama." This report was prepared by the Department of the Interior pursuant to section 965c of the Energy Policy Act of 2005.

A similar letter is being sent to the President of the Senate.

Sincerely,

Laura Daniel-Davis
Principal Deputy Assistant Secretary,
Land and Minerals Management

Enclosure

Copy to: The Honorable Bruce Westerman, Chairman
Committee on Natural Resources

The Honorable Raúl Grijalva, Ranking Member
Committee on Natural Resources

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

MAR - 2 2023

The Honorable Kamala Harris
President of the Senate
Washington, D.C. 20510

Dear Madam President:

I am enclosing the "Seventh Biennial Report to Congress: Estimates of Natural Gas and Oil Reserves, Reserves Growth, and Undiscovered Resources on the U.S. Outer Continental Shelf and in State Waters off the Coasts of Texas, Louisiana, Mississippi, and Alabama." This report was prepared by the Department of the Interior pursuant to section 965c of the Energy Policy Act of 2005.

A similar letter is being sent to the Speaker of the House.

Sincerely,

Laura Daniel-Davis
Principal Deputy Assistant Secretary,
Land and Minerals Management

Enclosure

Copy to: The Honorable Joe Manchin, Chairman
Committee on Energy and Natural Resources

The Honorable John Barrasso, Ranking Member
Committee on Energy and Natural Resources