

**ESTIMATED
OIL AND GAS RESERVES
SOUTHERN CALIFORNIA
OUTER CONTINENTAL SHELF
AS OF DECEMBER 31, 1984**

Prepared by
**MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION**

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1985

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Estimated Oil and Gas Reserves, Southern California Outer Continental Shelf,
as of December 31, 1984

By Steven A. Wolfson

ABSTRACT

Remaining recoverable reserves of oil* and gas in the Outer Continental Shelf off Southern California are estimated to be 1,205 million barrels of oil and 2,198 billion cubic feet of gas as of December 31, 1984. These reserves are attributed to 23 fields. Original recoverable reserves from these fields are estimated at 1,515 million barrels of oil and 2,400 billion cubic feet of gas. The estimates for both the remaining and the original recoverable reserves of oil and gas are higher than the corresponding estimates for December 31, 1983. Reserve estimates for 21 fields were based on individual volumetric reservoir studies. Decline-curve and volumetric analyses were used for the remaining two fields. At the end of 1984, seven fields were on production.

*The term "oil" as used in this report includes crude oil, condensate, and gas-plant liquids.

INTRODUCTION

This report, which supersedes OCS Report, MMS 84-0024 (Wolfson, 1984), presents estimates of original recoverable oil and gas reserves, cumulative production through 1984, and estimates of remaining recoverable reserves as of December 31, 1984, in the Outer Continental Shelf (OCS) off Southern California. These estimates were completed in May 1985.

The annual update of this report is part of a Minerals Management Service continuing program aimed at providing and maintaining a current inventory of oil and gas reserves on the Outer Continental Shelf. The estimates presented here were prepared by geologists, geophysicists, petroleum engineers, and other technical personnel within the Minerals Management Service's Pacific OCS Region in Los Angeles, California.

DEFINITION OF RESERVE AND RESOURCE TERMS

The reserve and resource terminology in this report conforms with Dolton and others (1981, p. 6-7). The quoted definitions of terms applicable to this report are:

"Resources.--Concentrations of naturally occurring liquid or gaseous hydrocarbons in the Earth's crust, some part of which is currently or potentially economically extractable."

"Measured reserves.--That part of the economic identified resource that is estimated from geologic evidence supported directly by engineering measurements. Measured reserves here are equivalent to proved reserves as defined by the American Petroleum Institute (API) and others (1976, p. 1)."

"Indicated reserves.--Reserves equivalent to API indicated additional reserves, that are defined as economic reserves in known productive reservoirs in existing fields expected to respond to improved recovery techniques such as fluid injection where (a) an improved recovery technique has been installed but its effect cannot yet be fully evaluated; or (b) an improved technique has not been installed but knowledge of reservoir characteristics and the results of a known technique installed in a similar situation are available for use in the estimating procedure (API, 1976, p. 1, 2)."

For this report other definitions used are:

Reserves.--That portion of the identified resource which can be economically extracted.

Demonstrated reserves.--A collective term for the sum of measured and indicated reserves.

APPLICATION OF TERMS IN PRESENT REPORT

In fields with limited well control, "measured reserves" as used in this report refer to hydrocarbons within boundaries defined by the use of both seismic interpretation and well control.

Six producing oil fields in the Southern California Outer Continental Shelf; Hueneme, Santa Clara, Hondo, Dos Cuadras, Carpinteria Offshore, and Beta (fig. 1), are undergoing fluid injection, and recovery beyond primary production is in progress or can be anticipated. For some remaining fields, where it was determined that indicated reserves could be anticipated by comparison with similar producing fields, indicated reserves were included with the measured reserves for a total estimate of demonstrated reserves.

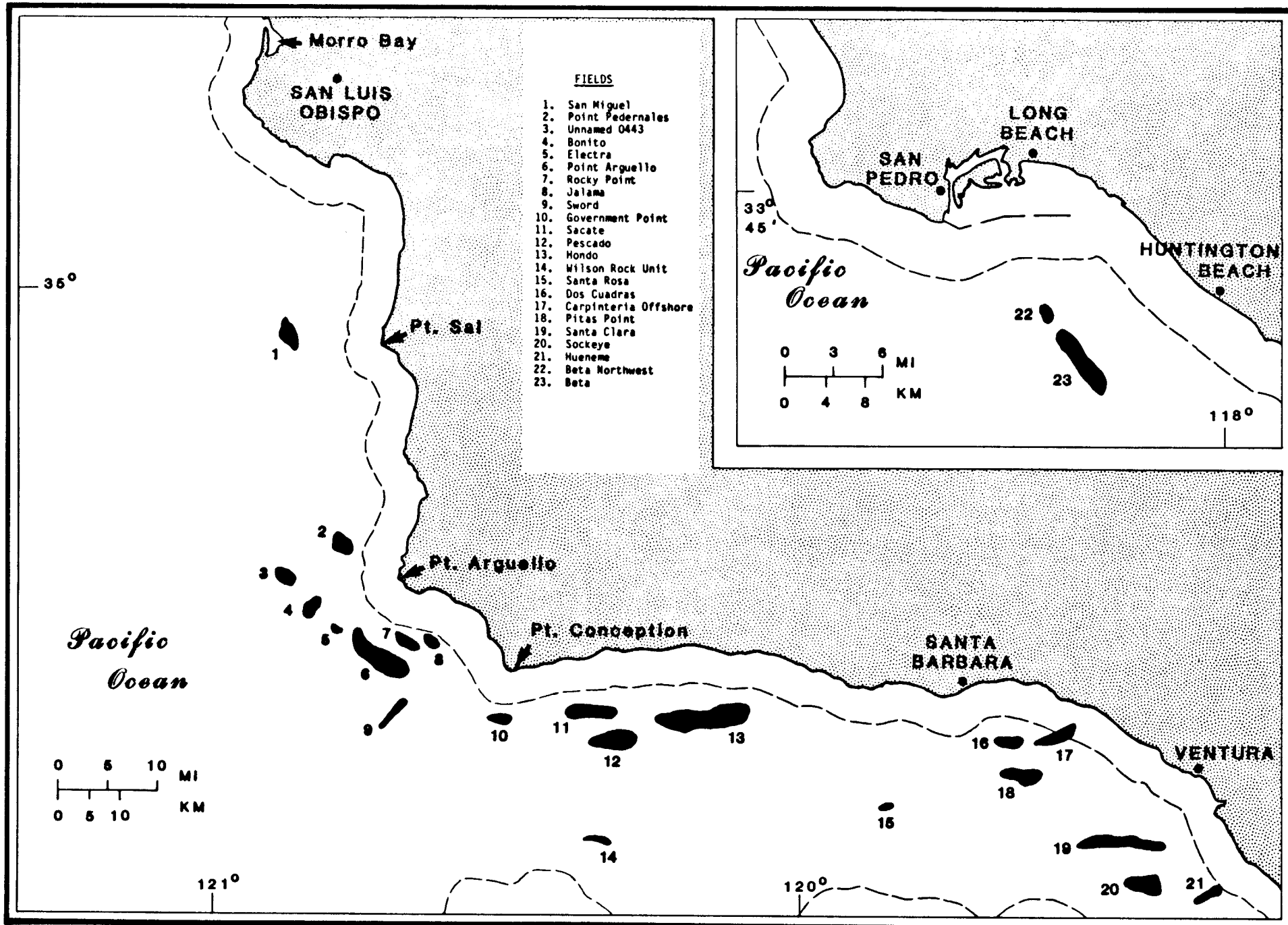


Figure 1. Recognized discoveries of federally controlled oil and gas fields in the Southern California Outer Continental Shelf. Dashed lines indicate 3-nautical-mile boundary between State and Federal waters.

Pacific Region OCS Order No. 4, "Determination of Well Producibility," provides criteria for determining, through evaluation of borehole testing, whether a well is capable of producing in paying quantities (Minerals Management Service, 1980). The term "paying quantities," as used herein, means production of oil and gas in quantities sufficient to yield a return in excess of operating costs. The quality and quantity of the data vary from field to field. In some instances, these "paying quantities" as defined in the OCS Order may not prove to be "economically extractable" reserves, and these accumulations are generally omitted from reserve calculations. The accumulations are included here, however, because they may be necessary for effective planning and lease management.

METHODS USED FOR RESERVES ESTIMATION

Volumetric calculation.--The amount of original oil and gas in place is estimated from the bulk volume of the reservoir as mapped by the use of data from drill holes and seismic profiles. Maps of net oil and gas sand thickness are made and planimetered, and the results are converted to bulk volume by use of pyramidal formulas. Porosity of the rock and the amount of water, oil, and gas in the pore space are interpreted from borehole logs and analyses of cores. The total amount of oil and gas in place is converted to standard conditions by analysis of pressure, volume, and temperature relationships, and the use of standard correlation charts.

The amount of the original oil and gas in place that can be recovered is estimated from knowledge of the reservoir-drive mechanism, spacing of the wells, and API recovery-factor equations (Arps and others, 1967, p. 19-20).

Decline curves.--In the decline-curve method, future production is estimated by extrapolating plots of production rates and fluid percentage against time. The original recoverable reserves are determined by adding past production to predicted future production.

FIELDS REPORTED

As of December 31, 1984, 23 fields in the Outer Continental Shelf off Southern California (fig. 1) are recognized as producing or capable of production on the basis of the "producible in paying quantities" criterion. Two of these fields are gas fields, 13 are oil fields, and eight are combination oil and gas fields.

The totals of the current estimates of the remaining and the original recoverable reserves for oil and gas are each higher than for the preceding year. The higher figures are because of the inclusion of oil and gas estimates for three newly discovered fields in the Santa Maria Basin. Modifications were made to several of the estimates of original recoverable reserves for the other fields.

Reserves are estimated for only the Federal portions of those fields that cover both State and Federal lands.

The Southern California OCS total estimates for oil and for gas are shown in table 1. These totals appear as composite numbers so as to protect the proprietary nature of the data used to determine the estimates.

STATUS OF DEVELOPMENT

As of December 31, 1984, three of the fields in the Southern California Outer Continental Shelf were fully drilled, i.e. Dos Cuadras, Carpinteria Offshore, and Hueneme (fig. 1, fields 16, 17 and 21). Of the 23 recognized fields, seven were producing at this time, namely Hondo, Dos Cuadras, Carpinteria Offshore, Pitas Point, Santa Clara, Hueneme, and Beta (fig. 1, fields 13, 16, 17, 18, 19, 21 and 23). Additional exploratory and delineation drilling is anticipated in many of the remaining fields so as to further define productive limits and aid in effective development. It is anticipated that the Pt. Arguello and Pt. Pedernales fields will soon commence production.

TABLE 1.----Estimated Demonstrated Oil and Gas Reserves for 23 Fields, Southern California Outer Continental Shelf, December 31, 1984 ["Oil" includes crude oil, condensate, and gas-plant products sold. "Gas" includes both associated and nonassociated dry gas.]

	Oil (million bbl)	Gas (billion ft ³)
Original reserves:		
Estimated as of 12/31/84 (this report)..	1,515	2,400
Estimated as of 12/31/83 (MMS 84-0024)..	1,433	2,298
Change.....	+82	+102
Cumulative production:		
Through 1984.....	310	202
Through 1983.....	280	156
Remaining reserves:		
Estimated as of 12/31/84 (this report)..	1,205	2,198
Estimated as of 12/31/83 (MMS 84-0024)..	1,153	2,141
Change.....	+52	+57

STUDIES CONDUCTED

Estimates of two of the producing fields, Dos Cuadras and Carpinteria Offshore (fig. 1, fields 16 and 17), were made from volumetric and decline-curve analyses. Individual reservoirs in each field were grouped for volumetric calculations. Decline-curve analyses were made on a lease-by-lease and platform basis. The remaining fields were studied on a reservoir-by-reservoir basis and the reserve estimates were made by the volumetric method.

FIELD-SIZE DISTRIBUTION

Figure 2 shows the field-size distribution of the original recoverable reserves of 21 oil and gas fields, and 2 gas fields. For convenience of comparison, gas reserves are expressed in terms of oil on the basis of equivalent heating

values (6,000 cubic feet of gas is equivalent to 1 barrel of oil). This histogram exhibits a lognormal distribution, with a majority of the fields in the 0 to 100-million-barrel category. About 70 percent of the combined reserves, however, are in the larger fields.

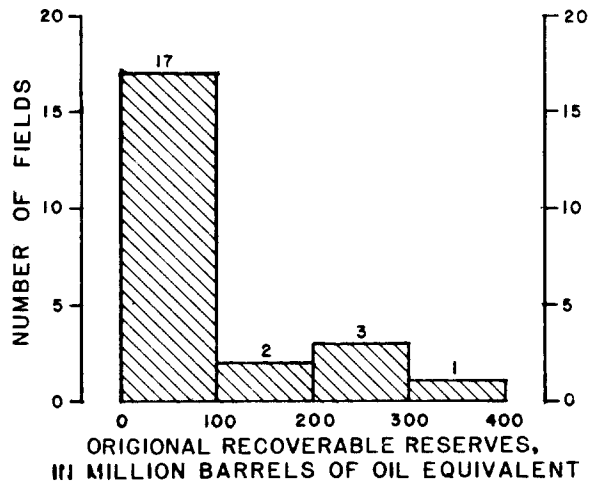


Figure 2. Histogram showing field-size distribution of oil and gas fields

CONCLUSIONS

As of December 31, 1984, the remaining recoverable reserves in 23 known oil and gas fields in the Southern California Outer Continental Shelf are estimated at 1,205 million barrels of oil and 2,198 billion cubic feet of gas. These figures represent increases of 52 million barrels of oil and 57 billion cubic feet of gas from the December 31, 1983, estimates. These increases primarily result from the inclusion of estimates for recently discovered fields and the modification of the estimates for several other fields.

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