



2021 Assessment of Oil and Gas Resources: Assessment of the Pacific Outer Continental Shelf Region



BOEM Bureau of
Ocean Energy Management

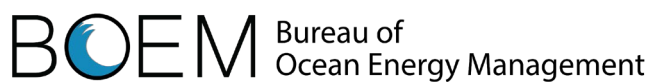
U.S. Department of the Interior
Bureau of Ocean Energy Management
Pacific Outer Continental Shelf Region

2021 Assessment of Oil and Gas Resources: Assessment of the Pacific Outer Continental Shelf Region

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Front Cover. Map of the Pacific OCS Region showing provinces and geologic basins defined for the 2021 National Assessment. Provinces are indicated by color as follows:

Pacific Northwest Province..... tan
Central California Provincegold
Santa Barbara-Ventura Basin Province green
Inner Borderland Province pink
Outer Borderland Province violet



U.S. Department of the Interior
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Pacific Outer Continental Shelf Region

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Abbreviations and Acronyms

API	American Petroleum Institute
°API	Degrees API, a unit of measurement of the American Petroleum Institute for the gravity of oil
Bbbl	billion (10^9) barrels
bbl	barrels
BBOE	billion (10^9) barrels of combined oil-equivalent resources
BOE	barrels of combined oil-equivalent resources
BOEM	Bureau of Ocean Energy Management
BSTB	Billion Standard Tank Barrels
cf	cubic feet
DOI	Department of the Interior
Mcf	thousand (10^3) cubic feet
OCS	Outer Continental Shelf
POCSR	Pacific Outer Continental Shelf Region
Tcf	trillion (10^{12}) cubic feet
UERR	Undiscovered economically recoverable resources
UTRR	Undiscovered technically recoverable resources
U.S.	United States

Introduction

The Bureau of Ocean Energy Management (BOEM, formerly the Minerals Management Service) is responsible for the periodic assessment of undiscovered oil and gas resources within the Outer Continental Shelf (OCS) of the United States. Quantitative assessments of these resources cover submerged Federal lands beyond the Federal-State boundaries in the Alaska, Atlantic, Gulf of Mexico, and Pacific OCS Regions. The most recent comprehensive report can be found in the Assessment of Undiscovered Oil and Gas Resources of the Nation's Outer Continental Shelf, (2021)¹.

This assessment focuses on the Pacific OCS region. It defines the hydrocarbon resource categories and how BOEM classifies them, describes the assessment methodology, the geologic provinces and the Pacific region planning areas. The assessment results are presented and include the total Pacific region hydrocarbon resource endowment along with a comparison to previous assessments.

Executive Summary

The Bureau of Ocean Energy Management (BOEM) is charged with the management and development of energy and mineral resources on the Outer Continental Shelf (OCS) of the United States in an environmentally and economically responsible way. This mandate includes assessing the amounts of technically and economically recoverable undiscovered oil and natural gas resources located outside known oil and gas accumulations for the U.S. OCS.

This report documents the 2021 assessment of undiscovered technically recoverable oil and gas resources (UTRR) and undiscovered economically recoverable resources (UERR) of the Pacific OCS Region of the United States. The Pacific OCS Region includes the Federal offshore areas of Washington, Oregon, California, and Hawaii. Although Hawaii is included in the region, this portion of the OCS has not been assessed (Figure 1).

The 2021 assessment of the Pacific OCS region was performed to develop an updated appraisal of the location and volume of undiscovered resources. It is based upon geological work that was performed for the 2016 National Assessment of Oil and Gas Resources and compiled into [OCS Report BOEM 2017-053](#)² (Ojukwu, C.O., and Smith, K., 2016). The assessment was performed by a team of geoscientists and engineers in Camarillo, California, using a large volume and variety of proprietary and nonproprietary data (including geologic, geochemical, geophysical, petroleum engineering, and economic data) available as of January 1, 2019. The hydrocarbon resources that have been assessed include *oil* (including crude oil and condensate) and *natural gas* (including associated and non-associated gas).

For the purpose of this report, *Oil* is a liquid hydrocarbon resource, which may include crude oil and/or condensate. Crude oil exists in a liquid state in both subsurface and surface conditions. *Condensate* (natural gas liquids) is a very high-gravity (generally greater than 50 °API) liquid, it may exist in a dissolved gaseous state at subsurface conditions but drops out as liquid at surface conditions. The volumetric estimates of oil resources from this assessment represent combined volumes of crude oil and condensate and are reported as standard stock tank barrels (barrels or bbl).

Natural gas is a gaseous hydrocarbon resource, which may include associated and/or non-associated gas. The terms natural gas and gas are used interchangeably in this report. *Associated gas* exists in spatial association with crude oil; it may exist in the subsurface as free (undissolved) gas within a “gas cap” or as gas that is dissolved in crude oil (“solution gas”). *Non-associated gas (dry gas)* does not exist in association with crude oil. Gas resources that can be removed from the subsurface with conventional extraction techniques have been assessed for this project; other gas resources (for example, gas shale and gas hydrates) have not been assessed. The volumetric estimates of gas resources from this assessment represent aggregate volumes of associated and non-associated gas and are reported as standard cubic feet (hereafter “cubic feet” or “cf”).

Oil-equivalent gas is a volume of gas (associated and/or non-associated) expressed in terms of its energy equivalence to oil (that is, 5,620 cubic feet of gas per barrel of oil) and is reported as barrels. The combined volume of oil and oil-equivalent gas resources is referred to as *combined oil-equivalent resources* or *BOE* (barrels of oil equivalent) and is reported as barrels.

For the current assessment, two categories of undiscovered resources were assessed: UTRR are those that can be removed from the subsurface with conventional extraction techniques; UERR are those undiscovered technically recoverable resources that can be extracted profitably under specified economic and technological conditions.

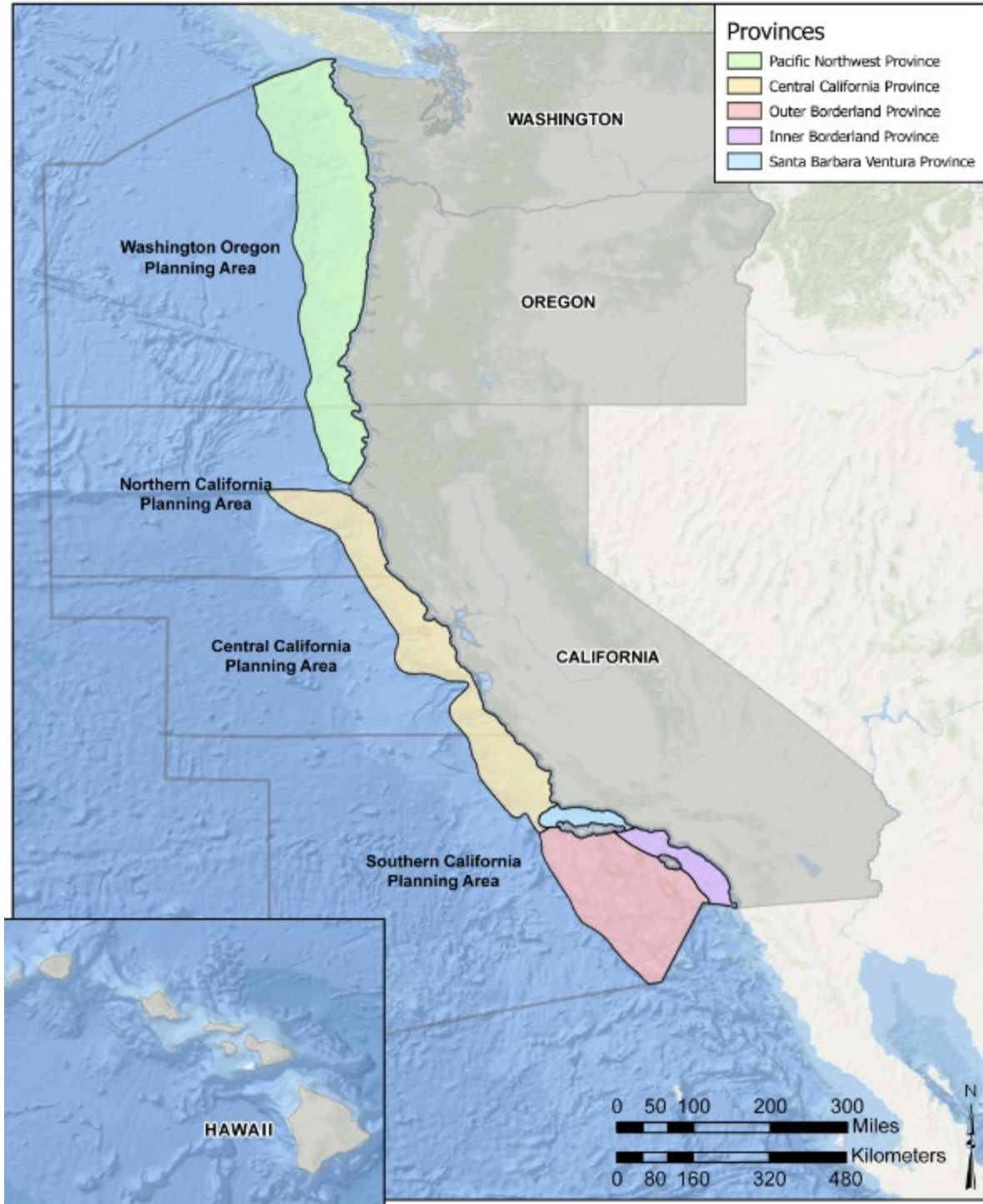


Figure 1: Map showing Pacific OCS Region including Hawaii.

The *total resource endowment* is the sum of the discovered resources (original recoverable reserves and undiscovered resources) has been estimated for areas where resources have been discovered. For areas where there are no known discoveries, the amount of undiscovered technically recoverable resources composes the total resource endowment. The estimation of total resource endowment is

based on previous assessments of discovered resources² and this assessment of undiscovered resources.

The Region is subdivided into five assessment provinces: Pacific Northwest, Central California, Santa Barbara-Ventura Basin, Inner Borderland, and Outer Borderland (Figure 2). The provinces encompass 20 geologic basins and areas in which sediments accumulated and hydrocarbons may have formed. Forty-five *petroleum geological plays* (groups of geologically related hydrocarbon accumulations) have been defined and described in 14 basins and areas, and 41 of these plays have been formally assessed².

For administrative purposes, the Pacific OCS Region is also divided into four planning areas: Washington—Oregon, Northern California, Central California, and Southern California (Figure 3). Planning area boundaries are based on political boundaries such as state or county lines, rather than on geological boundaries, and cut across the geologic assessment basins and areas. Resources have also been estimated for the planning areas; because the original assessment is based on geologic basins and areas, these estimates are more uncertain.

The total volume of UTRR (including crude oil and condensate) of the Region as of January 1, 2019, is estimated to range from 6.91 to 14.20 Bbbl with a mean estimate of 10.20 Bbbl. Relatively large volumes of these oil resources (greater than 1 Bbbl) are estimated to exist in the Point Arena, Bodega, and Santa Maria-Partington basins of the Central California Province, Santa Barbara-Ventura basin Province and Oceanside basin of the Inner Borderland Province. The total volume of undiscovered technically recoverable gas resources (including associated and non-associated gas) in the Region is estimated to range from 10.15 to 23.43 Tcf with a mean estimate of 16.07 Tcf. Relatively large volumes of these gas resources (greater than 1 Tcf) are estimated to exist in the Washington-Oregon area and Eel River basin of the Pacific Northwest Province, the Point Arena and Bodega basins of the Central California Province, the Santa Barbara-Ventura Basin Province, the Lost Angeles-Santa Monica-San Pedro area and Oceanside basin of the Inner Borderland Province, and the Cortes-Velero-Long area of the Outer Borderland Province. The most prolific plays are those having fractured siliceous reservoir rocks. These rocks are presumed to occur in the most of the other southern California basins.

The Region's UERR were estimated at January 1, 2019 market conditions. The price pair estimate used was \$100 per bbl of oil and \$5.34 per Mcf of natural gas. At this price pair, the total volume of UERR is estimated to be 7.15 Bbbl of oil and 9.05 Tcf of natural gas (mean values). These resources include relatively large volumes of oil (greater than 1 Bbbl) and gas (greater than 1 Tcf) in the Point Arena and Bodega basins of the Central California Province and in Santa Barbara-Ventura basin Province.

The total resource endowment of the Region is estimated to be 11.82 Bbbl of oil and 18.36 Tcf of gas (mean estimates). This estimated endowment is composed of discovered resources (originally recoverable reserves and undiscovered technically recoverable resources). Undiscovered resources are estimated to compose a major portion (approximately 79 percent on the basis of mean estimates) of the total oil and gas resource endowment of the Region.

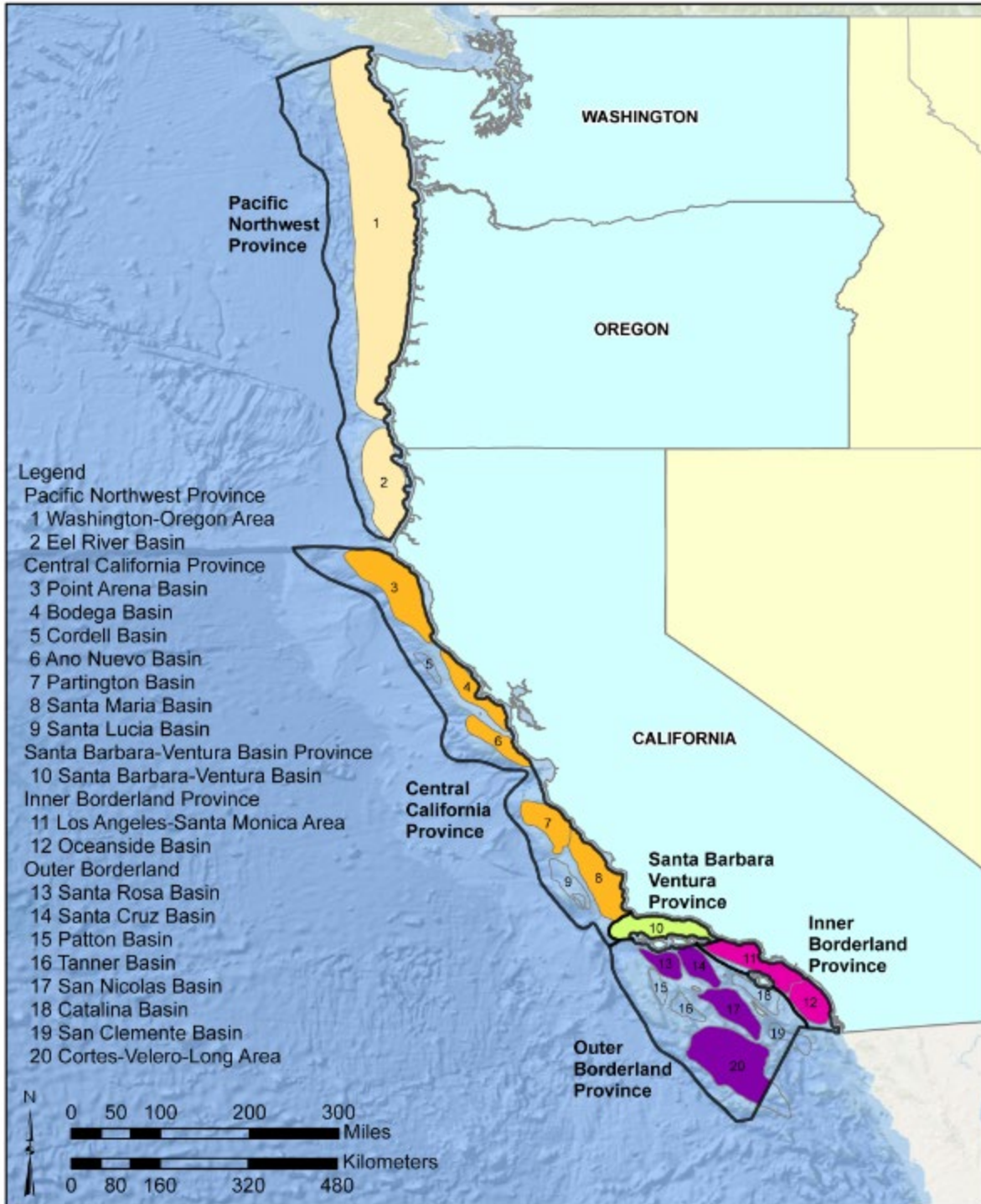


Figure 2: Map of the Pacific OCS Region showing assessment areas, geologic basins and provinces.
Note: Cordell, Santa Lucia, Patton, Tanner, Catalina, and San Clemente basins were not assessed.

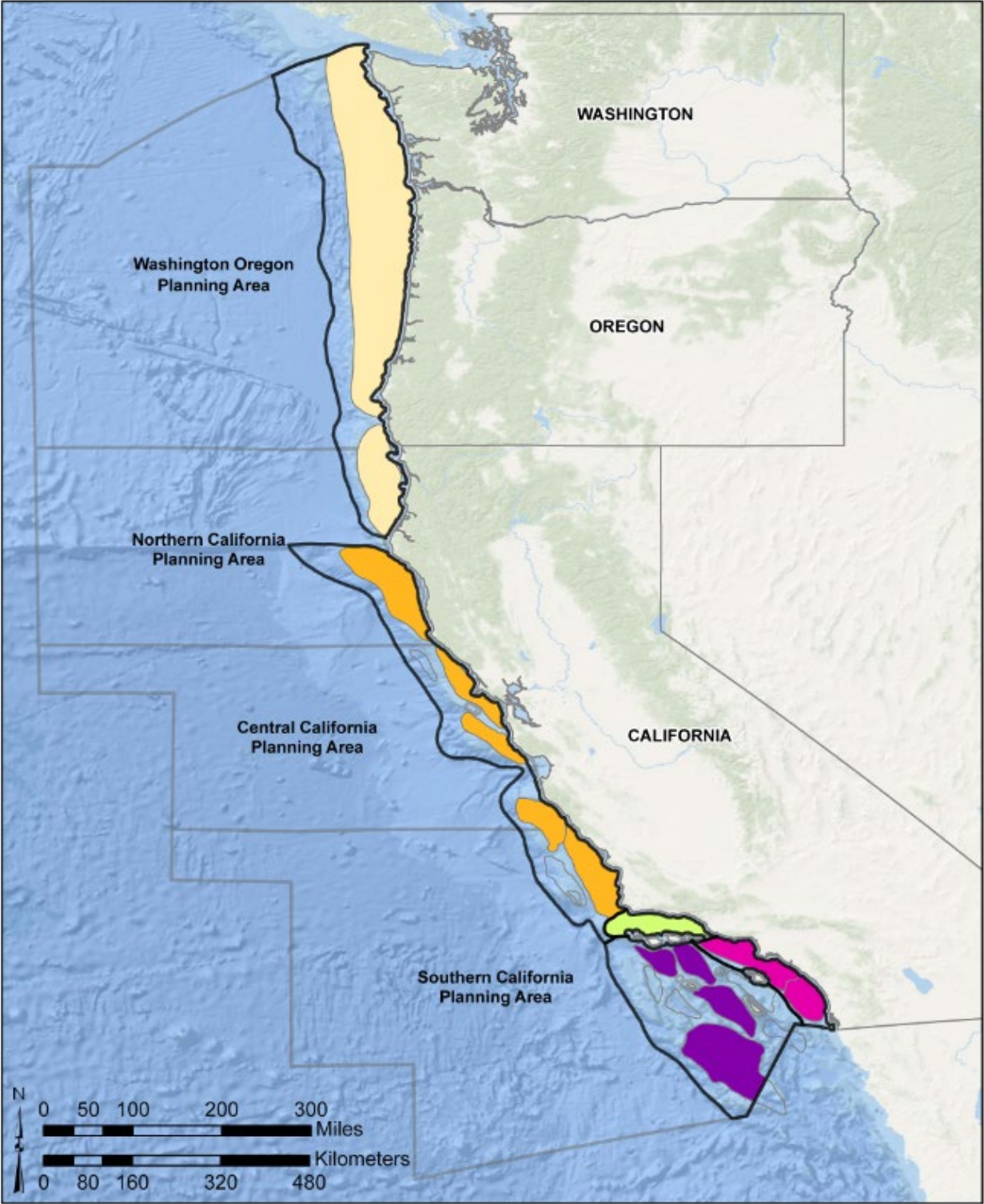


Figure 3: Map showing Pacific OCS planning areas, geologic basins and provinces

Resource Categories

Hydrocarbon resources are generally categorized by their discovery status and commerciality or economic viability. For this assessment, BOEM adopted the classification and definitions based on the Petroleum Resources Management System and Definitions (PRMS)³ developed jointly by the Society of Petroleum Engineers, American Association of Petroleum Geologists, World Petroleum Council and the Society of Petroleum Evaluations (Figure 4.0 and Figure 4.1). Two categories of undiscovered resources have been assessed for this project, and total resource endowments have been estimated. Discovered resources have not been assessed for this project. However, knowledge of their location and volume has been utilized² in the assessment of undiscovered resources and estimation of total resource endowment. The following definitions are provided to ensure proper understanding of the assessed resource categories.

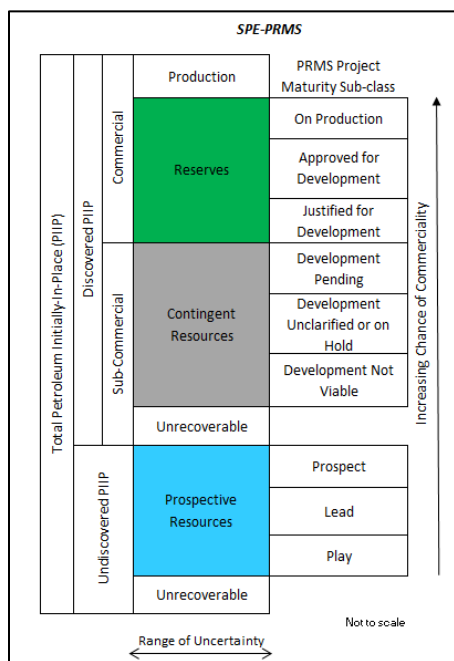


Figure 4.0: Hydrocarbon classification based on Project Maturity. From Petroleum Resources Management System (SPE-PRMS) sponsored by the Society of Petroleum Engineers (SPE), the American Association of Petroleum Geologists (AAPG), the World Petroleum Council (WPC), and the Society of Petroleum Evaluation Engineers (SPEE).

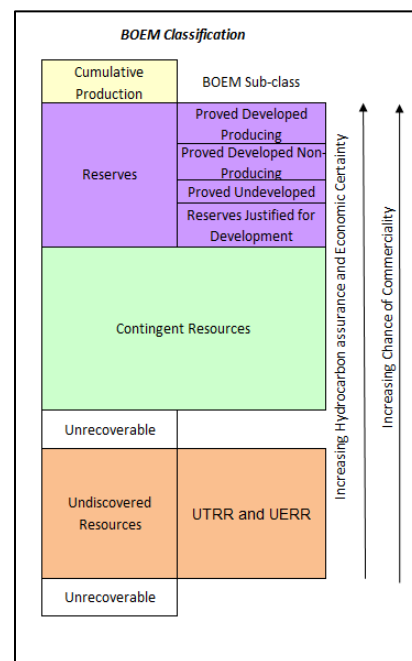


Figure 4.1: BOEM resource classification.

BOEM Resource Classification

Discovered resources are resources that have been discovered and whose location and volume have been estimated using specific geologic knowledge. They include cumulative production, remaining reserves, and recoverable resources.

Original recoverable reserves are the total amount of discovered resources that are estimated to be economically recoverable; they include cumulative production and, remaining. *Cumulative production* is the total amount of discovered resources that have been extracted from an area. *Remaining reserves* are discovered resources that remain to be extracted from an area; they include proved reserves and

unproved reserves. *Proved reserves* are discovered resources that can be estimated with reasonable certainty to be economically recoverable under current economic conditions.

Technically recoverable resources are resources that can be recovered from the subsurface with conventional extraction techniques (that is, technology the usage of which is considered common practice as of this assessment). They include moderate-to-high gravity (generally greater than 10° API) crude oil, condensate, and gas, but do not include low-gravity “heavy” oil, oil shale, gas shale, and gas hydrates.

Economically recoverable resources are technically recoverable resources that can be extracted profitably under specified economic conditions.

Total Resource Endowment, consists of the sum of the discovered resources (original recoverable reserves) and undiscovered resources. This has been estimated for areas where resources have been discovered. Elsewhere, the amount of undiscovered technically recoverable resources comprises the total resource endowment.

Geologic Provinces

For the National Assessment of Undiscovered Oil and Gas Resources, Pacific Region has been divided into geologic assessment provinces based on differences in their geologic and tectonic histories (Figure 2).

The Pacific Northwest province: This includes the Washington–Oregon area and Eel River basin, areas that are within the accretionary complex associated with the Cascadia subduction zone.

The Central California province: This province includes five basins that lie on the continental shelf and slope: Point Arena, Bodega, Año Nuevo, Partington, and Santa Maria. The Partington and Santa Maria basins have been combined as a single assessment area, due to the continuous extent of Neogene strata. Two late Tertiary, continental slope basins (Cordell and Santa Lucia) are also encompassed by the province; however, sufficient petroleum geologic data are lacking in these basins and they have not been evaluated.

The Santa Barbara–Ventura Basin province: has been considered as a separate province because of its unique tectonic and sedimentary history. As part of the western Transverse Ranges, it has undergone as much as 120 degrees of clockwise rotation which has created an incipient east-west trending convergent margin between the Pacific and North American plates, and this has contributed to one of the world’s highest rates of sedimentary accumulation⁴.

The Inner Borderland province: includes coastal basins that formed as a response to the combination of the rotation of the western Transverse Ranges and the accompanying extension of the California Continental Borderland. For this assessment, the Los Angeles basin has been included as a part of the Inner Borderland Province; previously it had been considered as a separate province.

The Outer Borderland province: was also formed as a result of the extension of the California Continental Borderland. However, its distal location and intervening islands and ridges resulted

in a more limited sedimentary section, and it is considered as a separate province for assessment purposes.

Estimates of technically and economically recoverable resources were developed for geologic plays. These plays were defined within basins (or areas) and aggregated to the basins/areas, the provinces and the Region as a whole. A detailed description of the plays, basins and provinces is provided in the Pacific OCS 2011 National Assessment Report ([BOEM 2014-667](#))⁴.

Planning Areas

For lease planning purposes and reporting at a common level in the aggregated National Assessment, the Pacific Region is divided into four planning areas. The planning areas are based on jurisdictional boundaries, rather than on natural geologic or geographic boundaries ([Figure 3](#)).

The Washington–Oregon Planning Area: includes the Washington–Oregon area, and the northern part of the Eel River basin. As such, it is entirely within the Pacific Northwest Province.

The Northern California Planning Area includes most of the Eel River basin and the Point Arena basin. It includes the southern part of the Pacific Northwest Province and the northern part of the Central California Province.

The Central California Planning Area includes the Bodega, Año Nuevo and Partington basins.

The Southern California Planning Area includes the Santa Maria and Santa Barbara basins, and all of the assessment areas of the Inner and Outer Borderland provinces.

Estimates of technically and economically recoverable resources were developed for the planning areas because they are used for the National Program and lease sales. Because the planning area boundaries divide basins and plays that form the basis for the technical evaluation, these estimates have an additional subjective element, that being the apportionment of basin resources to the planning areas.

Resource Assessment Methodology

There are many uncertainties regarding the geologic framework and petroleum geologic characteristics of a given area and the location and volume of its undiscovered oil and gas resources. BOEM used a play-based approach for identification and estimation of geologic resource parameters. For this assessment, BOEM employed probabilistic techniques to capture the range of uncertainty in the geologic resource assessment factors.

The estimate results are reported as a range of values which includes a low estimate corresponding to the 95th percentile value of the distribution (that is, the probability of existence of the estimated volume or more is 95 in 100), a mean (or expected) estimate corresponding to the statistical average of all values in the distribution, and a high estimate corresponding to the 5th percentile value of the distribution (i.e., the probability of existence of the estimated volume or more is 5 in 100). A detailed description of the methodology is provided in the Methodology section of the Pacific OCS 2011 National Assessment report ([BOEM 2014-667](#))⁴.

Consistent with all regional offices, BOEM Pacific incorporated a new standardized methodology for estimating the chance of success for both plays and individual prospects. This newly adopted methodology uses three probabilistic factors to estimate hydrocarbon source, reservoir, seal and their sub-components.

Updates to the Pacific OCS Region Cost Files

Market conditions drive much of the petroleum industry activity so, not surprisingly, economic factors must be considered in the estimation of UERR volumes. A range of hydrocarbon pool sizes (consistent with available region-specific G&G data), commodity prices, and capital asset expenditures throughout the exploration and production cycle were evaluated. These scenarios simulated how much of the petroleum resources thought to exist would be captured.

For the 2021 assessment updates were made to the Pacific cost files to reflect most recent available economic data. Costs were estimated for each of the capital assets used in the full cycle exploration, development and production of oil and gas resources in the Pacific OCS. These assets include exploration drilling, delineation drilling, production drilling and completion, platform hull, topsides and production processing equipment, and pipeline installation. The methodology used is comprised of two key steps 1) The simulation of exploration, delineation, development and production of hydrocarbon resources contained in different field sizes; and 2) the modelling, curve fitting and extrapolation of cost estimates at different values and combinations of cost driving parameters such as water depth, drill depth, number of slots in a platform, pipeline diameter, maximum production capacity, etc. BOEM used a commercially available cost estimation software (Ques\$tor)⁵ to represent the costs described above based on a six-month period in 2019.

The final cost files were updated for the following assets:

- a) Exploration drilling and delineation drilling costs and subsea drilling and completion costs were obtained using an appropriate range of water depths, rig types, and maximum drill depths.

- b) Platform production well drilling and completion costs were estimated from simulated field development assuming the drill rig was mounted on the production platform.
- c) Platform cost and platform removal costs were simulated using combinations of water depth and number of slots on the platform. Water depth governed the type of platform used; fixed platform (water depths < 1,000 ft) and floating platform (water depth >1,000 ft).
- d) Oil and gas production processing equipment costs were simulated based on the platform's maximum processing capacity which must meet or exceed the fields' production profile.
- e) Oil and gas pipeline costs were generated from simulated oil and gas fields. Pipeline cost per mile is a function of pipeline diameter and water depth. The pipeline diameters considered ranged in size from 2 to 42 inches. For each specific pipeline diameter, simulations were done at varying water depths.

Resource Assessment Results

Undiscovered Technically Recoverable Resources

Estimates of the total volume of undiscovered technically recoverable resources in the Region were developed by statistically aggregating the constituent play estimates. Based on this assessment, the Pacific OCS is assessed to contain a total volume of (mean estimates) UTRR of 10.20 Bbbl of oil and 16.07 Tcf of natural gas totaling 13.06 billion of barrels of oil equivalent (BBOE). Table 1 presents detailed UTRR values by basins for the low (95th percentile), mean, and high (5th percentile) estimates respectively. Figure 5 presents a schematic of the Pacific UTRR by basins.

In addition, Table 2 and Figure 6 presents the Pacific OCS UTRR results based on provinces at low (95th percentile), mean, and high (5th percentiles) estimates respectively. Table 3 and Figure 7 presents the Pacific OCS UTRR results based on planning areas low (95th percentile), mean, and high (5th percentile) estimates respectively. Table 4 presents the Pacific OCS UTRR results based on water depths.

Table 1: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by basin

Pacific OCS Region		2021 Undiscovered Technically Recoverable Resources (UTRR)								
Province	Basin	Oil (Bbbl)			Gas (Tcf)			BOE (BBOE)		
		95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Pacific Northwest	Washington-Oregon Area	0.00	0.40	1.14	0.00	2.21	5.83	0.00	0.79	2.18
	Eel River	0.01	0.07	0.16	0.27	1.52	2.61	0.06	0.34	0.62
Central California	Point Arena	0.99	2.00	3.43	0.98	2.07	3.67	1.16	2.37	4.08
	Bodega	0.50	1.41	2.69	0.50	1.52	3.05	0.59	1.68	3.24
	Ano Nuevo	0.33	0.71	1.26	0.35	0.75	1.30	0.39	0.84	1.49
	Santa Maria-Partington	0.41	1.11	2.31	0.31	0.83	1.75	0.47	1.25	2.62
Santa Barbara-Ventura	Santa Barbara-Ventura	0.34	1.35	3.52	0.53	2.78	7.62	0.44	1.85	4.87
Inner Borderland	Los Angeles- Santa Monica-San Pedro	0.10	0.90	2.20	0.10	1.03	2.63	0.12	1.08	2.66
	Oceanside-Capistrano	0.00	1.06	2.95	0.00	1.12	3.46	0.00	1.26	3.56
Outer Borderland	Santa Cruz-Santa Rosa	0.00	0.40	0.87	0.00	0.69	1.58	0.00	0.52	1.15
	San Nicolas	0.00	0.49	1.82	0.00	0.79	3.19	0.00	0.63	2.39
	Cortez-Valero-Long Area	0.00	0.31	1.30	0.00	0.75	3.18	0.00	0.44	1.86

Resource values are in billion barrels of oil (Bbbl), trillion cubic feet of gas (Tcf) and billion barrel of oil equivalent (BBOE) for barrel of oil equivalent. 95% indicates a 95 percent chance of at least the amount listed; 5% indicates a 5 percent chance of at least the amount listed. Only mean values are additive. Some total mean values may not be equal the sum of the component values due to independent rounding of tabulated values.

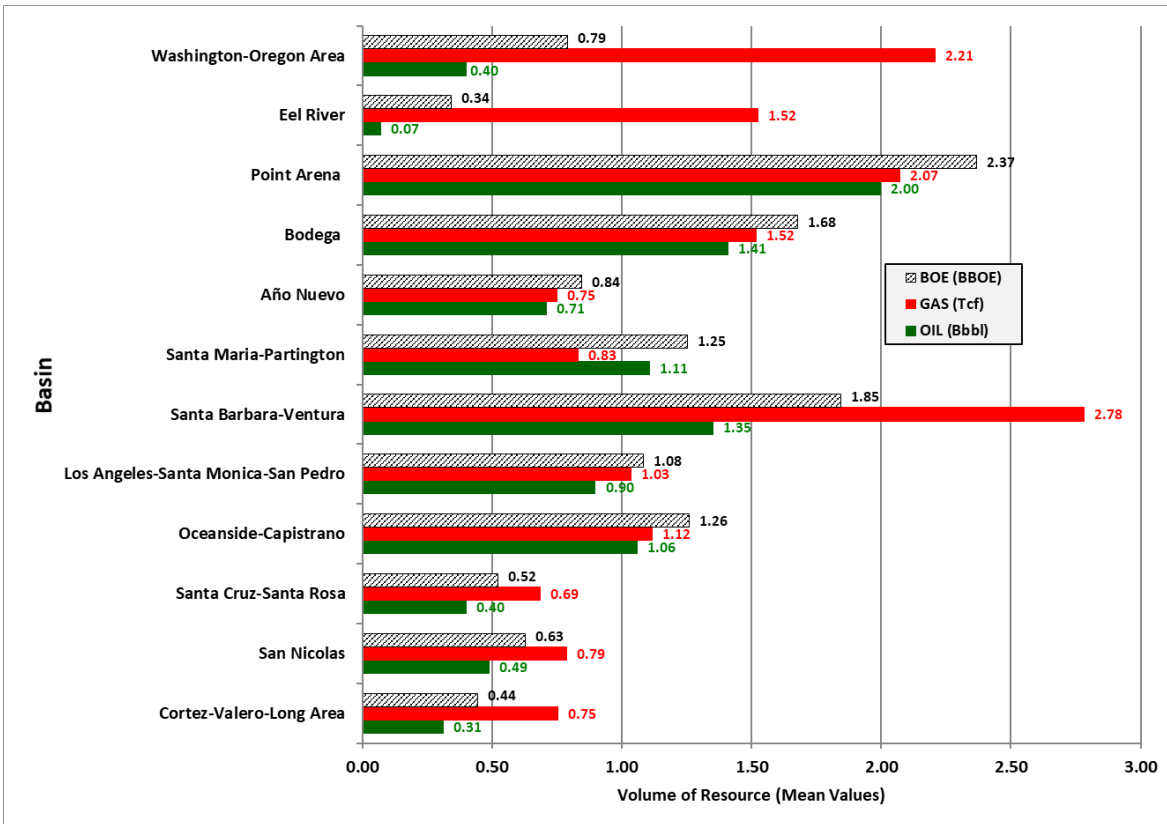


Figure 5: Undiscovered Technically Recoverable Oil and Gas Resources by basin (mean values)

Note: Barrel of Oil Equivalent (BOE) resource is the additive sum of the oil resource and gas resource (in barrel of oil equivalent)

Table 2: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by province

Pacific OCS Region	2021 Undiscovered Technically Recoverable Resources (UTRR)								
	Oil (Bbbl)			Gas (Tcf)			BOE (BBOE)		
Province	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Pacific Northwest	0.03	0.47	1.20	0.88	3.73	7.56	0.18	1.13	2.54
Central California	3.41	5.22	7.46	3.27	5.18	7.53	4.00	6.14	8.80
Santa Barbara-Ventura	0.34	1.35	3.52	0.53	2.78	7.62	0.44	1.85	4.87
Inner Borderland	0.21	1.96	4.26	0.21	2.15	5.12	0.25	2.34	5.17
Outer Borderland	0.15	1.20	2.83	0.24	2.23	5.44	0.20	1.60	3.80
Pacific OCS Total	6.91	10.20	14.20	10.15	16.07	23.43	8.72	13.06	18.37

Resource values are in billion barrels of oil (Bbbl), trillion cubic feet of gas (Tcf) and billion barrel of oil equivalent (BBOE) for barrel of oil equivalent. 95% indicates a 95 percent chance of at least the amount listed; 5% indicates a 5 percent chance of at least the amount listed. Only mean values are additive. Some total mean values may not be equal the sum of the component values due to independent rounding of tabulated values.

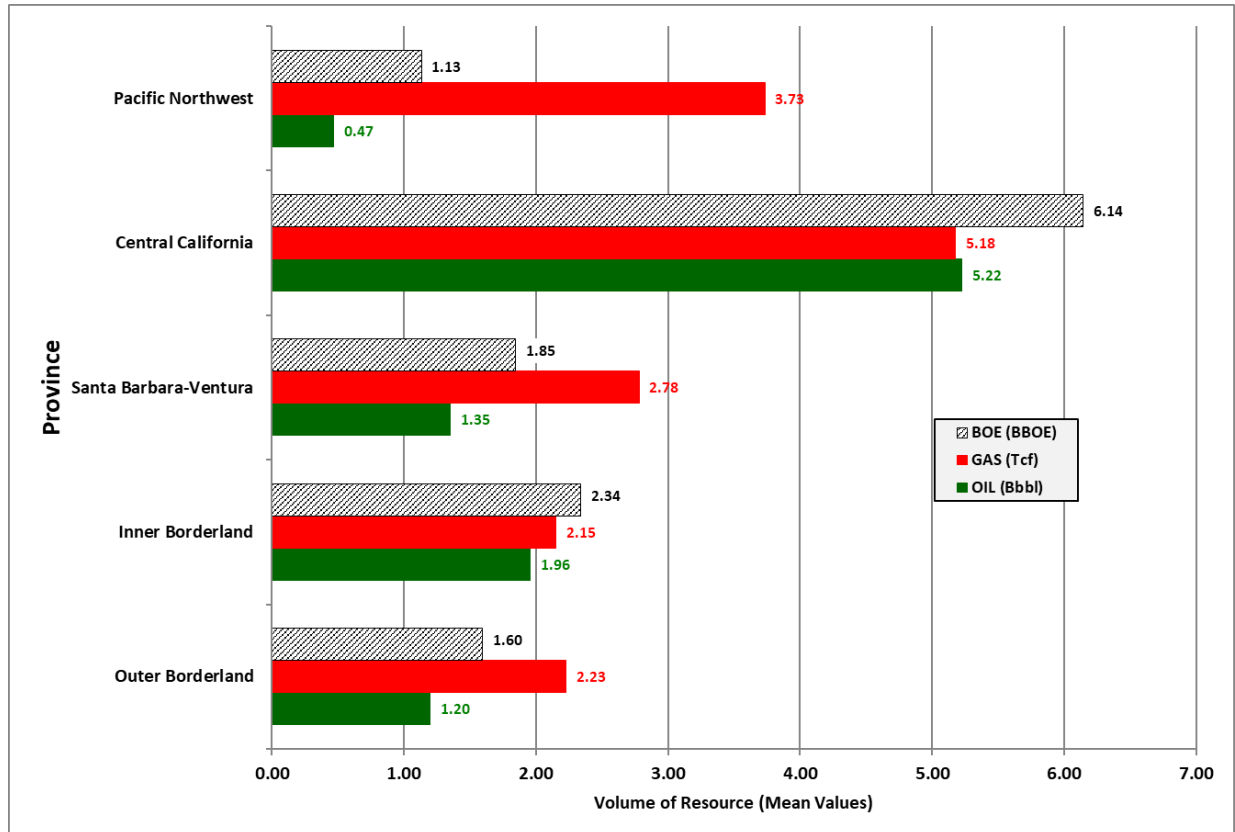


Figure 6: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by province (mean values)

Note: Barrel of Oil Equivalent (BOE) resource is the additive sum of the Oil resource and gas resource (in barrel of oil-equivalent)

Table 3: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by planning area

Pacific OCS Region	2021 Undiscovered Technically Recoverable Resources (UTRR)								
	Oil (Bbbl)			Gas (Tcf)			BOE (BBOE)		
	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Washington/Oregon	0.00	0.40	1.14	0.03	2.25	5.89	0.01	0.80	2.19
Northern California	1.06	2.07	3.49	2.13	3.55	5.32	1.44	2.70	4.43
Central California	1.22	2.41	3.89	1.18	2.49	4.19	1.43	2.85	4.64
Southern California	2.58	5.33	8.81	3.51	7.78	13.75	3.20	6.71	11.25
Pacific OCS Total	6.91	10.20	14.20	10.15	16.07	23.43	8.72	13.06	18.37

Resource values are in billion barrels of oil (Bbbl), trillion cubic feet of gas (Tcf) and billion barrel of oil equivalent (BBOE) for barrel of oil equivalent. 95% indicates a 95 percent chance of at least the amount listed; 5% indicates a 5 percent chance of at least the amount listed. Only mean values are additive. Some total mean values may not be equal the sum of the component values due to independent rounding of tabulated values.

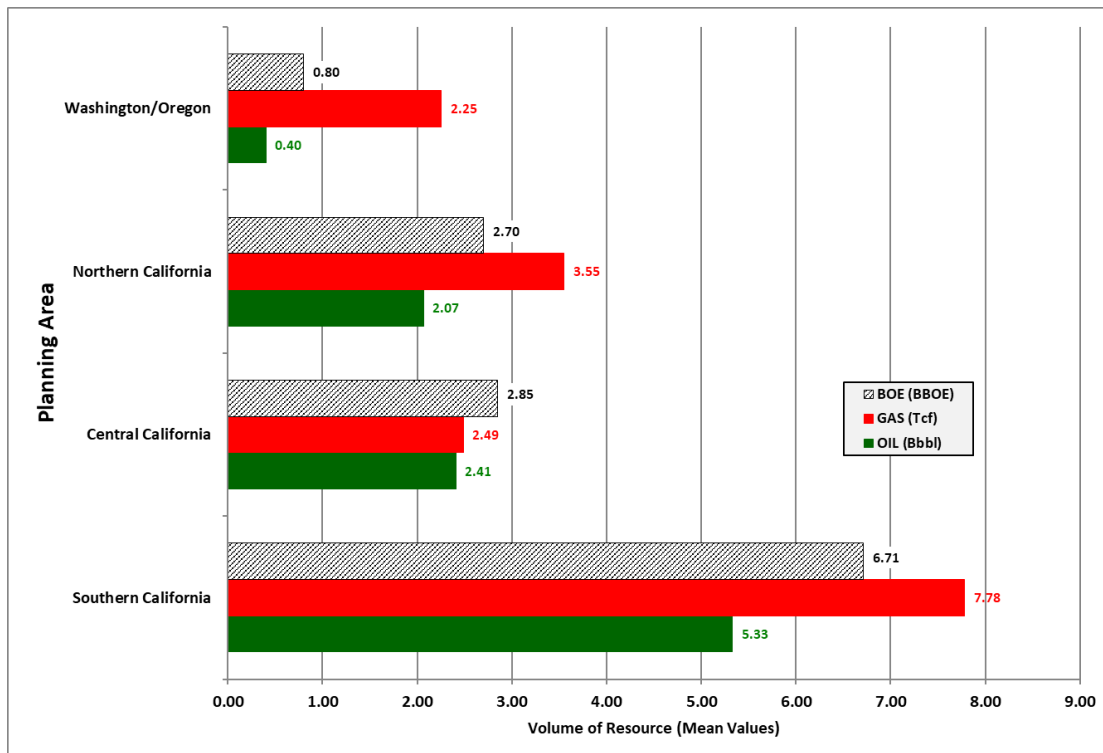


Figure 7: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by planning area (mean values)
Note: Barrel of Oil Equivalent (BOE) resource is the additive sum of the Oil resource and gas resource (in barrel of oil-equivalent).

Table 4: Undiscovered Technically Recoverable Oil and Gas Resources by water depth in the Pacific OCS Region by planning area.

Pacific OCS Region		2021 Undiscovered Technically Recoverable Resources (UTRR)								
Planning Area	Water Depth	Oil (Bbbl)			Gas (Tcf)			BOE (BBOE)		
		95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Washington/Oregon		0.00	0.40	1.14	0.03	2.25	5.89	0.01	0.80	2.19
	0 – 200 m	0.00	0.30	0.85	0.00	1.66	4.37	0.00	0.59	1.63
	200 – 800 m	0.00	0.10	0.28	0.03	0.60	1.51	0.01	0.21	0.55
Northern California		1.06	2.07	3.49	2.13	3.55	5.32	1.44	2.70	4.43
	0 – 200 m	0.20	0.40	0.69	0.24	0.46	0.78	0.24	0.48	0.83
	200 – 800 m	0.28	0.55	0.89	1.08	1.69	2.51	0.47	0.85	1.33
	> 800 m	0.56	1.11	1.90	0.81	1.44	2.33	0.70	1.37	2.32
Central California		1.22	2.41	3.89	1.18	2.49	4.19	1.43	2.85	4.64
	0 – 200 m	0.70	1.48	2.54	0.71	1.59	2.78	0.83	1.77	3.03
	200 – 800 m	0.40	0.68	1.02	0.39	0.69	1.06	0.47	0.80	1.21
	> 800 m	0.12	0.24	0.43	0.11	0.21	0.36	0.14	0.28	0.50
Southern California		2.58	5.33	8.81	3.51	7.78	13.75	3.20	6.71	11.25
	0 – 200 m	0.40	0.83	1.61	0.53	1.34	2.89	0.50	1.07	2.13
	200 – 800 m	1.18	2.55	4.43	1.51	3.61	6.94	1.45	3.19	5.67
	> 800 m	0.63	1.95	3.72	0.74	2.83	5.92	0.76	2.45	4.77
Pacific OCS Total		6.91	10.20	14.20	10.15	16.07	23.43	8.72	13.06	18.37
	0 – 200 m	1.90	3.01	4.41	2.41	5.05	8.24	2.33	3.91	5.88
	200 – 800 m	2.40	3.88	5.83	4.21	6.54	10.12	3.15	5.05	7.63
	> 800 m	1.77	3.30	5.22	2.17	4.48	7.73	2.16	4.10	6.60

Undiscovered Economically Recoverable Resources

Estimates of the total volume of undiscovered economically recoverable resources in the Region were assessed under various economic scenarios. Oil prices are coupled with a specific gas price assuming a 30 percent economic value for gas relative to oil (i.e., a gas price adjustment of 0.3). These oil/gas price pairs are: \$30 and \$1.60/Mcf; \$40/bbl and \$2.14/Mcf; \$60 and \$3.20/Mcf; \$100/bbl and \$5.34/Mcf; and \$160/bbl and \$8.54/Mcf. These economic results were generated by statistically aggregating the constituent assessment area estimates. Based on this assessment, 7.30 Bbbl of oil and 9.43 Tcf of natural gas are estimated to be economically recoverable under economic conditions existing in this assessment (that is, \$100-per barrel of oil scenario). Larger volumes of resources are expected to be economic under increasingly favorable economic conditions. Estimates of economically recoverable resources at several pricing scenarios are given in [Table 5](#) (by basin), [Table 6](#) (by province), [Table 7](#) (by planning area) and [Table 8](#) (by water depth). Also, estimates of economically recoverable resources are illustrated in [Figure 8 through 10](#) (by basin), [Figures 11 through 13](#) (by province) and [Figure 14 through 16](#) (by planning areas). Regional estimates of economically recoverable resources are illustrated in the form of price-supply curves in [Figure 17](#).

Table 5: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2019 for five economic scenarios by basin.
Oil prices are coupled with a specific gas price assuming a 30 percent economic value for gas relative to oil (i.e., gas price adjustment of 0.3)

Pacific OCS Region		2021 Undiscovered Economically Recoverable Resources														
		\$30/bbl & \$1.60/Mcf			\$40/bbl & \$2.14/Mcf			\$60/bbl & \$3.20/Mcf			\$100/bbl & \$5.34/Mcf			\$160/bbl & \$8.54/Mcf		
Province	Basin	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Pacific Northwest	Washington-Oregon Area	0.05	0.18	0.08	0.07	0.23	0.11	0.11	0.35	0.17	0.15	0.49	0.24	0.18	0.58	0.28
	Eel River	0.00	0.02	0.01	0.01	0.04	0.02	0.02	0.08	0.03	0.03	0.14	0.05	0.03	0.18	0.06
Central California	Point Arena	0.71	0.73	0.84	0.91	0.94	1.08	1.19	1.22	1.41	1.40	1.43	1.66	1.50	1.53	1.77
	Bodega	0.58	0.62	0.69	0.79	0.84	0.94	0.99	1.06	1.18	1.12	1.20	1.33	1.19	1.28	1.42
	Ano Nuevo	0.34	0.36	0.40	0.44	0.46	0.53	0.55	0.57	0.65	0.61	0.64	0.72	0.63	0.66	0.75
	Santa Maria-Partington	0.26	0.19	0.29	0.36	0.27	0.40	0.56	0.42	0.64	0.74	0.55	0.84	0.82	0.61	0.93
Santa Barbara-Ventura	Santa Barbara-Ventura	0.79	1.60	1.08	0.97	1.84	1.30	1.15	2.09	1.52	1.23	2.25	1.63	1.26	2.33	1.68
Inner Borderland	Los Angeles- Santa Monica-San Pedro	0.33	0.44	0.41	0.45	0.57	0.55	0.59	0.73	0.72	0.69	0.83	0.84	0.73	0.87	0.89
	Oceanside-Capistrano	0.36	0.42	0.43	0.51	0.57	0.61	0.71	0.76	0.85	0.82	0.87	0.98	0.87	0.92	1.04
Outer Borderland	Santa Cruz-Santa Rosa	0.04	0.08	0.05	0.05	0.11	0.07	0.10	0.18	0.13	0.15	0.26	0.19	0.18	0.32	0.24
	San Nicolas	0.08	0.14	0.10	0.11	0.20	0.15	0.17	0.29	0.22	0.19	0.31	0.24	0.20	0.34	0.26
	Cortez-Valero-Long Area	0.00	0.03	0.01	0.01	0.03	0.01	0.01	0.05	0.02	0.02	0.08	0.03	0.03	0.11	0.04
Total Pacific OCS Region (Mean Values)		3.55	4.81	4.40	4.69	6.11	5.77	6.15	7.81	7.54	7.15	9.05	8.76	7.63	9.73	9.36

Table 6: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2019 for five economic scenarios by province.
Oil prices are coupled with a specific gas price assuming a 30 percent economic value for gas relative to oil (i.e., gas price adjustment of 0.3)

Pacific OCS Region		2021 Undiscovered Economically Recoverable Resources														
		\$30/bbl & \$1.60/Mcf			\$40/bbl & \$2.14/Mcf			\$60/bbl & \$3.20/Mcf			\$100/bbl & \$5.34/Mcf			\$160/bbl & \$8.54/Mcf		
Province		Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Pacific Northwest		0.05	0.21	0.09	0.08	0.28	0.12	0.13	0.44	0.21	0.18	0.63	0.29	0.21	0.75	0.35
Central California		1.89	1.91	2.23	2.51	2.51	2.95	3.30	3.27	3.88	3.87	3.83	4.55	4.14	4.09	4.87
Santa Barbara-Ventura		0.79	1.60	1.08	0.97	1.84	1.30	1.15	2.09	1.52	1.23	2.25	1.63	1.26	2.33	1.68
Inner Borderland		0.70	0.85	0.85	0.97	1.14	1.17	1.31	1.49	1.57	1.51	1.70	1.82	1.60	1.79	1.92
Outer Borderland		0.11	0.25	0.16	0.17	0.35	0.23	0.27	0.51	0.36	0.35	0.65	0.47	0.41	0.76	0.54
Pacific OCS Total		3.55	4.81	4.40	4.69	6.11	5.77	6.15	7.81	7.54	7.15	9.05	8.76	7.63	9.73	9.36

Table 7: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2019 for five economic scenarios by planning area. Oil prices are coupled with a specific gas price assuming a 30 percent economic value for gas relative to oil (i.e., gas price adjustment of 0.3)

Pacific OCS Region	2021 Undiscovered Economically Recoverable Resources														
	\$30/bbl & \$1.60/Mcf			\$40/bbl & \$2.14/Mcf			\$60/bbl & \$3.20/Mcf			\$100/bbl & \$5.34/Mcf			\$160/bbl & \$8.54/Mcf		
	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
Planning Area	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Washington/Oregon	0.05	0.18	0.08	0.07	0.24	0.11	0.11	0.36	0.17	0.15	0.49	0.24	0.18	0.58	0.28
Northern California	0.72	0.76	0.85	0.92	0.98	1.10	1.21	1.30	1.44	1.43	1.57	1.71	1.53	1.71	1.83
Central California	0.99	1.03	1.17	1.33	1.38	1.57	1.69	1.74	2.00	1.92	1.98	2.27	2.03	2.10	2.41
Southern California	1.79	2.84	2.30	2.37	3.52	3.00	3.14	4.40	3.92	3.64	5.01	4.54	3.88	5.34	4.83
Pacific OCS Total	3.55	4.81	4.40	4.69	6.11	5.77	6.15	7.81	7.54	7.15	9.05	8.76	7.63	9.73	9.36

Table 8: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2019 for five economic scenarios by water depth. Oil prices are coupled with a specific gas price assuming a 30 percent economic value for gas relative to oil (i.e., gas price adjustment of 0.3)

Pacific OCS Region	2021 Undiscovered Economically Recoverable Resources														
	\$30/bbl & \$1.60/Mcf			\$40/bbl & \$2.14/Mcf			\$60/bbl & \$3.20/Mcf			\$100/bbl & \$5.34/Mcf			\$160/bbl & \$8.54/Mcf		
	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
Planning Area	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Water Depth	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Washington/Oregon	0.05	0.18	0.08	0.07	0.24	0.11	0.11	0.36	0.17	0.15	0.49	0.24	0.18	0.58	0.28
0 – 200 m	0.03	0.14	0.06	0.05	0.18	0.08	0.08	0.27	0.13	0.11	0.37	0.18	0.13	0.43	0.21
200 – 800 m	0.01	0.05	0.02	0.02	0.06	0.03	0.03	0.09	0.04	0.04	0.13	0.06	0.05	0.15	0.07
Northern California	0.72	0.76	0.85	0.92	0.98	1.10	1.21	1.30	1.44	1.43	1.57	1.71	1.53	1.71	1.83
0 – 200 m	0.14	0.15	0.17	0.18	0.19	0.22	0.24	0.25	0.28	0.28	0.29	0.33	0.30	0.31	0.36
200 – 800 m	0.18	0.20	0.22	0.24	0.27	0.28	0.31	0.37	0.38	0.37	0.46	0.45	0.40	0.52	0.49
> 800 m	0.39	0.41	0.47	0.50	0.52	0.60	0.66	0.69	0.78	0.78	0.82	0.92	0.83	0.88	0.99
Central California	0.99	1.03	1.17	1.33	1.38	1.57	1.69	1.74	2.00	1.92	1.98	2.27	2.03	2.10	2.41
0 – 200 m	0.64	0.68	0.76	0.86	0.91	1.02	1.07	1.14	1.27	1.20	1.28	1.43	1.27	1.36	1.51
200 – 800 m	0.28	0.29	0.33	0.37	0.38	0.44	0.48	0.49	0.56	0.54	0.55	0.64	0.58	0.58	0.68
> 800 m	0.07	0.07	0.09	0.10	0.09	0.12	0.14	0.12	0.16	0.18	0.15	0.20	0.19	0.16	0.22
Southern California	1.79	2.84	2.30	2.37	3.52	3.00	3.14	4.40	3.92	3.64	5.01	4.54	3.88	5.34	4.83
0 – 200 m	0.36	0.64	0.47	0.45	0.75	0.58	0.57	0.89	0.73	0.65	0.99	0.82	0.68	1.05	0.87
200 – 800 m	1.00	1.60	1.28	1.31	1.94	1.65	1.70	2.38	2.13	1.96	2.68	2.44	2.08	2.83	2.58
> 800 m	0.44	0.61	0.55	0.61	0.83	0.76	0.87	1.13	1.07	1.03	1.33	1.27	1.12	1.46	1.38
Pacific OCS Total	3.55	4.81	4.40	4.69	6.11	5.77	6.15	7.81	7.54	7.15	9.05	8.76	7.63	9.73	9.36
0 – 200 m	1.17	1.60	1.45	1.54	2.02	1.90	1.96	2.54	2.41	2.24	2.93	2.76	2.39	3.15	2.95
200 – 800 m	1.47	2.13	1.85	1.93	2.65	2.40	2.52	3.32	3.11	2.92	3.82	3.60	3.10	4.08	3.83
> 800 m	0.90	1.09	1.10	1.22	1.44	1.47	1.67	1.94	2.02	1.98	2.30	2.39	2.14	2.50	2.59

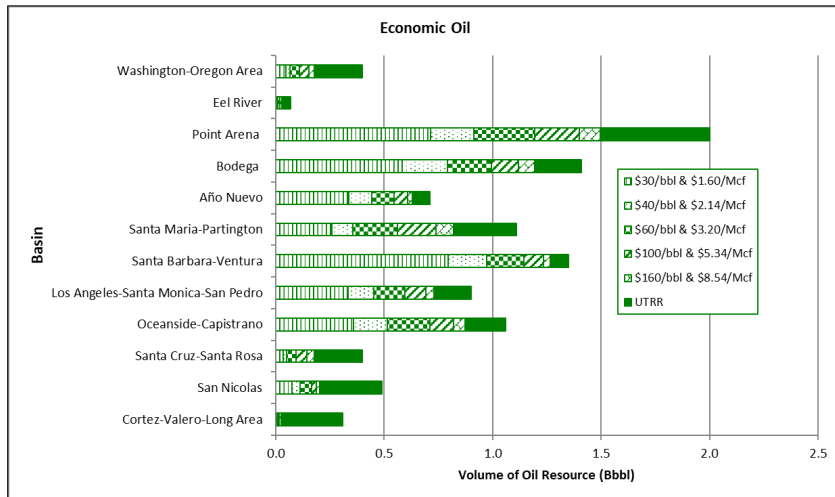


Figure 8: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by basin

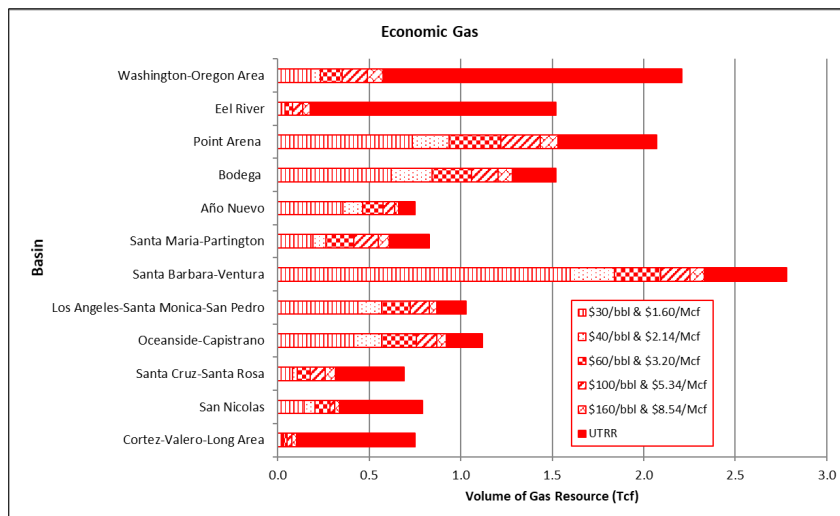


Figure 9: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by basin

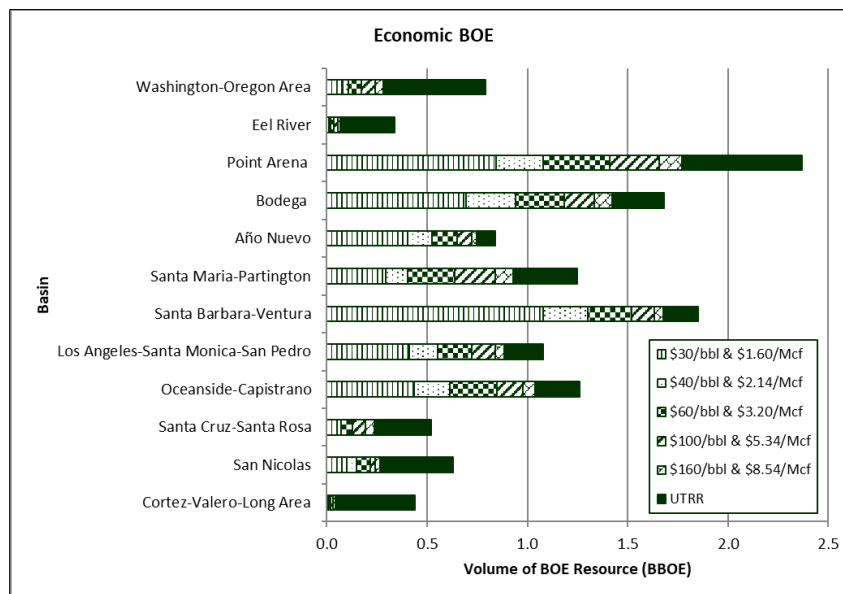


Figure 10: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by basin

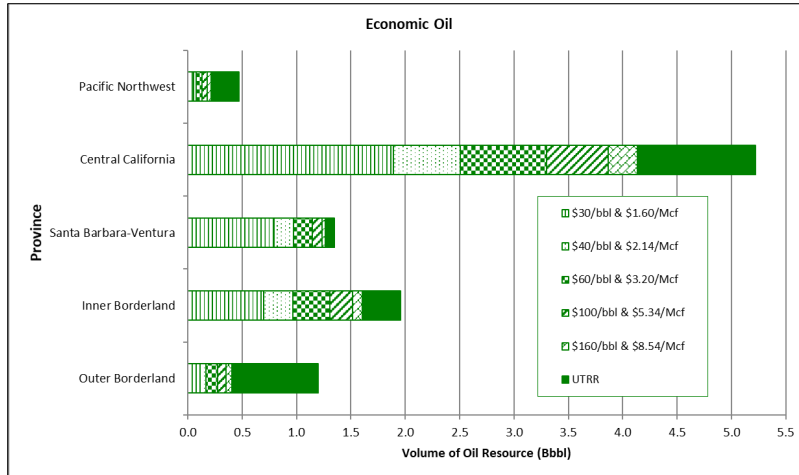


Figure 11: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by province

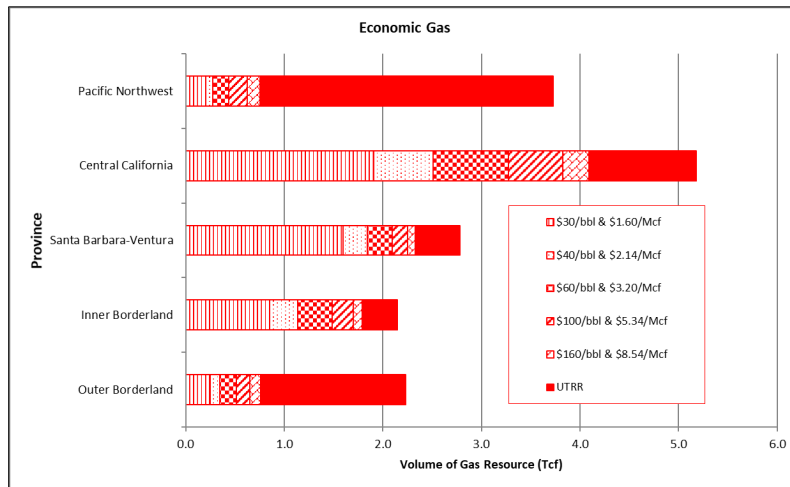


Figure 12: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by province

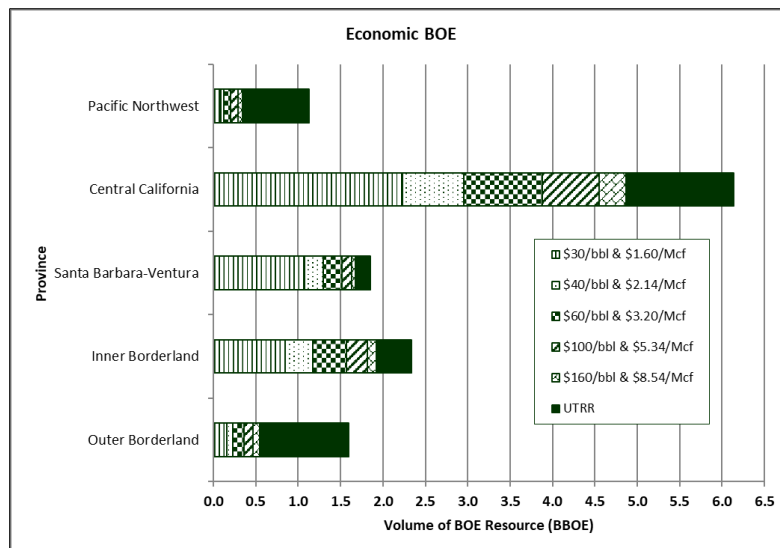


Figure 13: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by province

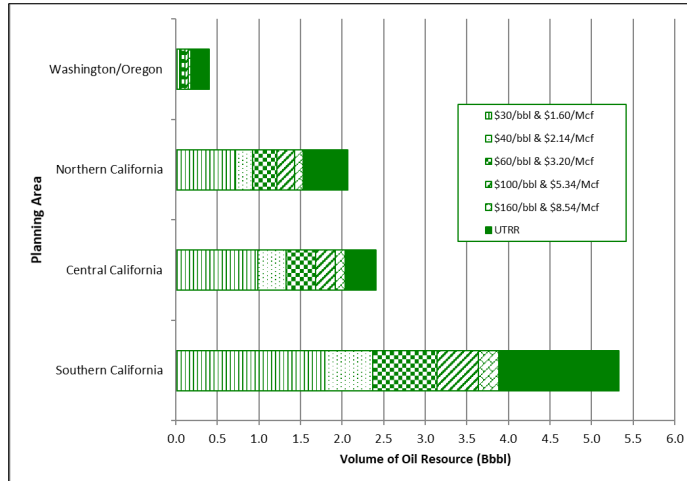


Figure 14: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by planning area

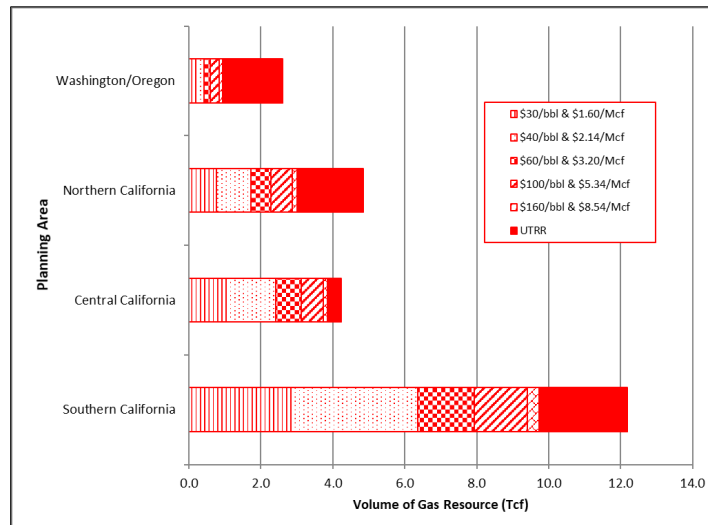


Figure 15: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by planning area

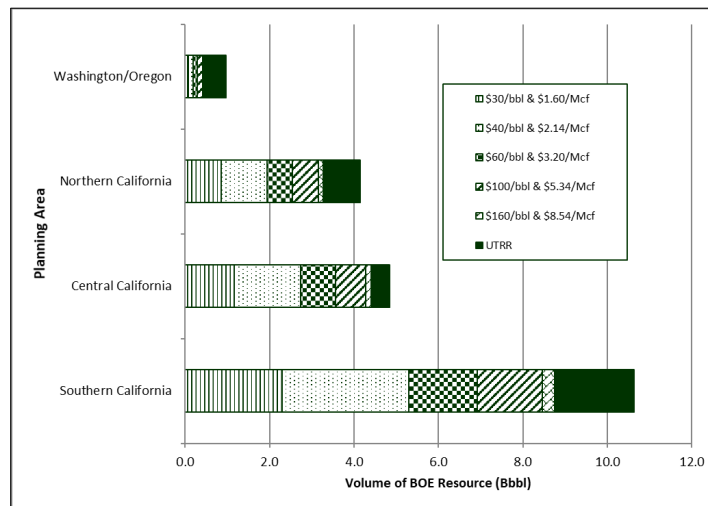


Figure 16: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by planning area

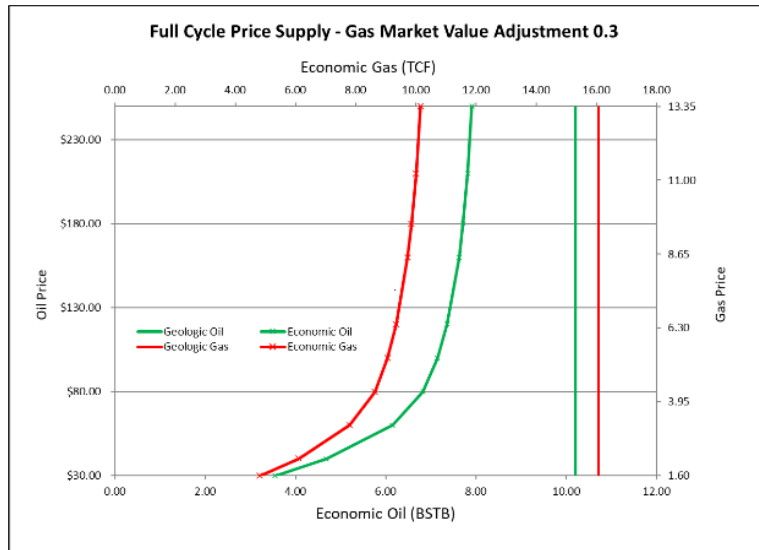


Figure 17: Price supply of the Pacific OCS. Vertical lines represent UTRR and are independent of commodity price
Curved lines represent UERR and are price dependent

Comparison of Resource Estimates with Previous Assessments

The total endowment for the Pacific OCS was calculated to be 13.15 Bbbl of oil and 19.30 Tcf of natural gas (total 16.59 BBOE). This estimated endowment is composed of the originally recoverable reserves (cumulative production and remaining reserves) in developed Fields and undiscovered technically recoverable resources (mean values). These results are as summarized in [Table 9](#) and illustrated in [Figure 18](#) as shown below.

Multiple assessments of the undiscovered oil and gas resources have been conducted for the Pacific OCS Region. Comparisons of resource estimates from these assessments are meaningful only if comparable areas, hydrocarbon commodities (e.g., oil vs. gas), and resource categories (e.g., technically recoverable or economically recoverable) have been assessed, and comparable types of estimates (e.g., conditional vs. risked and percentile vs. mean) are compared. Such comparisons demonstrate the degree to which resource estimates have changed and may provide insight regarding the factors that contributed to the change.

Here a comparison is made of resource estimates from BOEM 2021, 2016² and 2011⁴ assessments. The 2011 assessment made a comparison of five previous assessments of the Pacific OCS Region from 1995 through 2011. The 2011 assessment was the first full assessment publication for the Pacific Region since 1995, and it included revisions in plays and technically recoverable resources since that time. In 2016, no changes were made in technically recoverable resources; however, economic analysis was made using updated commodity price pairs that led to revisions in estimates of economically recoverable resources. This 2021 assessment includes changes in the petroleum system risking methodology. These changes enabled BOEM to capture geologic uncertainties pertaining to important assessment factors (e.g., hydrocarbon source, seals, and reservoirs) on a consistent basis at the national level, and contributed to the small changes reported in UTRR UERR volumes.

Undiscovered Technically Recoverable Resources

Comparable estimates of the volume of undiscovered technically recoverable oil and gas resources in the Region for the 2011, 2016, and 2021 assessments are shown in Figure 18. These regional estimates (mean values) have remained the same for oil and roughly the same for gas during the three most recent assessments.

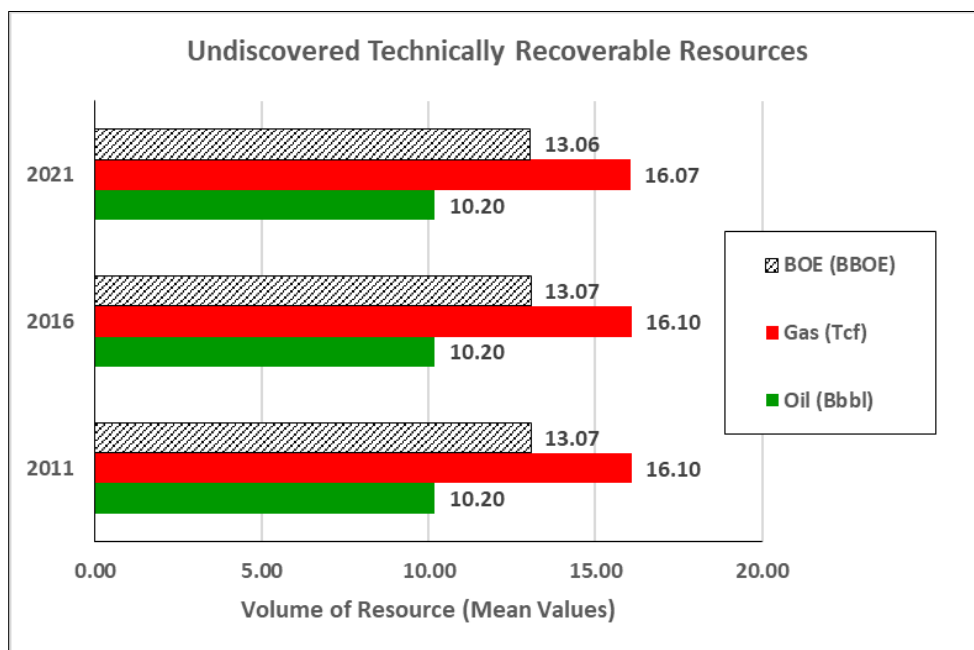


Figure 18: UTRR comparison from BOEM Pacific 2011, 2016 and 2021 Assessments

Undiscovered Economically Recoverable Resources

The commodities and category of hydrocarbon resources referred to as undiscovered economically recoverable resources for this and the previous assessments are conceptually comparable; however, estimates of the volume of these oil and gas resources result from different economic assumptions (i.e., prices, costs, and timing) and are; therefore, not directly comparable.

The “\$60-per-barrel economic scenario” is the oil price scenario that is consistent among the 2011, 2016, and 2021 assessments. Therefore, this “\$60-per barrel price scenario” was adopted for comparison purposes.

The gas price scenario is based on the given oil price and a Gas Market Value Adjustment factor percent (i.e., economic value for gas relative to oil, on the basis of energy equivalence). In the 2011 assessment, the factor was 0.4 (i.e., 40 percent economic value for gas relative to oil, on the basis of energy equivalence). Whereas the 2016 and 2021 assessments both utilized a 0.3 Gas Market Value Adjustment factor.

As depicted in Figure 19, the comparison of 2011, 2016, and 2021 assessments show a decrease in the mean UERR results for the region. Changes in the Pacific OCS aggregate UERR are due to updates in

the economic modeling inputs. The decline from the 2016 to the 2021 assessment results may be attributable to updated costs for exploration and development, corporate tax rates and structure, and transportation tariff assumptions and costs. Although, identical economic inputs were used for the 2011 and 2016 assessments, the UERR decline is attributable to different Gas Market Value Adjustment factors.

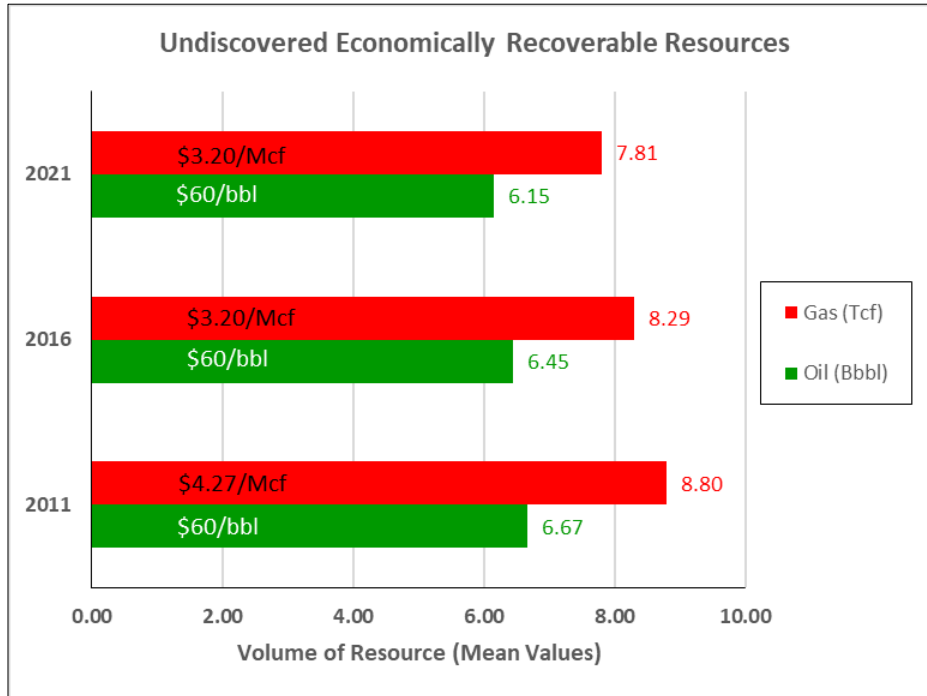


Figure 19: Comparison of POCS Region total estimates of UERR oil and gas for assessments from 2011 to 2021

Endowment for the Pacific OCS

The estimated endowment is composed of the originally recoverable reserves (cumulative production and remaining reserves) and undiscovered technically recoverable resources (mean values). The total endowment for the Pacific OCS was calculated to be 11.82 Bbbl of oil and 18.36 Tcf of natural gas (total 15.09 BBOE). These results are as summarized in Table 9 and illustrated in Figure 20 as shown below.

Table 9: Estimates of the total endowment of oil and gas resources in the Pacific OCS Region

		Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
Originally Recoverable Reserves (Developed Fields)	Cumulative Production	1.37	1.86	1.70
	Remaining Proved Reserves	0.26	0.43	0.34
	Total	1.63	2.29	2.04
Undiscovered Technically Recoverable Resources		10.20	16.07	13.06
2021 Pacific OCS Total Endowment		11.82	18.36	15.09

Estimates of originally recoverable reserves are as of January 1, 2019. Originally recoverable reserves include cumulative production and remaining reserves. Estimates of undiscovered technically resources are risked values. Some total values are not equal to the sum of the component values due to independent values.

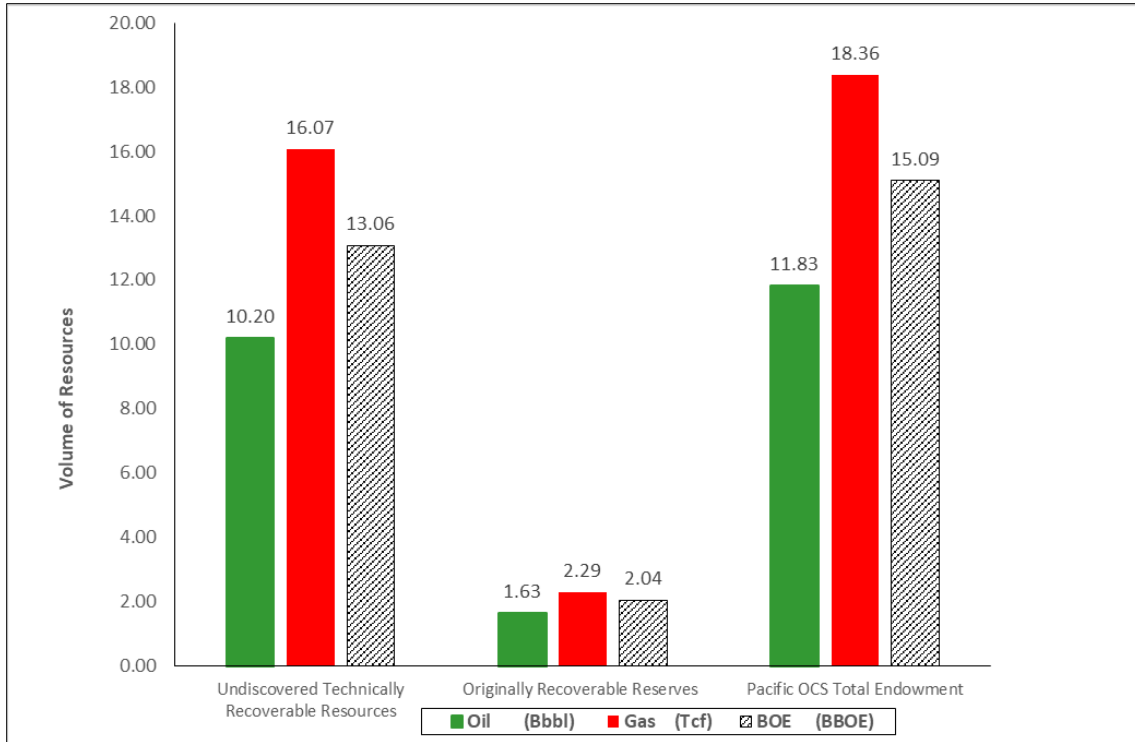


Figure 20: Total Endowment for the Pacific Outer Continental Shelf

As of date for the 2021 assessment report, the UTRR (mean value) represents approximately 88 percent (13.06 billion barrels of oil equivalent) of the total endowment (15.09 billion barrels of oil equivalent) in the Pacific OCS. Oil and gas production to date equals 1.70 Bbbl (oil equivalent), which accounts for 11 percent of the total endowment. Therefore, it is estimated that 89 percent (13.40 Bbbl – oil equivalent) of the total endowment in the Pacific OCS remain untapped.

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Glossary

Approved for Development: This is a development project for which necessary approvals have been obtained, capital funds have been committed, and implementation of the development project is under way

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

Basin (geologic basin): A *basin* is a depressed and geographically confined area of the earth's crust in which sediments accumulated and hydrocarbons may have formed.

Contingent Resources: These are discovered resources estimated to be potentially recoverable from known accumulations but are not available for commercial development due to one or more contingencies. These contingencies could include resources on relinquished leases, lack of viable markets, commercial recovery dependent on technology under development, and where evaluation of the accumulation is insufficient to clearly assess commerciality, etc.

Commercial: When a project is commercial, this implies that the essential social, environmental, and economic conditions are met, including political, legal, regulatory, and contractual conditions. In addition, a project is commercial if the degree of commitment is such that the accumulation is expected to be developed and placed on production within a reasonable time frame.

Conditions/Contingencies: The economic, marketing, legal, environmental, social, and governmental factors forecasted to exist and impact the project during the time period being evaluated.

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

Development Not Viable: A discovered accumulation for which there are no current plans to develop or to acquire additional data at the time due to limited production potential. A project maturity sub-class that reflects the actions required to move a project towards commercial production.

Development Pending: A discovered accumulation where project activities are ongoing to justify commercial development in the foreseeable future. A project maturity sub-class that reflects the actions required to move a project towards commercial production. The operator has demonstrated a financial commitment to project development.

Development Unclassified or On Hold: A discovered accumulation where project activities are on hold and/or where justification as a commercial development may be subject to significant delay. A project maturity sub-class that reflects the actions required to move a project toward commercial production.

Discovered Petroleum Initial-In-Place: Discovered Petroleum Initially-in-Place is that quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations prior to production. Discovered Petroleum Initially-in-Place may be subdivided into Commercial, Sub-Commercial, and Unrecoverable.

Field: A Field is an area consisting of a single reservoir or multiple reservoirs all grouped on, or related to, the same general geologic structural feature and/or stratigraphic trapping condition. There may be two or more reservoirs in a field that are separated vertically by impervious strata, laterally by local geologic barriers, or by both.

Justified for Development: Implementation of the development project is justified on the basis of reasonable forecast commercial conditions at the time of reporting, and there are reasonable expectations that all necessary approvals/contracts will be obtained.

Not Commercial: This is a project not able to be developed at a profit under prevailing economic conditions and fiscal terms, nor under such conditions and terms that may be expected in the future based on current information.

On Production: The development project is currently producing and selling petroleum to market. A project status/maturity sub-class that reflects that actions required to move a project toward commercial production.

Original Recoverable Reserves: Those quantities of petroleum, which is estimated, on a given date, to be potentially recoverable from known accumulation, plus those quantities already produced from the same known accumulation.

Outer Continental Shelf: 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.

Original Recoverable Reserves: The total amount of discovered resources that are estimated to be economically recoverable; they include cumulative production and remaining reserves.

Petroleum Initially-in-Place (PIIP): Petroleum Initially-in-Place is the total quantity of petroleum that is estimated to exist originally in naturally occurring reservoirs.

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

Conceptual plays: Those play in which hydrocarbons have not been discovered and the petroleum system has not been proven to exist.

Established plays: Those play in which hydrocarbon accumulations have been discovered.

Pool: A discovered or undiscovered accumulation of hydrocarbons, typically within a single stratigraphic interval.

Planning Area: OCS *planning areas* are not based on geology or geography, but are delineated based on political boundaries such as state or county lines

Production: Production is the cumulative quantity of petroleum that has been actually recovered over a defined time period.

Prospect: A *prospect* is an untested geologic feature having the potential for trapping and accumulating hydrocarbons; a pool or potential field.

Province: This is an area of petroleum geologic homogeneity, which may include one or more geologic basins or geologic areas.

Project Development on Hold: No current plans to develop or to acquire additional data at this time.

Project Development Pending: Requires further data acquisition and/or evaluation in order to confirm commerciality.

Reserves: Reserves are those quantities of petroleum 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 projects(s) applied.

Proved Reserves: Proved Reserves are those quantities of petroleum which by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under defined economic conditions, operating methods, and government regulations.

Proved Developed Reserves: Proved Developed Reserves are those Proved Reserves that can be expected to be recovered through existing wells and facilities and by existing operating methods. Developed reserves are expected to be recovered from existing wells, including reserves behind pipe. Improved recovery reserves can be considered as Proved Developed Reserves only after an improved recovery project has been installed and favorable response has occurred or is expected with a reasonable degree of certainty. Developed reserves may be sub-categorized as producing or non-producing.

Proved Developed Nonproducing Reserves: Reserves subcategorized as non-producing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from (1) completion intervals which are open at the time of the estimate, but which have not started producing, (2) wells which were shut-in for market conditions or pipeline connections, or (3) wells not capable of production for mechanical reasons.

Proved Developed Producing Reserves: Proved Developed Producing Reserves are expected to be recovered from completion intervals that are open and producing at the time of the estimate. Improved recovery reserves are considered producing only after improved recovery project is in operation.

Proved Undeveloped Developed Reserves: Proved undeveloped Reserves are those Proved Reserves that are expected to be recovered from future wells and facilities, including future improved recovery projects which are anticipated with a high degree of certainty in reservoirs which have previously shown favorable response to improved recovery project.

Unproved Reserves: Unproved Reserves are based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved. Unproved

reserves may be estimated assuming future economic conditions different from those prevailing at the time of the estimate.

Remaining Reserves: Discovered resources that remain to be extracted from an area; they include proved reserves and unproved reserves.

Total resource endowment: This is the sum of the discovered resources (original recoverable reserves) and undiscovered resources—has been estimated for areas where resources have been discovered.

Undiscovered Resources: Resources postulated, based on 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):*** Oil and gas that could be produced as a consequence of natural pressure, artificial lift, pressure maintenance, or other secondary recovery methods, but without any consideration of economic viability. They are primarily outside of known fields.
- ***Undiscovered Economically Recoverable Resources (UERR):*** The portion of the undiscovered technically recoverable resources that is economically recoverable under imposed economic and technologic conditions.



The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.