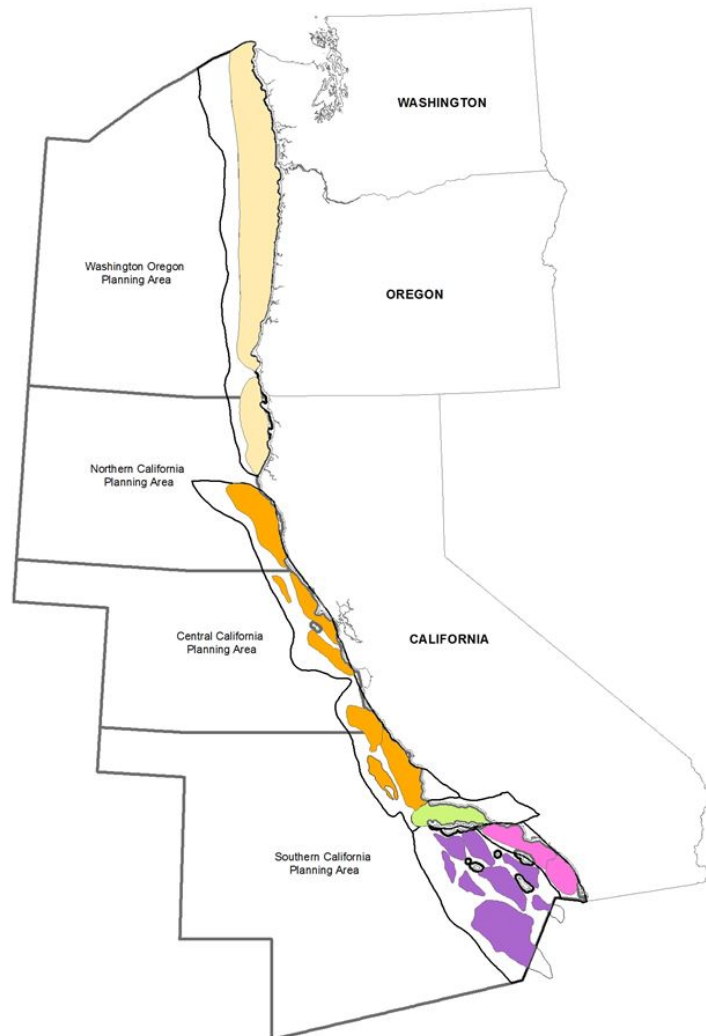




2016 Assessment of Oil and Gas Resources: Assessment of the Pacific Outer Continental Shelf Region



BUREAU OF OCEAN ENERGY MANAGEMENT

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

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Front Cover. Map of the Pacific OCS Region showing provinces and planning areas defined for the 2016 National Assessment. Planning areas are as annotated on the map. 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
Bureau of Ocean Energy Management
Pacific Outer Continental Shelf Region

Camarillo, California
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Abbreviations ad 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
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) 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 2016 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 region OCS 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 2016 assessment of the Pacific OCS region was performed in order to develop an updated appraisal of the location and volume of undiscovered resources. It is based upon geological work that was performed for the 2011 National Assessment of Oil and Gas Resources and compiled into [OCS Report BOEM 2014-667¹](#) (Piper and Ojukwu 2014). 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, 2014. The hydrocarbon resources that have been assessed include *oil* (including crude oil and condensate) and *natural gas* (including associated and nonassociated 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 nonassociated 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”). *Nonassociated 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 nonassociated gas and are reported as standard cubic feet (hereafter “cubic feet” or “cf”).

Oil-equivalent gas is a volume of gas (associated and/or nonassociated) 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: *undiscovered technically recoverable resources* (UTRR) are those that can be removed from the subsurface with conventional extraction techniques; *undiscovered economically recoverable resources* (UERR) are those

undiscovered technically recoverable resources that can be extracted profitably under specified economic and technological conditions.

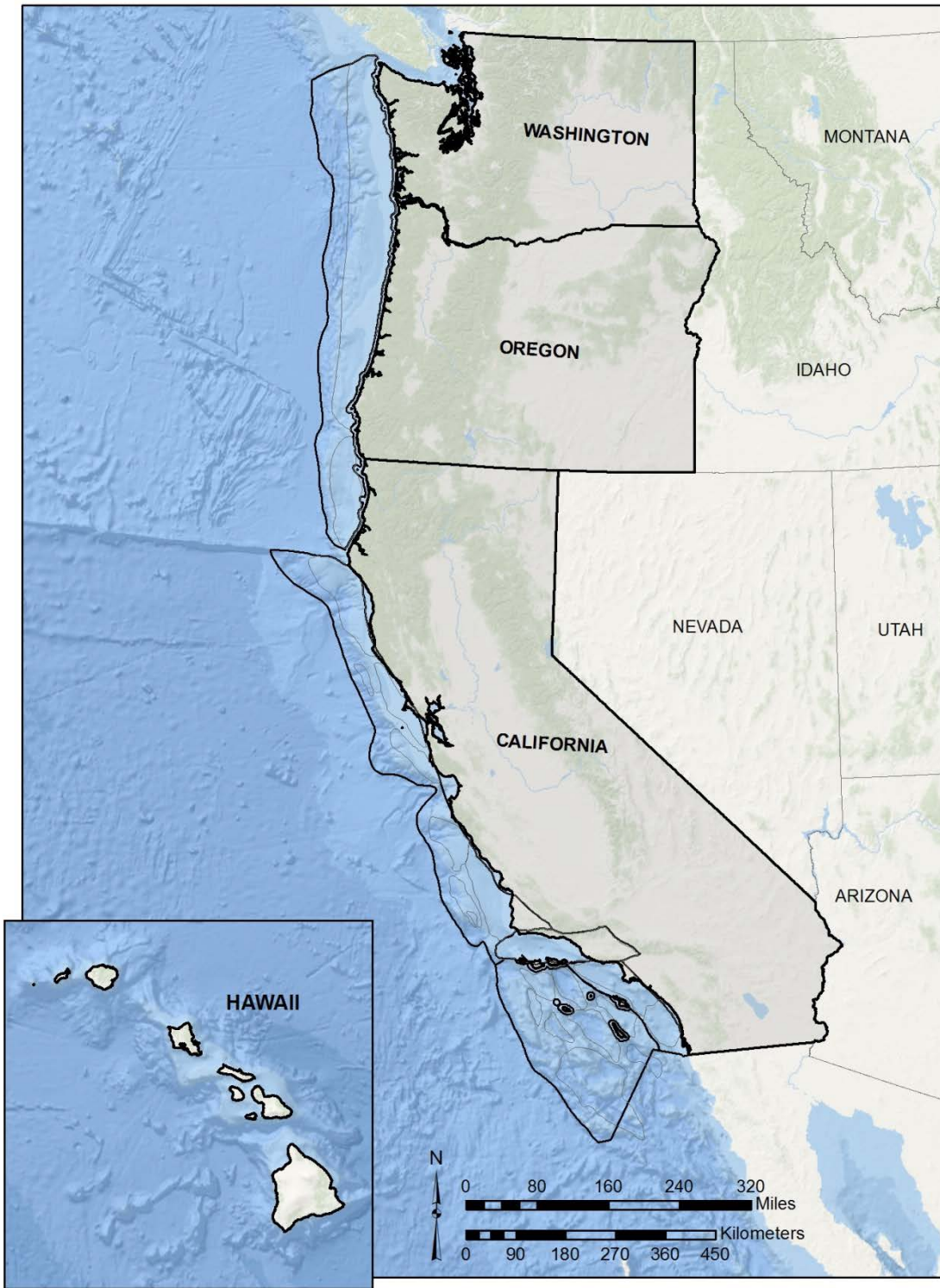


Figure 1: Map showing Pacific OCS Region including Hawaii.

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 12 basins and areas, and 41 of these plays have been formally assessed¹.

For planning purposes, the Pacific OCS Region was 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, 2014, is estimated to range from 6.96 to 14.03 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 nonassociated gas) in the Region is estimated to range from 10.52 to 23.92 Tcf with a mean estimate of 16.1 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, 2014 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 7.30 Bbbl of oil and 9.3 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 13.1 Bbbl of oil and 19.4 Tcf of gas (mean estimates). This estimated endowment is composed of discovered resources (originally recoverable reserves and contingent resources totaling 2.8 Bbbl oil and 2.9 Tcf gas) 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.

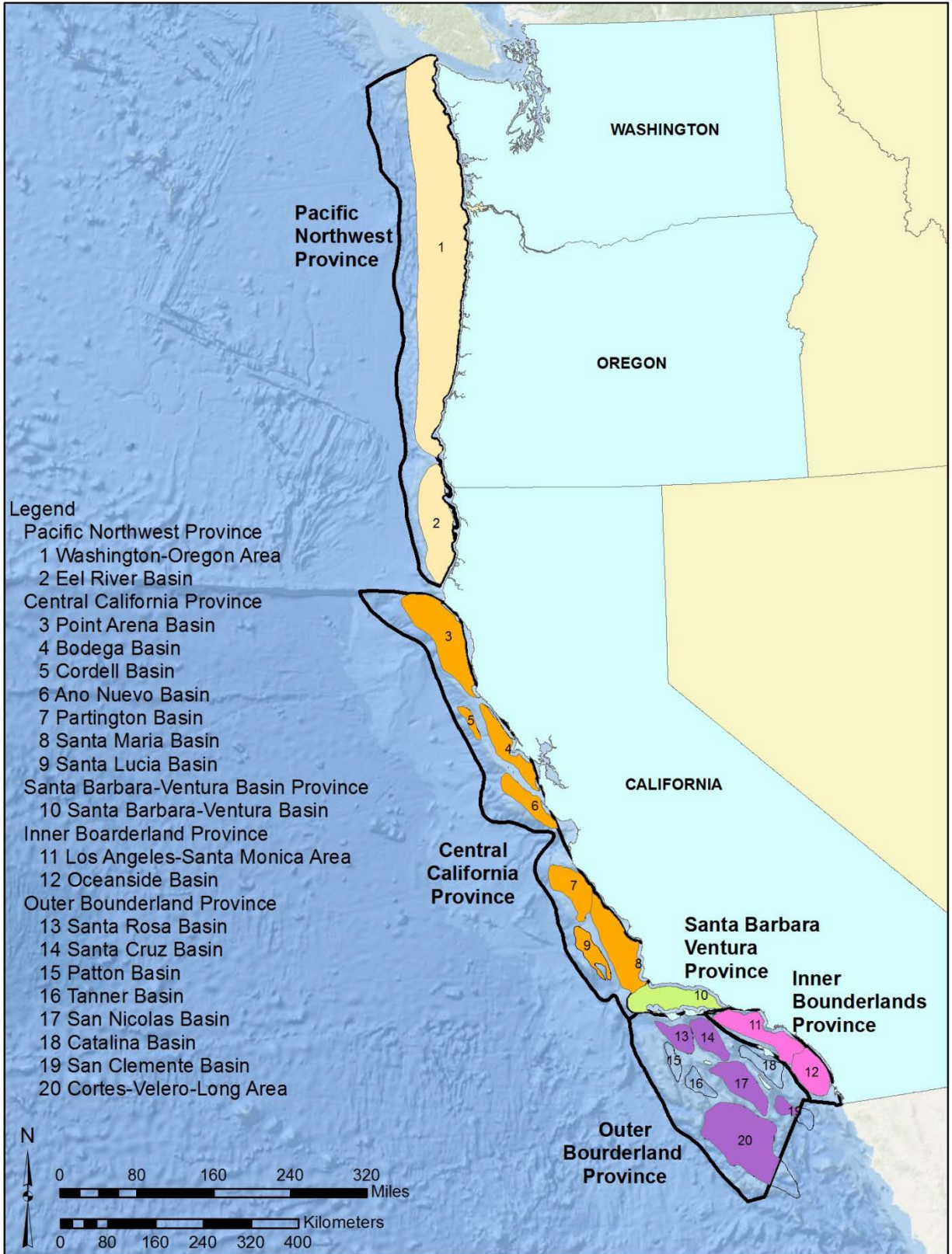


Figure 2: Map of the Pacific OCS Region showing assessment areas, geologic basins and provinces.
Note: Patton, Tanner and Catalina Basins respectively were not assessed.

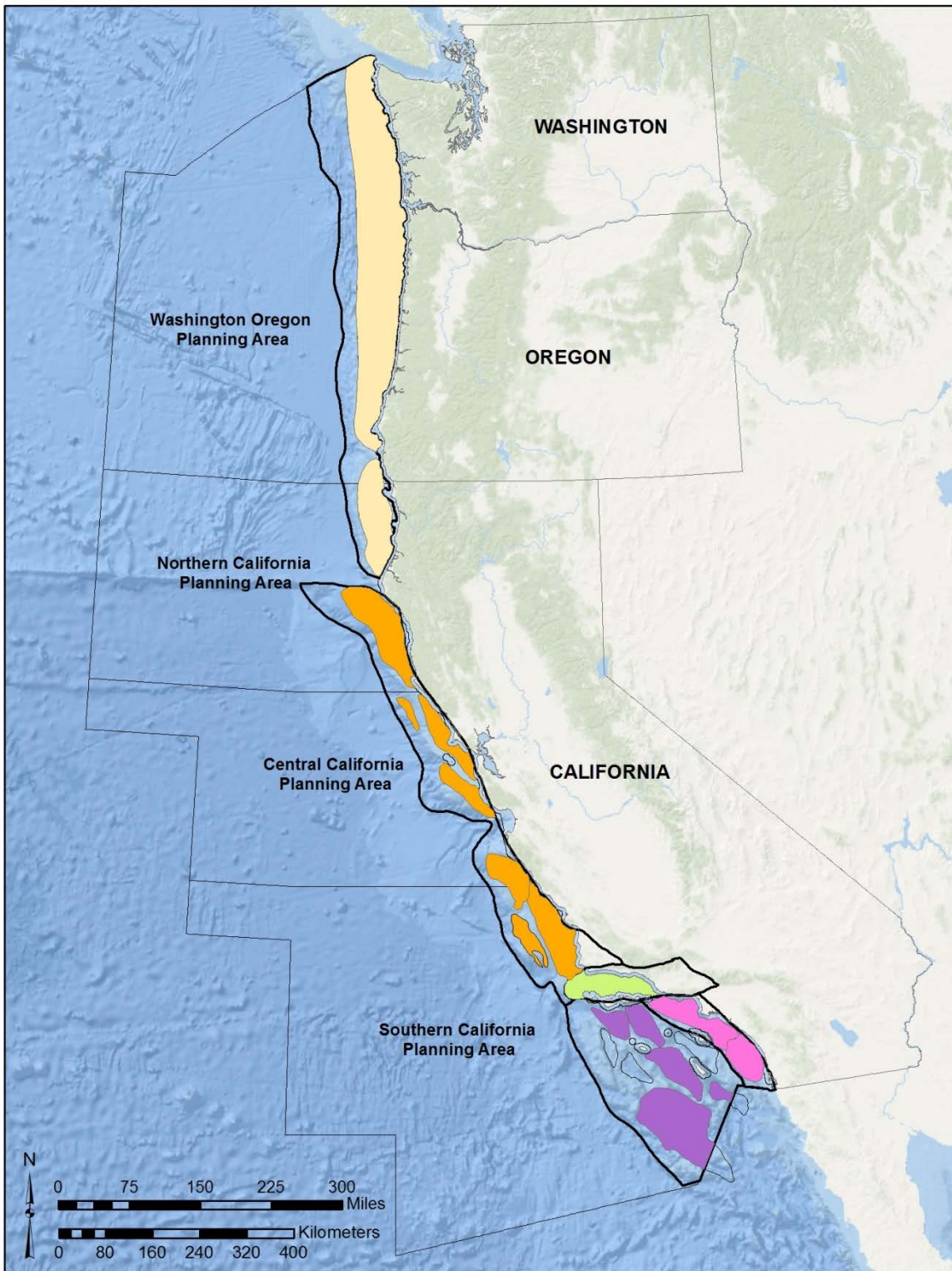


Figure 3: Map showing Pacific OCS planning areas, geologic basins and provinces

Resource Categories

Hydrocarbon resources are generally categorized by their discovery status and commerciality or economic viability. For this assessment, BOEM have adopted the classification and definitions based on the Petroleum Resources Management System and Definitions (PRMS) 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 endowments. The following definitions are provided to ensure proper understanding of the assessed resource categories.

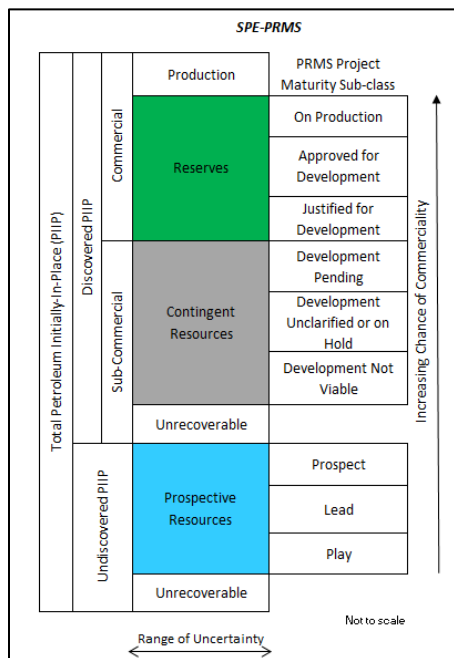


Figure 4.0: Hydrocarbon classification based on Project Maturity. From Petroleum Resources Management System (SPE-PRMS) sponsored by the Society of Petroleum Engineers (SPE), the American Association of Petroleum Geologists (AAPG), the World Petroleum Council (WPC), and the Society of Petroleum Evaluation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

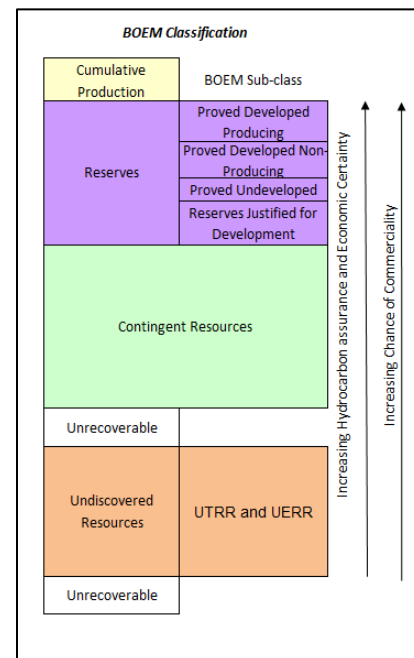


Figure 4.1: BOEM resource classification.

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, contingent resources, and unrecoverable resources.

Original recoverable reserves are the total amount of discovered resources that are estimated to be economically recoverable; they include cumulative production, remaining reserves and contingent resources. *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.

Unproved reserves are discovered resources that cannot be estimated with reasonable certainty to be economically recoverable under current economic conditions. *Contingent resources* are discovered resources estimated to be potentially recoverable from known accumulations, but are not available for commercial development due to one or more contingencies. Examples of contingencies 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.

Undiscovered Discovered resources are resources that have not been discovered but are estimated to exist outside and within known accumulations based on broad geologic knowledge and theory. Two categories of undiscovered resources – technically recoverable resources and economically recoverable resources have been assessed.

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 accumulation.

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](#))¹.

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 OCS 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 OCS 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 OCS Planning Area includes the Bodega, Año Nuevo and Partington basins.

The Southern California OCS 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](#))¹.

Resource Assessment Results

Undiscovered Technically Recoverable Resources

Estimates of the total volume of undiscovered technically recoverable resources in the Region have been 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) undiscovered technically recoverable resources (UTRR) of 10.20 Bbbl of oil and 16.10 Tcf of natural gas totaling 13.07 billion of barrels of oil equivalent (BBOE). [Table 1](#) presents detailed UTRR values by basins for the low (95th percentile), Mean, and high (5th percentiles) 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 percentiles) 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		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	2.23	5.76	0.00	0.80	2.17
	Eel River	0.01	0.07	0.17	0.28	1.52	2.59	0.06	0.34	0.63
Central California	Point Arena	1.00	2.01	3.46	0.99	2.10	3.85	1.18	2.38	4.14
	Bodega	0.50	1.40	2.67	0.50	1.52	3.06	0.59	1.68	3.21
	Año Nuevo	0.22	0.71	1.46	0.22	0.75	1.54	0.26	0.84	1.73
	Santa Maria-Partington	0.41	1.11	2.34	0.31	0.84	1.83	0.47	1.26	2.66
Santa Barbara-Ventura	Santa Barbara-Ventura	0.34	1.34	3.50	0.53	2.74	7.01	0.44	1.83	4.75
Inner Borderland	Los Angeles-Santa Monica-San Pedro	0.10	0.89	2.16	0.10	1.03	2.62	0.12	1.08	2.62
	Oceanside-Capistrano	0.00	1.06	2.16	0.00	1.12	2.37	0.00	1.26	2.59
Outer Borderland	Santa Cruz-Santa Roza	0.00	0.40	1.42	0.00	0.69	2.63	0.00	0.52	1.89
	San Nicolas	0.00	0.49	1.84	0.00	0.79	3.17	0.00	0.63	2.40
	Cortez-Valero-Long Area	0.00	0.31	1.28	0.00	0.76	3.11	0.00	0.45	1.84

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.

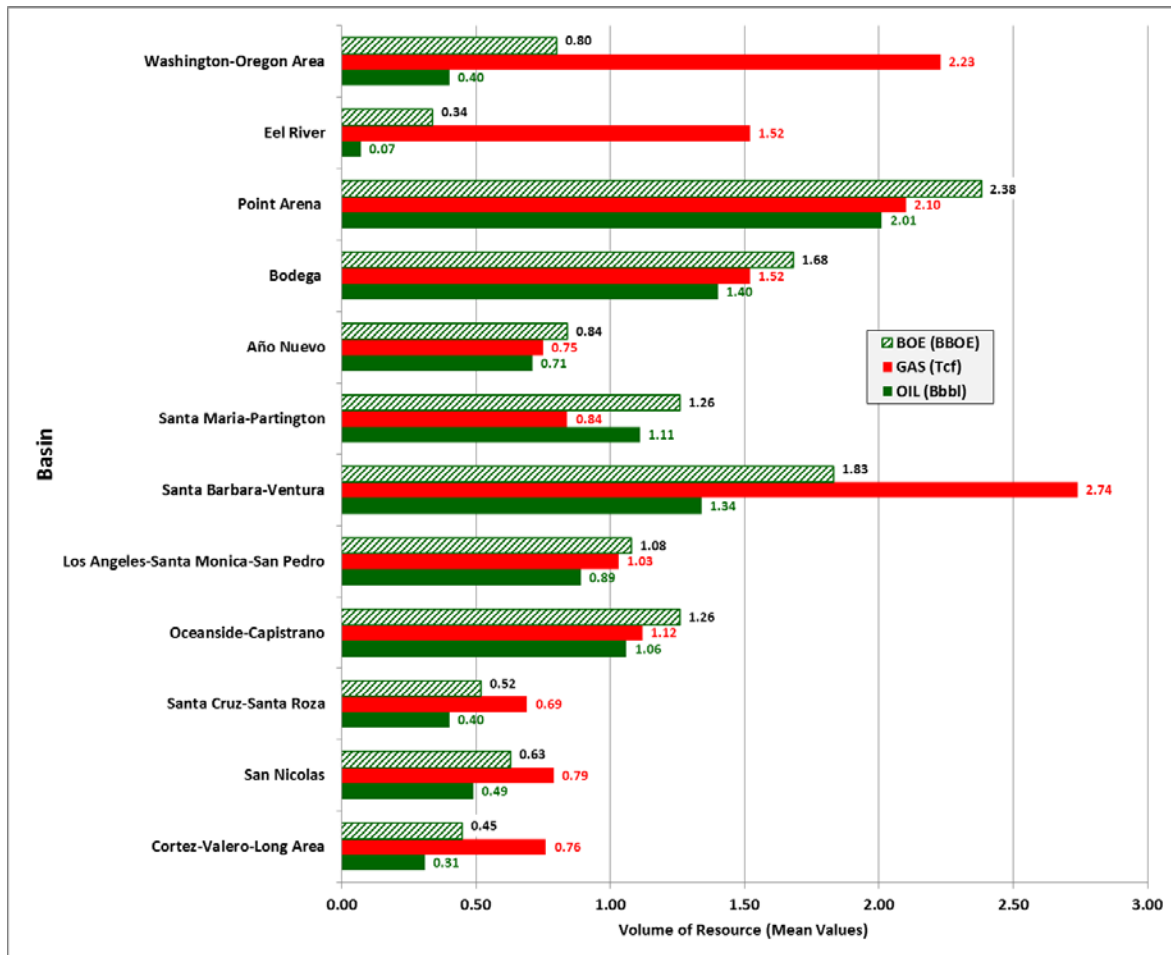


Figure 5: Undiscovered Technically Recoverable Oil and Gas Resources by basin (mean values)

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	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	1.22	0.89	3.76	7.43	0.19	1.14	2.54
Central California	3.33	5.23	7.53	3.15	5.21	7.70	3.89	6.16	8.90
Santa Barbara-Ventura	0.34	1.34	3.50	0.53	2.74	7.01	0.44	1.83	4.75
Inner Borderland	0.58	1.96	3.62	0.68	2.15	4.28	0.70	2.34	4.38
Outer Borderland	0.00	1.20	3.02	0.00	2.24	6.00	0.00	1.60	4.09
Pacific OCS Total	6.96	10.20	14.03	10.52	16.10	23.92	8.83	13.07	18.28

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.

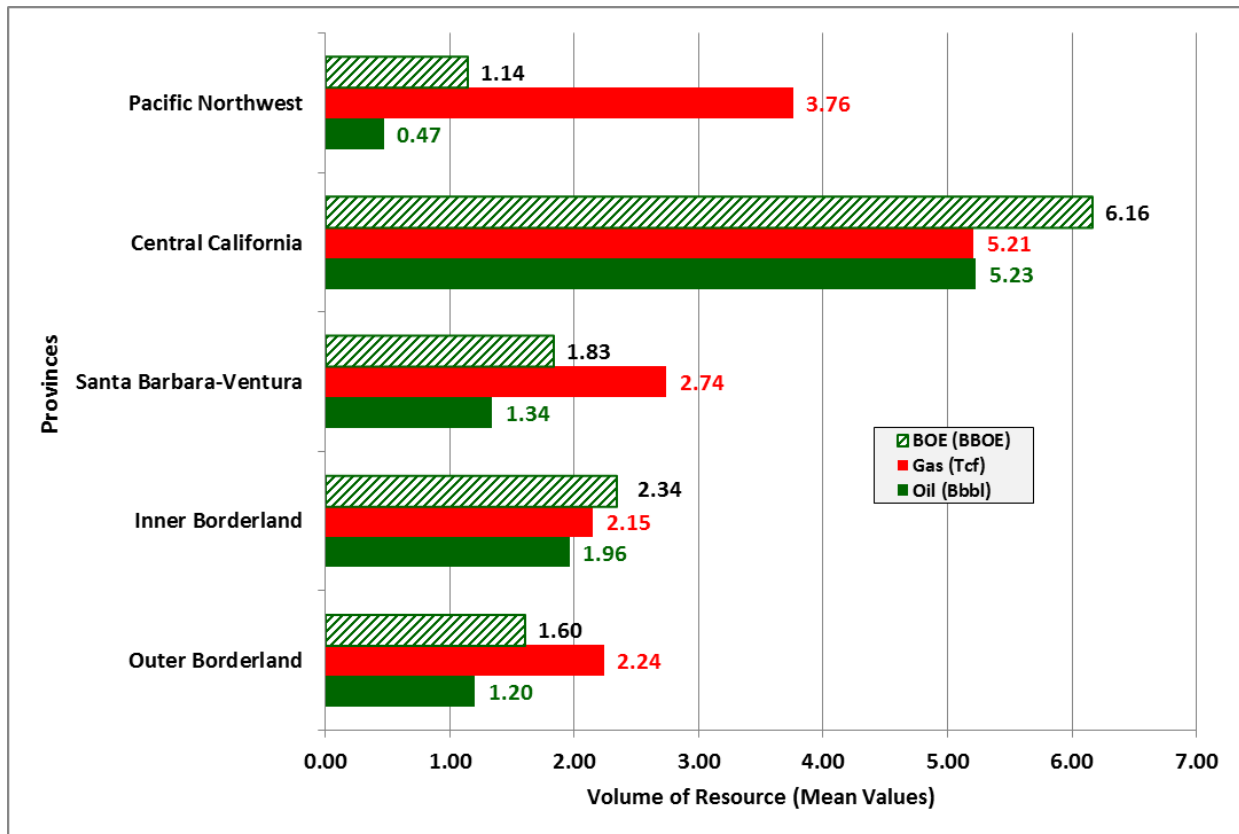


Figure 6: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by province (mean values)

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

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

Pacific OCS Region	Undiscovered Technically Recoverable Resources (UTRR)								
	Oil (Bbbl)			Gas (Tcf)			BOE (BBOE)		
Province	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Washington/Oregon Planning	0.00	0.40	1.14	0.03	2.28	5.80	0.01	0.81	2.18
Northern California	1.07	2.08	3.55	2.14	3.58	5.35	1.45	2.71	4.50
Central California	1.22	2.40	3.87	1.16	2.49	4.19	1.42	2.84	4.61
Southern California	2.82	5.32	8.70	3.58	7.76	13.60	3.46	6.70	11.12
Pacific OCS Total	6.96	10.20	14.03	10.52	16.10	23.92	8.83	13.07	18.28

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.

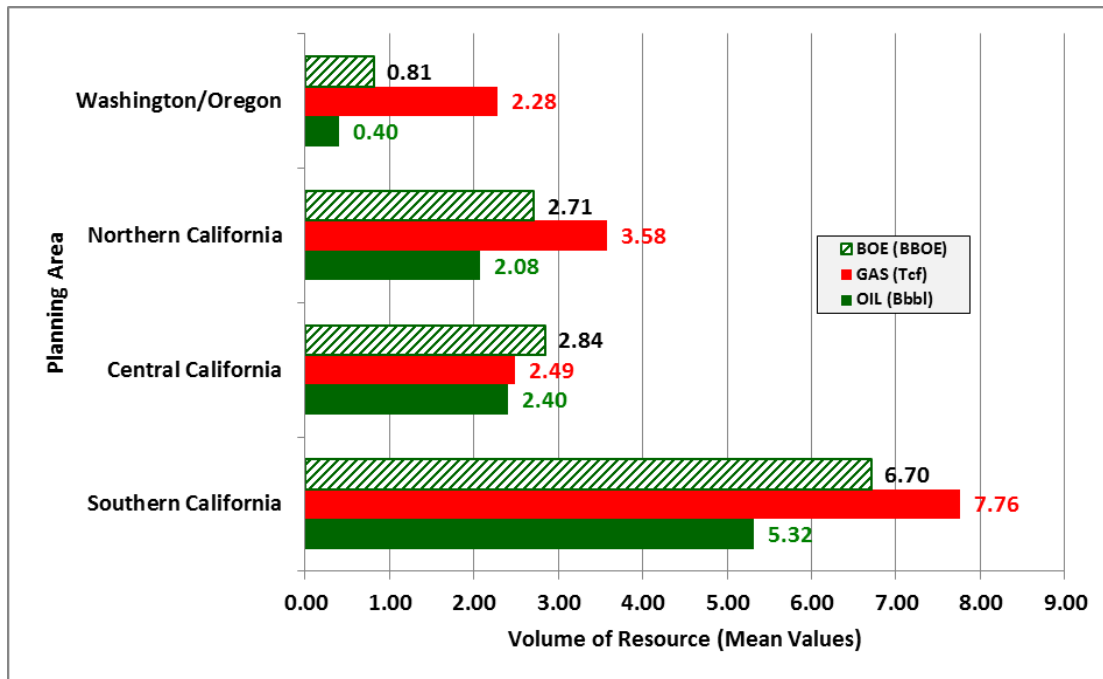


Figure 7: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by planning area (mean values)
Note: Barrel of Oil Equivalent (BOE) resource is the additive sum of the Oil resource and gas resource (in barre of oil-equivalent)

Table 4: Undiscovered Technically Recoverable Oil and Gas Resources of the Pacific OCS Region by water depth

Pacific OCS Region		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 Planning		0.00	0.40	1.14	0.03	2.28	5.80	0.01	0.81	2.18
	0 - 200 m	0.00	0.30	0.86	0.00	1.67	4.32	0.00	0.60	1.62
	200 - 800 m	0.00	0.10	0.29	0.03	0.60	1.48	0.01	0.21	0.55
Northern California		1.08	2.08	3.55	2.17	3.62	5.39	1.46	2.73	4.51
	0 - 200 m	0.20	0.40	0.69	0.24	0.47	0.82	0.25	0.49	0.84
	200 - 800 m	0.29	0.56	0.92	1.06	1.70	2.44	0.48	0.86	1.36
	+800m	0.57	1.12	1.92	0.82	1.46	2.45	0.71	1.38	2.35
Central California		1.22	2.40	3.87	1.16	2.49	4.19	1.42	2.84	4.61
	0 - 200 m	0.66	1.48	2.54	0.67	1.59	2.83	0.78	1.76	3.05
	200 - 800 m	0.42	0.80	1.28	0.36	0.68	1.08	0.34	0.69	1.14
	+800m	0.11	0.24	0.44	0.10	0.21	0.38	0.13	0.28	0.51
Southern California		2.82	5.32	8.70	3.58	7.76	13.60	3.46	6.70	11.12
	0 - 200 m	0.38	0.83	1.60	0.51	1.33	2.85	0.47	1.06	2.11
	200 - 800 m	1.35	2.54	4.23	1.70	3.59	6.70	1.65	3.18	5.42
	+800m	0.70	1.95	3.71	0.74	2.84	6.05	0.84	2.45	4.78
Pacific OCS Total		6.96	10.20	13.97	10.63	16.15	23.64	8.85	13.08	18.18
	0 - 200 m	1.84	3.01	4.39	2.37	5.07	8.20	2.26	3.91	5.85
	200 - 800 m	2.57	3.88	5.69	4.30	6.58	9.62	3.33	5.05	7.40
	+800m	1.85	3.31	5.18	2.18	4.50	7.73	2.24	4.11	6.56

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: \$40/bbl and \$2.14/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 at of 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 graphically illustrated in [Figure 8 through 10](#) (by basin). More so, the economically recoverable resources are shown in [Figures 11 through 13](#) by province and [Figures 14 through 16](#) planning area.

Table 5: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2014 for three 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		Undiscovered Economically Recoverable Resources (UERR)																										
		\$40/bbl & \$2.14/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)		
		95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Pacific Northwest	Washington-Oregon Area	0.00	0.14	0.52	0.00	0.46	1.68	0.00	0.22	0.82	0.00	0.23	0.78	0.00	0.78	2.56	0.00	0.37	1.23	0.00	0.26	0.84	0.00	0.92	2.91	0.00	0.43	1.36
	Eel River	0.00	0.02	0.06	0.00	0.06	0.23	0.00	0.03	0.10	0.00	0.04	0.11	0.01	0.18	0.55	0.00	0.07	0.21	0.00	0.04	0.12	0.02	0.28	0.75	0.01	0.09	0.26
Central California	Point Arena	0.24	0.82	1.84	0.24	0.85	2.07	0.28	0.97	2.20	0.53	1.30	2.58	0.52	1.34	2.87	0.62	1.54	3.09	0.64	1.46	2.77	0.63	1.51	3.08	0.75	1.72	3.32
	Bodega	0.31	1.00	2.08	0.32	1.08	2.40	0.37	1.19	2.50	0.43	1.25	2.43	0.44	1.35	2.80	0.51	1.49	2.93	0.45	1.30	2.51	0.46	1.41	2.89	0.54	1.55	3.03
	Ano Nuevo	0.13	0.51	1.14	0.13	0.54	1.21	0.16	0.61	1.36	0.19	0.63	1.33	0.18	0.66	1.40	0.22	0.74	1.58	0.20	0.66	1.38	0.20	0.69	1.45	0.24	0.78	1.63
Santa Barbara-Ventura	Santa Maria-Partington	0.08	0.45	1.28	0.06	0.34	0.95	0.09	0.51	1.45	0.23	0.79	1.84	0.17	0.60	1.41	0.26	0.90	2.10	0.28	0.89	2.01	0.20	0.67	1.54	0.31	1.01	2.28
Santa Barbara-Ventura	Santa Barbara-Ventura	0.18	1.04	3.07	0.19	1.89	5.78	0.21	1.37	4.10	0.28	1.24	3.36	0.32	2.26	6.34	0.33	1.64	4.48	0.30	1.28	3.40	0.36	2.38	6.49	0.36	1.70	4.56
Inner Borderland	Los Angeles-Santa Monica-San Pedro	0.01	0.46	1.47	0.01	0.57	1.91	0.01	0.56	1.81	0.04	0.67	1.86	0.04	0.81	2.33	0.04	0.82	2.28	0.05	0.73	1.95	0.05	0.87	2.43	0.06	0.89	2.39
	Oceanside-Capistrano	0.00	0.60	1.35	0.00	0.65	1.52	0.00	0.71	1.62	0.00	0.86	1.82	0.00	0.91	1.99	0.00	1.03	2.18	0.00	0.92	1.92	0.00	0.97	2.10	0.00	1.09	2.30
Outer Borderland	Santa Cruz-Santa Roza	0.00	0.02	0.10	0.00	0.05	0.19	0.00	0.03	0.13	0.00	0.11	0.53	0.00	0.20	0.97	0.00	0.15	0.71	0.00	0.16	0.73	0.00	0.28	1.36	0.00	0.21	0.97
	San Nicolas	0.00	0.05	0.27	0.00	0.12	0.70	0.00	0.08	0.39	0.00	0.18	0.88	0.00	0.31	1.68	0.00	0.23	1.18	0.00	0.20	0.96	0.00	0.34	1.80	0.00	0.26	1.28
	Cortez-Valero-Long Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.03	0.08	0.00	0.01	0.03
Total OCS Region (Mean Values)			5.11			6.61			6.28			7.30			9.41			8.98			7.90			10.35			9.74	

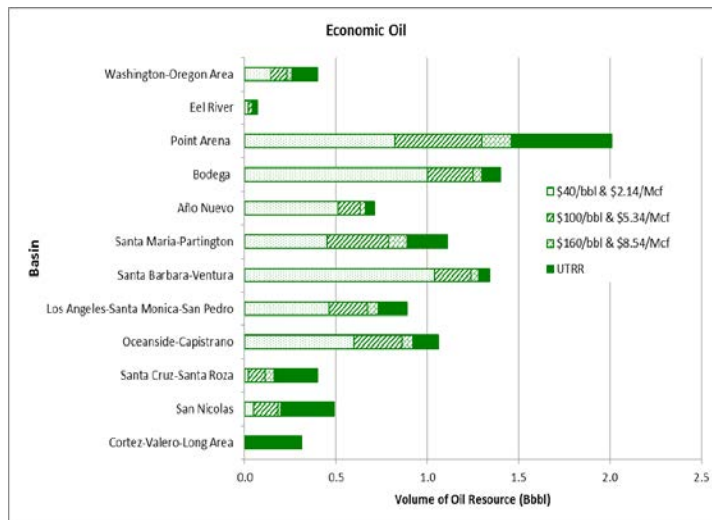


Figure 8: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by basin

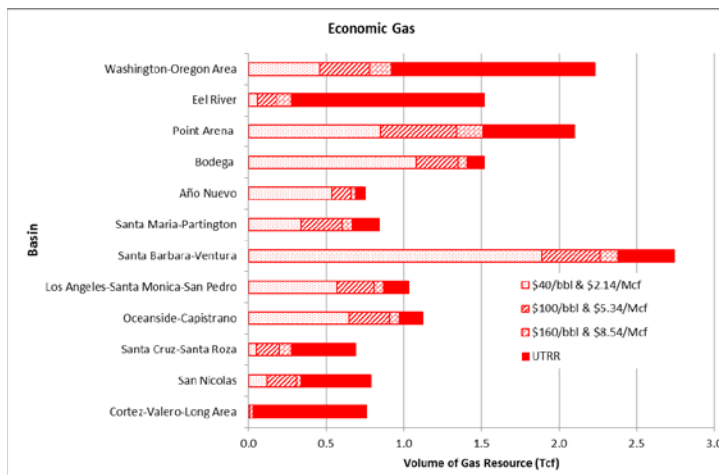


Figure 9: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by basin

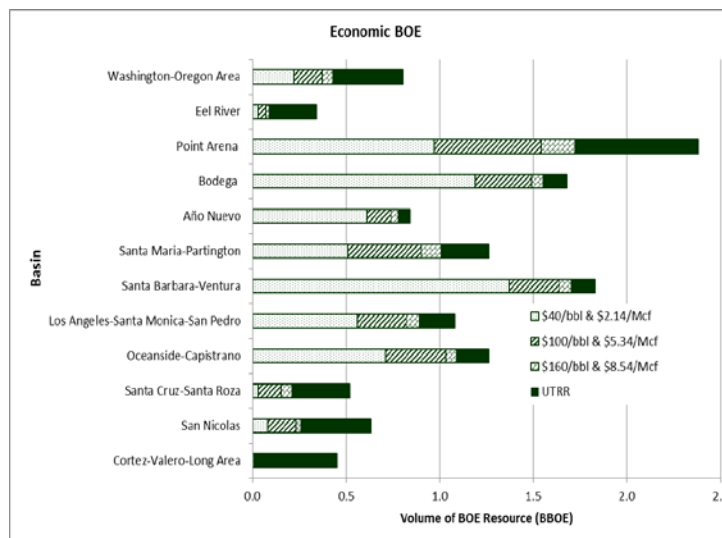


Figure 10: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by basin

Table 6: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2014 for three 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	Undiscovered Economically Recoverable Resources (UERR)																										
	\$40/bbl & \$2.14/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)		
Province	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Pacific Northwest	0.00	0.15	0.56	0.00	0.52	1.77	0.00	0.24	0.88	0.01	0.27	0.82	0.03	0.97	2.72	0.01	0.44	1.30	0.01	0.30	0.89	0.06	1.20	3.14	0.02	0.52	1.45
Central California	1.46	2.78	4.47	1.40	2.81	4.61	1.71	3.28	5.29	2.35	3.97	6.03	2.21	3.96	6.16	2.74	4.67	7.12	2.60	4.30	6.43	2.45	4.27	6.56	3.04	5.06	7.60
Santa Barbara-Ventura	0.18	1.04	3.07	0.19	1.89	5.78	0.21	1.37	4.10	0.28	1.24	3.36	0.32	2.26	6.34	0.33	1.64	4.48	0.30	1.28	3.40	0.36	2.38	6.49	0.36	1.70	4.56
Inner Borderland	0.19	1.05	2.31	0.23	1.22	2.92	0.23	1.27	2.83	0.36	1.54	3.05	0.44	1.72	3.69	0.44	1.84	3.71	0.42	1.65	3.22	0.50	1.84	3.86	0.51	1.98	3.91
Outer Borderland	0.00	0.08	0.31	0.00	0.18	0.82	0.00	0.11	0.46	0.00	0.29	1.01	0.00	0.52	2.10	0.00	0.38	1.38	0.00	0.36	1.21	0.00	0.65	2.52	0.00	0.48	1.66
Pacific OCS Total	3.16	5.10	7.51	3.73	6.61	11.36	3.82	6.28	9.53	4.84	7.30	10.32	5.71	9.43	15.22	5.85	8.98	13.03	5.30	7.89	11.01	6.39	10.35	16.37	6.44	9.73	13.92

Table 7: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2014 for three 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	Undiscovered Economically Recoverable Resources (UERR)																										
	\$40/bbl & \$2.14/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)		
Planning Area	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%
Washington/Oregon	0.00	0.14	0.52	0.00	0.46	1.66	0.00	0.22	0.82	0.00	0.23	0.78	0.00	0.79	2.56	0.00	0.37	1.23	0.00	0.26	0.84	0.00	0.93	2.91	0.00	0.43	1.36
Northern California	0.24	0.83	1.89	0.26	0.91	2.11	0.29	0.99	2.26	0.57	1.34	2.63	0.63	1.52	3.00	0.68	1.61	3.17	0.67	1.50	2.83	0.79	1.77	3.31	0.81	1.81	3.42
Central California	0.74	1.63	2.86	0.72	1.71	3.14	0.87	1.93	3.42	1.02	2.08	3.45	0.98	2.17	3.76	1.19	2.47	4.12	1.08	2.18	3.59	1.04	2.27	3.90	1.27	2.59	4.28
Southern California	1.21	2.50	4.70	1.44	3.54	7.36	1.46	3.13	6.01	1.93	3.65	6.29	2.23	4.94	9.41	2.33	4.53	7.96	2.11	3.95	6.66	2.48	5.37	9.96	2.56	4.90	8.44
Pacific OCS Total	3.16	5.10	7.51	3.73	6.61	11.36	3.82	6.28	9.53	4.84	7.30	10.32	5.71	9.43	15.22	5.85	8.98	13.03	5.30	7.89	11.01	6.39	10.35	16.37	6.44	9.73	13.92

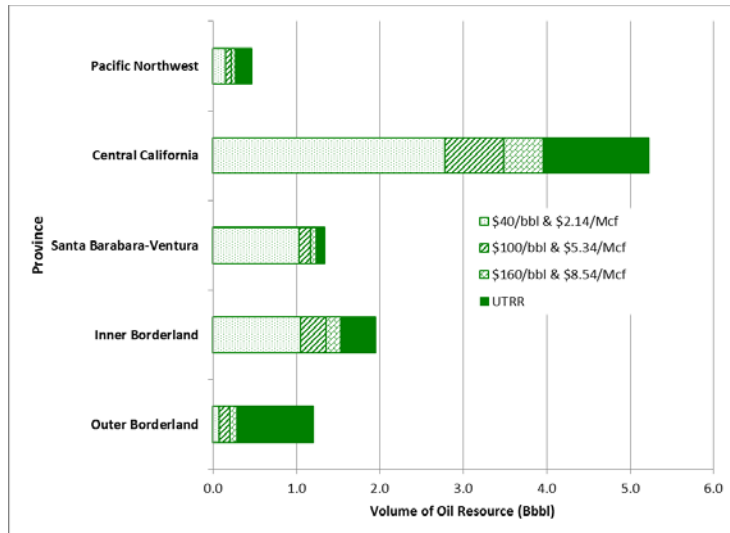


Figure 11: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by province

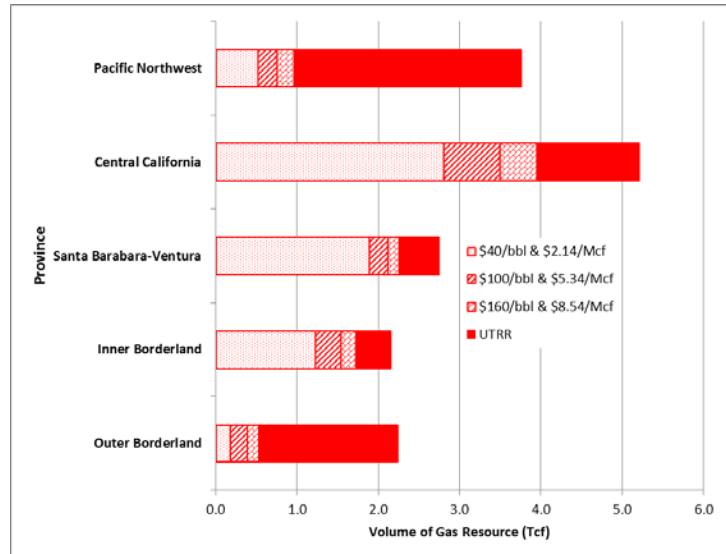


Figure 12: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by province

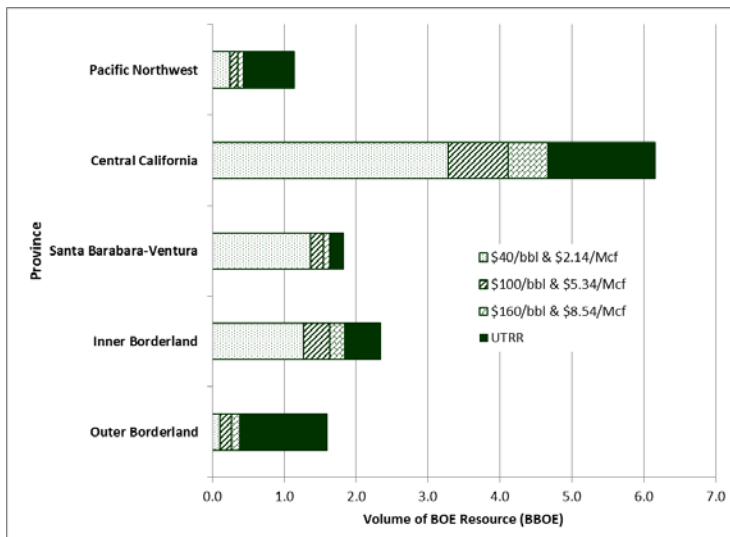


Figure 13: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by province

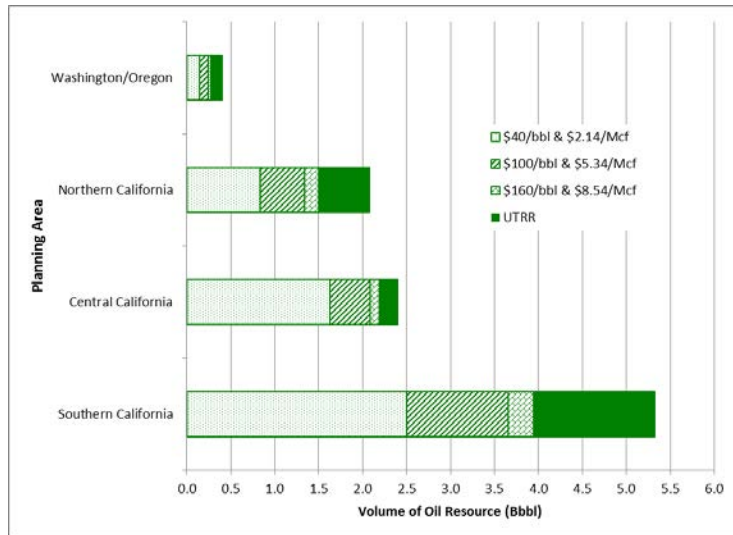


Figure 14: Undiscovered Economically Recoverable Oil Resource of the Pacific OCS by planning area

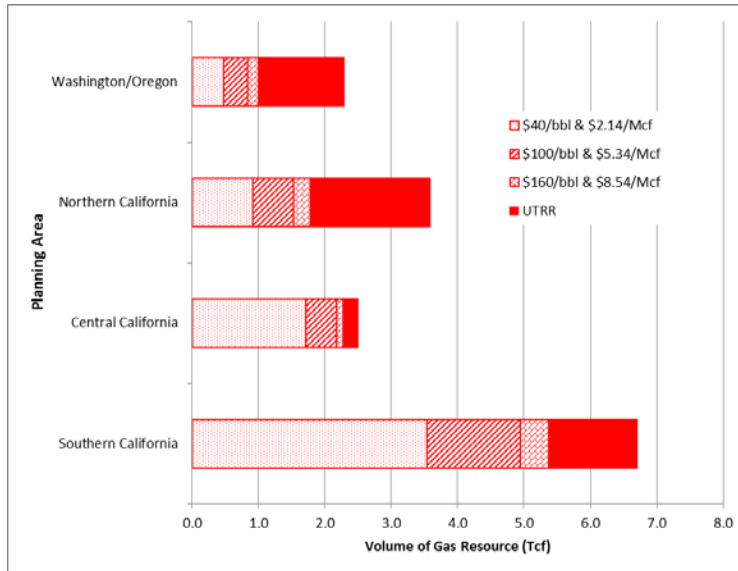


Figure 15: Undiscovered Economically Recoverable Gas Resource of the Pacific OCS by planning area

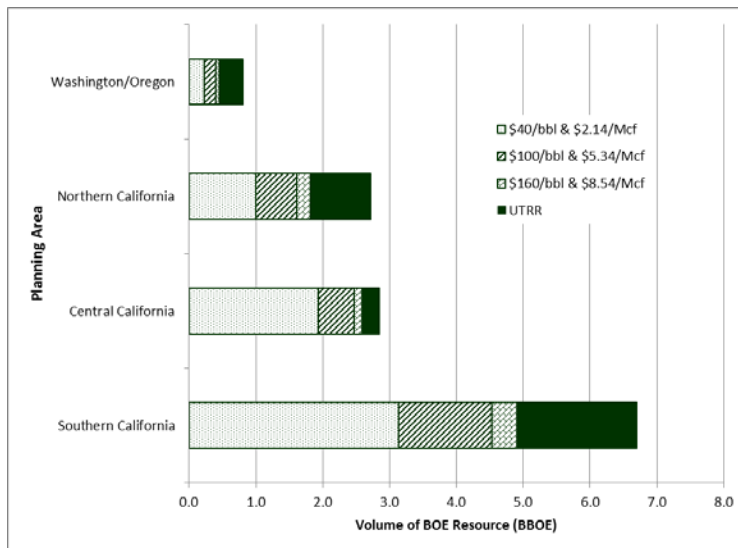


Figure 16: Undiscovered Economically Recoverable BOE Resource of the Pacific OCS by planning area

Table 8: Estimates of undiscovered economically recoverable oil and gas resources in the Pacific OCS Region as of January 1, 2014 for three 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		Undiscovered Economically Recoverable Resources (UERR)																										
		\$40/bbl & \$2.14/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)		
Planning Area	Water Depth	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%	95%	Mean	5%			
Washington/Oregon Planning		0.00	0.14	0.52	0.00	0.46	1.66	0.00	0.22	0.82	0.00	0.23	0.78	0.00	0.79	2.56	0.00	0.37	1.23	0.00	0.26	0.84	0.00	0.93	2.91	0.00	0.43	1.36
	0 - 200 m	0.00	0.10	0.39	0.00	0.34	1.26	0.00	0.16	0.62	0.00	0.17	0.58	0.00	0.59	1.92	0.00	0.28	0.93	0.00	0.20	0.63	0.00	0.69	2.18	0.00	0.32	1.02
	200 - 800 m	0.00	0.03	0.13	0.00	0.12	0.43	0.00	0.06	0.21	0.00	0.06	0.20	0.00	0.20	0.65	0.00	0.10	0.31	0.00	0.07	0.21	0.00	0.24	0.74	0.00	0.11	0.34
Northern California		0.25	0.83	1.89	0.26	0.91	2.12	0.30	0.99	2.26	0.57	1.34	2.64	0.62	1.53	3.01	0.68	1.61	3.17	0.67	1.50	2.84	0.78	1.78	3.32	0.81	1.81	3.43
	0 - 200 m	0.05	0.16	0.37	0.05	0.17	0.42	0.05	0.19	0.44	0.11	0.26	0.52	0.11	0.27	0.58	0.12	0.31	0.62	0.13	0.29	0.55	0.13	0.31	0.62	0.15	0.35	0.67
	200 - 800 m	0.07	0.22	0.46	0.07	0.26	0.57	0.08	0.26	0.56	0.15	0.35	0.67	0.18	0.48	0.92	0.18	0.44	0.83	0.18	0.40	0.72	0.25	0.59	1.07	0.22	0.50	0.92
	+800m	0.13	0.45	1.03	0.14	0.48	1.18	0.16	0.54	1.24	0.29	0.72	1.43	0.31	0.78	1.62	0.35	0.86	1.72	0.35	0.81	1.53	0.39	0.88	1.75	0.42	0.97	1.84
Central California		0.74	1.63	2.86	0.72	1.71	3.14	0.87	1.93	3.42	1.02	2.08	3.45	0.98	2.17	3.76	1.19	2.47	4.12	1.08	2.18	3.59	1.04	2.27	3.90	1.27	2.59	4.28
	0 - 200 m	0.44	1.06	1.95	0.44	1.14	2.17	0.51	1.26	2.33	0.58	1.31	2.30	0.59	1.41	2.56	0.68	1.56	2.76	0.61	1.37	2.38	0.62	1.47	2.65	0.72	1.63	2.86
	200 - 800 m	0.21	0.45	0.78	0.20	0.47	0.83	0.24	0.53	0.93	0.30	0.58	0.95	0.28	0.60	1.01	0.35	0.69	1.13	0.32	0.61	0.99	0.30	0.63	1.05	0.37	0.73	1.18
	+800m	0.04	0.12	0.27	0.04	0.11	0.23	0.05	0.14	0.31	0.08	0.19	0.36	0.07	0.16	0.31	0.09	0.21	0.42	0.09	0.20	0.39	0.07	0.17	0.33	0.10	0.23	0.45
Southern California		1.21	2.50	4.70	1.44	3.54	7.36	1.46	3.13	6.01	1.93	3.65	6.29	2.23	4.94	9.41	2.33	4.53	7.96	2.11	3.95	6.66	2.48	5.37	9.96	2.56	4.90	8.44
	0 - 200 m	0.15	0.49	1.18	0.17	0.77	2.08	0.18	0.62	1.55	0.26	0.65	1.39	0.28	0.99	2.38	0.31	0.83	1.82	0.29	0.70	1.45	0.33	1.06	2.49	0.35	0.88	1.89
	200 - 800 m	0.58	1.43	2.88	0.67	2.03	4.73	0.70	1.80	3.72	0.96	1.99	3.57	1.07	2.70	5.56	1.15	2.47	4.56	1.06	2.14	3.74	1.20	2.90	5.86	1.27	2.65	4.79
	+800m	0.26	0.58	0.96	0.26	0.73	1.40	0.30	0.71	1.21	0.43	1.01	1.83	0.43	1.26	2.60	0.51	1.23	2.29	0.49	1.11	2.01	0.48	1.41	2.92	0.57	1.36	2.53
Pacific OCS Total		3.21	5.10	7.71	3.77	6.61	11.30	3.88	6.28	9.72	4.90	7.30	10.37	5.79	9.43	15.03	5.93	8.98	13.04	5.35	7.89	11.03	6.45	10.35	16.13	6.50	9.73	13.90
	0 - 200 m	1.00	1.81	2.87	1.14	2.42	4.28	1.20	2.24	3.63	1.42	2.40	3.62	1.62	3.26	5.46	1.71	2.98	4.60	1.52	2.55	3.82	1.77	3.54	5.85	1.84	3.18	4.86
	200 - 800 m	1.20	2.14	3.62	1.37	2.87	5.32	1.44	2.65	4.57	1.84	2.99	4.65	2.17	3.97	6.67	2.23	3.70	5.84	2.02	3.21	4.92	2.45	4.35	7.14	2.46	3.99	6.19
	+800m	0.65	1.16	1.69	0.66	1.32	2.18	0.77	1.39	2.08	1.11	1.91	2.93	1.12	2.19	3.72	1.31	2.30	3.59	1.27	2.13	3.20	1.30	2.46	4.09	1.50	2.57	3.93

Endowment for the Pacific OCS

The total endowment for the Pacific OCS was calculated to be 13.11 Bbl of oil and 19.41 Tcf of natural gas (total 16.56 BBOE). This estimated endowment is composed of the originally recoverable reserves (cumulative production and remaining reserves) in developed Fields, contingent resources (undeveloped Fields) and undiscovered technically recoverable resources (mean values). These results are as summarized in Table 9 and illustrated in Figure 17 as shown below.

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

Resource Description	Oil (Bbbl)	Gas (Tcf)	BOE (BBOE)
Undiscovered Technically Recoverable Resources	10.20	16.10	13.07
Continent Resources (Undeveloped Fields)	1.31	0.93	1.47
Originally Recoverable Reserves (Developed Fields)	Remaining Reserves	0.29	0.39
	Cumulative Production	1.31	1.80
Pacific OCS Total Endowment	13.11	19.41	16.56

Estimates of discovered resources, including originally recoverable reserves and contingent resources, are as of January 1, 2014. Originally recoverable reserves include cumulative production and remaining reserves. Estimates of undiscovered technically recoverable resources are risk values. Some total values may not equal the sum of the component values due to independent rounding.

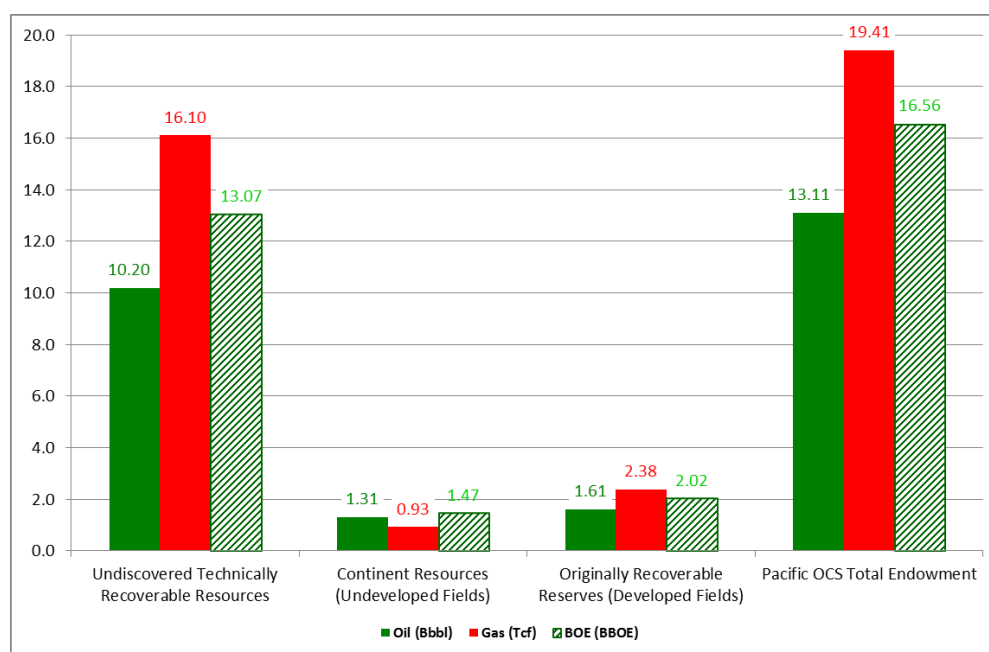


Figure 17: Total Endowment for the Pacific Outer Continental Shelf

As of date of the report, the UTRR (mean value) represents approximately 79 percent (13.08 billion barrels of oil equivalent) of the total endowment (16.56 billion barrels of oil equivalent) in the Pacific OCS. To date, we have produced 1.63 Bbbl (oil equivalent), which accounts for 10 percent of the total endowment. Therefore, it is estimated that 90 percent (14.9 Bbbl – oil equivalent) of the total endowment in the Pacific OCS remain untapped.

References

1. Piper, K., and Ojukwu, C.O., 2014, BOEM (Bureau of Ocean Energy Management, U.S. Department of the Interior), 2011 National Assessment of United States Oil and Gas Resources on the Outer Continental Shelf, (OCS Report BOEM 2014-667). <https://www.boem.gov/2014-667-2011-National-Assessment/>
2. Ojukwu, C.O., Bureau of Ocean Energy Management, Pacific OCS Region, 2014, Field and Reservoir Reserve Estimates Report as of December 2014. <https://www.boem.gov/2014-Pacific-Field-Reserve-Estimate-Summary-Report/>
3. Society of Petroleum Engineers (SPE), American Association of Petroleum Geologists (AAPG), World Petroleum Council (WPC), and Society of Petroleum Evaluation Engineers (SPEE), 2007, Petroleum Resources Management System, 49p: <http://www.spe.org/spe-app/spe/industry/reserves/prms.htm>

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

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 total amount of discovered resources that have been extracted from an area prior to a specified date.

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.

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 Unclarified 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.

Discovered Resources: Those resources that have been discovered and whose location and volume have been estimated using specific geologic knowledge. They include cumulative production, remaining reserves, contingent resources, and unrecoverable resources.

Field: A *field* is a single- or multiple-pool accumulation of hydrocarbon resources that has been discovered.

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, remaining reserves and contingent resources.

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 detected but for which data suggest that hydrocarbon accumulations may exist.
- **Established plays:** Those play in which hydrocarbon accumulations have been discovered.

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

Pool: A *pool* is a discrete accumulation (discovered or undiscovered) of hydrocarbon resources that are hydraulically separated from any other hydrocarbon accumulation; it is typically related to a single stratigraphic interval or structural feature.

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

Prospect: A *prospect* is an untested geologic feature having the potential for trapping and accumulating hydrocarbons.

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.

Sub-Commercial: A project is Sub-Commercial if the degree of commitment is not such that the accumulation is expected to be developed and placed on production within a reasonable time frame. While 5 years is recommended as benchmark, a longer time frame could be applied where, for example, a development of economic projects are deferred at the option of the producer for, among other things, market-related reasons, or to meet contractual or strategic objective. Discovered sub-commercial projects are classified as Contingent Resources.

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: These are resources that have not been discovered but are estimated to exist outside and within known accumulations based on broad geologic knowledge and theory. Undiscovered may be categorized into:

- ***Technically Recoverable Resources*** are resources that can be removed from the subsurface with conventional extraction techniques (that is, technology whose usage is considered common practice as of this assessment).
- ***Economically Recoverable Resources*** are technically recoverable resources that can be extracted profitably under specified economic 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.

