# H-3070-2 - Economic Evaluation of Oil and Gas Properties Handbook

Table of Contents

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# CHAPTER I - INTRODUCTION

## A. PURPOSE

In order to assure receipt of fair market value (FMV) for oil and gas leases, rights or properties, the Department of the Interior (DOI) may conduct economic evaluations (appraisals). These valuations estimate the market value or equivalent of such properties for use in determining whether fair market value (FMV) is being received. The Department evaluates tracts subject to disposal, acquisition and exchange under the Federal Land Policy and Management Act of 1976 (P.L. 94-579). Also, the Bureau of Land Management (BLM) appraises the FMV of many Indian tracts offered for sale, lease or gifted and the FMV equivalent of Indian tracts negotiated agreements under the Indian Mineral Development Act of 1982 (P.L. 97-382) and related Acts. Since the passage of the Federal Onshore Oil and Gas Leasing Reform Act of 1987 (P.L. 100-203), the Department does not evaluate oil and gas leases at non-North Slope Federal sales and relies instead on competition to assure FMV.

The purpose of this Handbook is to provide guidance to economic evaluation personnel and managers in the evaluation of oil and gas properties. This Handbook provides guidance in the use of those evaluations in Indian oil and gas lease sales, and Indian and Federal disposal, acquisitions, and exchanges.

Economic evaluations consists of the assessment of the oil and gas resources, the valuation of the resource in the market and the use of the evaluation in considering the bid, exchange offer or other actions. Full development of all three components of the economic evaluation is essential if it is to be a successful evaluation.

## B. MARKET VALUE

The Appraisal of Real Estate The Appraisal of Real Estate. 10th ed., Appraisal Institute, Chicago. Illinois, 1992. provides an up-to-date definition of fair market value, as follows:

"[market value is] the most probable price, ..., in cash, or terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self interest, and assuming that neither is under undue duress."

The salient features of fair market value are as follows:

1. Fair market value is characterized as, representative of, an arms length transaction between a knowledgeable buyer and a knowledgeable seller.

2. Neither buyer nor seller is obligated or under duress to buy or sell.

3. Fair market value is determined by reference to a competitive market, rather than to the personal or inherent value of the property.

4. The property is exposed to a competitive market for a reasonable time.

5. Market value is only that value transferrable from one typical owner to another. In most cases, this means private market value.

6. Properties lacking potential buyer competition, which are likely to become part of a larger property with

potential buyer competition, can be given an estimated market value as part of the larger property.

7. If royalty streams are exchanged or included, they are part of market value.

8. In accordance with the market concept, the price paid for a similar property in an arm's-length transaction is accepted as the best evidence of fair market value. Lacking similar property transactions a capitalization of the property's likely net earning power may be used to estimate its market value.

## C. THE ECONOMIC EVALUATION PROCESS

The evaluation process embraces a range of procedures which, when applied to available data, leads to an estimation of the rights or property's value. In application, the data from which the evaluation is drawn are limited, leading to an estimate that inherently is uncertain.

An evaluation begins with the collection and review of data from which the estimate of FMV will be drawn. The evaluators are concerned with the type, quantity, and quality of data available because these characteristics determine the valuation approach employed and provide a basis for establishing confidence in the value obtained through the evaluation process. After the data has been collected and examined a method must be selected. These guidelines discuss two commonly accepted methods for value estimation: the comparable sales approach and the income approach.

The comparable sales approach is a valuation procedure in which the prices paid in prior transactions of similar oil and gas rights or properties are used to value the rights or property to be disposed of through leasing, exchange, or other means. This procedure generally is preferred to income procedures, if prior sales data is available, since it is thought that prices paid in prior transactions of similar oil and gas properties provide the best indication of value. However, in developed oil and gas areas, where tracts tend to be unique and information good, the income approach described below is often used instead. In comparable sales similar oil and gas rights or properties are those of similar geologic, engineering and oil or gas marketing prospects. These characteristics are usually heavily dependent on time and geographic proximity.

The income approach is the alternative approach to the comparable sales approach and it involves the estimation of annual net income from the expected annual costs and revenues associated with the development of the oil and gas rights or property under realistic conditions. Annual net cash income from the difference between expected annual revenues and costs are discounted to their present value. Thus, the rights or property's net income potential, discounted to the present, provides an estimate of current tract sale value if similar tract sales data is not available.

This Handbook explains how the evaluation process is usually documented in a written report or summary report. The report or summary report presents the data used in the evaluation, the rationale for selecting a specific evaluation approach, and the method used to obtain the estimate of FMV. The supporting information and the summary for each tract are placed in the tract case file. The Handbook also discusses the report review process.

The valuation procedures discussed in this Handbook apply also to mineral land exchanges. An oil and gas land exchange involves negotiation between the Government and the interested party to provide realistic information for BLM, applicant and/or contractor appraisal. After the exchange of information a BLM appraisal is developed and an applicant appraisal may be developed as well. Both appraisals are reviewed for conformance with BLM guidelines and good appraisal procedure and BLM evaluators recommend an appraised value to the State Director. The State Director then tries to arrange a mutually acceptable exchange. Legislation authorizing oil and gas leasing, sale or property land exchange usually mandates that the Federal Government receive at least equal value in exchange.

# CHAPTER II - DATA COLLECTION AND GEOLOGIC ASSESSMENT

The oil and gas property economic evaluation process begins with collection of data on the parcel and surrounding area. These data should be used in part to create a geologic and engineering assessment which should be summarized and plotted on a base map.

A. DATA COLLECTION

The data collected should generally include:

1. Parcel and surrounding area identification and location.

2. Parcel and surrounding area geologic maps and cross sections, field studies, maps, etc.

3. Surrounding area oil and gas tract engineering data including drill stem tests, well site geologic reports, well logs, and core analyses.

4. Geologic indications of the amounts and likelihood of oil and gas discovery in the parcel. Particular attention should be paid to times of change in the outlook for discovery.

5. Location, bonus bid or price per acre, and sale date for surrounding oil and gas parcels.

6. Area oil and gas marketing information should be researched. Particular attention should be paid to times of change in the area's oil and gas prices and markets.

7. Detailed product pricing and cost information for oil or gas exploration and development should be collected if the discounted cash flow method (DCF) is expected to be used.

Information relating to well and lease production can be secured from Dwights Energydata, Inc. (Dwights); Petroleum Information, Inc. (PI), individual well records (IWR); Monthly Reports of Operations, State Oil and Gas Commissions, and operators. Geologic information sources include reservoir geologic reports such as old KGS determinations, drainage or diligence reports, lease/unit files, American Association of Petroleum Geologists (AAPG) reports, universities and State agencies, professional society journals, and other published sources.

Product price and cost information and property sale price sources include: State agencies, lessees, other operating oil companies, professional and trade journals, the local press leads, technical society meetings, U.S. Lease Price Report, lease brokerage firms, mineral owners, energy industry forecasting services, MMS, PI and others.

Several sample data collection forms are shown: Illustration 1 is a summary geologic data form, Illustration 2 shows sample wells drilled form, and Illustration 3 is a list of neighboring lease sale prices. Illustration 4 shows a tract-specific lease sale data base form.

B. GEOLOGIC AND ENGINEERING ASSESSMENT

The geologic and engineering assessment process is the principal technical step in assessing characteristics for the area in which the tract is located. The geologic and engineering assessment process includes the following:

1. The lease parcel being offered is plotted.

2. All nearby lease parcel information including lease price data and dates are collected and plotted.

3. Existing wells data are collected and plotted.

a. Standard symbols for well status are used.

b. Productive horizon(s) are indicated.

4. Geologic and engineering data are gathered which may include:

a. Existing geologic maps and cross-sections.

b. Field studies and maps.

c. Drill stem tests.

d. Well site geologist reports.

e. Well logs.

f. Core analyses.

5. Likely productive horizons for parcels area are examined.

6. Subsurface geologic maps may be constructed.

a. Structure contour maps for each potentially productive horizon may be developed which indicate:

(1) Derived oil/water, gas/water, or gas/oil contacts.

(2) Faults, porosity or permeability, pinchouts, lithology changes, geologic trends, etc.

(3) Isopach maps may be inferred or prepared for each potential producing zone when net thickness is required.

7. The probability of oil and gas accumulations occurring within the parcel and the dry hole risk are estimated.

8. The amount of recoverable hydrocarbon resources on the tract is considered given likely production technologies and assuming that a reservoir extends into the tract.

## CHAPTER III - METHODS AND MODELS USED FOR ECONOMIC EVALUATION

### A. INTRODUCTION

An economic evaluation process is designed to produce an unbiased estimate of the value of property. The evaluation process is a systematic approach to property valuation. It consists of defining data requirements, assembling the best available data, and applying an appropriate evaluation method. The principles of real estate valuation are presented in the Uniform Appraisal Standards for Federal Land Acquisitions 1992 and in The Appraisal of Real Estate 1992. These principles provide very general guidance to formulating procedures for estimating the value of an oil and gas property. In addition, three useful books that specifically address how to conduct some types or portions of oil and gas evaluations are Paul Newendorp, Decision Analysis for Petroleum Exploration 1975, John M. Campbell, Analysis and Management of Petroleum Investments 1992, and I. J. Stermole, Economic Evaluation and Investment Decision Methods 1993.

Two evaluation methods are discussed: (1) the comparable sales approach and (2) the income approach. In the comparable sales approach, the value of a property is estimated from prior sales of comparable properties. The basis for estimation is that the market would impute the value to the subject property in the same manner that it determines the value of comparable competitive properties. In the income approach, the value assigned to the property derives from the present worth of expected future net cash income. When prior sales are available and determined to be comparable, the comparable sales approach is preferred to the income approach. Never-the-less in developed areas, tracts tend to be unique and the income approach is used more frequently.

### B. COMPARABLE SALES APPROACH

The comparable sales approach relates the value of the property being appraised to the value of similar properties previously leased or sold. However, variations in property attributes (such as reserves) between the property being evaluated and the comparable properties may exist. They may sometimes be accounted for through a monetary adjustment to each comparable property's value. Adjustments can be measured based on the impact of variation in development attributes on a representative discounted cash flow value. Adjustment may also be made by simply comparing the value of tracts which are similar except for a single characteristic difference. For example, comparable sale values per oil equivalent barrel can frequently be calculated or acquired and they can be used to value tracts with different amounts of reserves.

The general method for the comparable sales approach is as follows:

Data Collection. Research sources of comparable sales transactions to obtain information about transactions of similar properties.

Eligibility. Determine the accuracy and completeness of information and evidence of an arms length transaction between knowledgeable and prudent participants not obligated to buy or sell.

Selectability. Review the prior sale's property attributes for similarity to the property being appraised to determine if their sale prices data can be used without adjustment or with adjustment.

At the same time determine the geologic and engineering conditions in the offered and comparable tracts so that they can be used to compare tract conditions in detail. Make adjustments if necessary and possible.

Estimation of Value. Estimate value of offered property using the selected comparable sale transactions. Reconcile multiple comparable sales estimates of value into a single estimate of value by selecting the superior comparable or combine multiple values with a weighted averaging scheme.

1. Selection of Comparable Leases or Tracts

The parcel value is estimated by comparing its physical characteristics, income potential, and sale timing with those of the most comparable Federal, Indian, State, or private leases awarded in competitive sales. Computerized lease sale data bases and other sources may be utilized to provide the basic data required.

Special lease sale circumstances must be considered. These characteristics include: distinctive geologic features; proximity to transportation facilities; parcel size and depth; dry hole risk; recoverable resource potential; exploration, development, and operating costs; oil and gas prices; time of sale; changes in market conditions, lease terms and stipulation.

In the vicinity of the tract being valued, tracts previously leased and sold are examined using four tests to determine which, if any, are most representative of the subject tract. These tests are: (1) proximity in time; (2) proximity in location; (3) similarity in physical, geologic, geographic, and engineering characteristics; and (4) market conditions.

The important characteristics to be considered in selecting the comparable leases include:

a. Depths to, and names of, the objective formations.

b. Types and properties of hydrocarbons previously discovered in that formation.

c. Estimated recoverable reserves.

d. The likelihood that those quantities will be discovered.

e. Location of the subject parcel and the comparable leases, relative to the reservoir.

f. Distance to markets and availability of pipelines.

g. Terrain, geologic hazards, and other things that may affect drilling and/or development costs.

h. Past and present drilling activity.

i. General formation characteristics.

j. Geologic attributes of the tract and its possible comparables.

k. Inflation/deflation.

l. Price for and cost of production of oil and gas (now and then).

m. Remote location and transportation access.

n. Lease terms.

(1) Royalty rates.

(2) Rentals.

(3) Primary term.

(4) Bonus bid

o. Special lease stipulations.

p. Time of sale.

1. Sources that can be used to compile past sale transaction data include:

a. Previous Federal, State, and Indian sales

b. National and State oil and gas publications

c. State oil and gas commissions

d. U.S. Lease Price Report

e. Lease brokerage firms

f. Oil and gas companies

g. Courthouse records

h. Mineral owners

2. Evaluation of Comparable Leases or Tracts

The evaluation of comparable tracts to select a value estimate can most effectively be accomplished, by explicitly

listing the important tract characteristics for each possible comparable tract and for the subject parcel. This listing or matrix should be developed in order to be able to compare the important factors between the subject parcel and the potential comparables. The tract or tracts which seem most comparable in the major factors should be selected and their multiple estimates of value reconciled into a single estimate either by selecting the clearly superior value or by combining the values using a weighted averaging scheme. A comparable sales flow chart is shown in Illustration 5.

If the prior sales are not close comparables, the potential comparables selected should at least include tracts whose major factors are both better and worse than the offered tract. Often a recent sale of a single similar tract is the best indicator. Geologically informed judgment must be exercised in selecting the comparable sale value. Comparables which share the same target producing zone with the subject parcel, that are relatively nearby, and are geologically similar should be selected. The lists of sales, dates, legal descriptions, geologic data, prices, and the like should be supported by interpretive data in the narrative.

Monetary adjustments to comparable sales values can sometimes be made for factors which differ between the comparable tracts and the offered tract. Any adjustments should be based on quantifiable and measurable differences in the relevant factors. The size of the adjustment should be based on substantive information. The procedures used in making the adjustments are to be documented in the administrative record for the parcel.

Sometimes these adjustments can be calculated by merely comparing the tracts characteristics and isolating the effect of one characteristic, such as the amount of reserves. More usually, if a similar tract discounted cash flow (DCF) model is available, it can be run several times to measure the effect of the characteristic differences, such as production costs, on value .

It is also common when there are major charteristic differences and good information to switch entirely to the discounted cash flow approach explained below. In this case the potential comparable sales might just be used to bracket the discounted cash flow estimate. In fact, in some areas, where development is extensive and information plentiful, the DCF method is used most often.

3. Minimum Value Tracts

Based on the area geologic-engineering assessment, the comparable sales survey and general information from industry representatives and publications, parcels with little or no apparent hydrocarbon potential or value can now be identified as minimum valued tracts. Among the tracts likely to have low development potential are tracts with dry holes or depleted wells that tested the lowest known productive horizon in the field and whose tracts/spacing units are outside the interpreted reservoir

limits of all potential productive horizons. Similar tracts lacking valuable comparable tracts around them may be minimum valued. Parcels in the minimum value classification require little further evaluation. However, an effort should be made to see if it equals or exceeds the typical comparative sale value, if any, for similarly unpromising tracts.

C. INCOME APPROACH-DISCOUNTED CASH FLOW METHOD (DCF)

The DCF method (or equivalently the income approach) to tract evaluation calculates the present value of the projected annual cash incomes from the tract. These annual cash incomes are derived by subtracting each year's projected cash costs including taxes from that year's projected cash revenues assuming development. This present value is then reduced by the risk that development will never occur.

1. Use of the Income Approach

The DCF or income approach is used:

a. When appropriate comparable sales are not available.

b. When relevant well completions and/or dry holes have been completed subsequent to the available sales data, i.e., the use of the prior sales data is made inappropriate by changing geologic interpretations.

c. When an abundance of well and production data are available so that reserves and their expected costs and revenues can be estimated with reasonable confidence.

d. When the parcel is included or will be included in an existing communitization or unit agreement whose expected production and revenues may reasonably be estimated.

e. In areas where each tract is so unique and valuable that precise engineering cost as well as production estimates are necessary.

f. When oil and gas marketing conditions have changed to a degree that the prior sales available are inappropriate.

g. When large prospects with multiple unique tracts exist as in outer continental shelf and other frontier areas. An example of the flow charts for this type evaluation are provided in Illustration 6.

2. Income Approach Steps

The key steps in discounted cash flow analyses are shown below and in the flow chart in Illustration 7.

a. All data gathered as part of the geologic-engineering assessment, as explained in II-B, are reviewed. The plat and a well summary table identifying the parcel and the surrounding area with all oil and gas completions, well locations, and dry holes, are reviewed.

b. Drilling depth is estimated.

c. Production data from nearby wells are gathered.

d. Representative wells should be selected and the primary producing horizon(s), depth(s), and cumulative production recorded. Oil and gas reserves for a producing well or spacing unit should be estimated. Recoverable reserves and annual oil and gas production rates for the parcel or spacing unit are estimated. The estimated production, decline rate, and reserves should reflect any model well(s) being utilized.

The reserve estimates must be based on, and must reconcile, the most reasonable data available and include the following steps:

(1) Sources include:

(a) Dwights Energydata, Inc.

(b) State Oil and Gas Commissions.

(c) Monthly Report of Operations (Federal and Indian wells).

(d) Petroleum Information, Inc. (PI) Production Data.

(e) Operator.

(2) Production information can be allocated or actual.

(3) Model well selected based on geologic and -engineering assessment.

(4) Decline rate method:

(a) Decline rates are estimated for the well(s) modeled.

(b) Reserves can be estimated based on decline curve analysis. The oil reserves can be estimated from the production data of the reference well by plotting a production decline curve (production versus time), determining the decline rate, and extrapolating the curve to an estimated abandonment value. Recoverable reserves are the sum of production to date plus the estimated remaining recoverable reserves. Recoverable gas reserves can be estimated by plotting production versus time and extrapolating to an abandonment rate or, if pressure data are available, by plotting BHP/Z (bottom-hole pressure over the gas compressibility factor) versus cumulative gas production and extrapolating the curve to abandonment pressure. The Garrett ARIES model will carry out this calculation.

(c) Reserve figures are adjusted to consider the geologic relationship of the wells modeled to the subject parcel.

(d) If the tract is smaller than one spacing unit, the tracts share of the estimated sum of recoverable reserves is estimated. Alternatively, the tracts share of the resource may be estimated based on its proportion of the spacing unit acreage.

(5) Volumetric method:

(a) Information on reservoir parameters gathered includes:

(i) Net thickness (from isopach maps).

(ii) Porosity.

(iii) Water saturation.

(iv) Oil and/or gas saturation.

(v) Reservoir area.

(vi) Formation volume factor.

(vii) Gas compressibility factor, Z.

(b) Gross in-place hydrocarbon resources are estimated.

(c) Net recoverable reserves are estimated based on an estimated recovery factor.

(d) Based on the estimated recoverable reserves, the years of constant production (if any), the decline rate, and the economic limit, the DCF model predicts annual production.

e. Costs for exploratory and development drilling are estimated, as are costs for completion and surface facilities. Assume well(s) drilled in first year of lease. Unsuccessful exploratory wells and reclamation costs should also be estimated, if possible.

(1) Sources include:

(a) Drilling contractors.

(b) Oil and gas companies.

(c) Oil and Gas Journal.

(d) API Joint Associated Survey on Drilling Costs

(e) PI

(f) State oil and gas agencies

f. Annual operating costs are estimated.

(1) Sources include:

(a) Operators.

(b) Oil and gas companies.

(c) Locality specific (appropriate) operating cost formulas.

(d) Evaluator information such as taxes. Most States have severance taxes, ad valorem taxes, State income taxes, and Federal income taxes which must be accounted for in the DCF. Income taxes are merely a negative cash flow but their calculation, through a non-cash flow accounting system, appears to take up much of the DCF program. The various tax inputs and calculations in the DCF are explained in John M. Campbell, Analysis and Management of Petroleum Investments, 1992, and F. J. Stermole, Economic Evaluation and Investment Decision Methods 1993. Tax laws may change from year to year so up-to-date information must be continuously acquired.

g. The economic limit is computed where operating costs exceed revenues.

h. Expected crude oil and natural gas prices are estimated for the producing life of the well(s). Prices are usually held constant at the current local level if a real discount rate is used or increased at the projected inflation rate if a nominal discount rate (which includes inflation) is used. If prices are increased at the projected inflation rate and the nominal discount rate are used all costs must also be increased at the projected inflation rate. Price and cost escalation over and above the inflation rate have proved unreliable and are not recommended.

i. Once the costs and prices of exploration, development and production are estimated, as explained above, they are entered into a discounted cash flow model (DCF) on an annual basis. The model subtracts each year's costs from its revenues (price x production) and discounts the annual differences (net incomes) back to their net present value.

3. Income Approach-DCF Models

Several computer DCF models are currently available for use by the Bureau of Land Management, the ARIES model from the Munro Garrett International is the primary one. This model provides assistance in estimating production, as well as in calculating the DCF value, by accessing neighboring tract production data and standard decline formulas.

4. Geologic and Economic Risk

The net present value of the tract calculated from the DCF above must be adjusted for the risk that it will not occur. The DCF net present value encompasses a range of costs, prices and production represented by the point estimates that were included in the model run. Its net present value must be adjusted for the possibility that the tract may be dry, that the tract may have too little resource to be developed and transported or that development may be unexpectedly difficult and uneconomic. For our purposes it is probably best to estimate a combined risk from these factors and use it to estimate a probability of success and a probability of failure. This is done by multiplying the probability of success times the DCF net present value assuming commercial oil or gas is found and subtracting the probability of failure times the exploration costs.

Estimation of geologic risk is a difficult research problem requiring examinations of all the areas below with particular attention to site-specific conditions. Regional average risks should not be used without full adjustment to site-specific information, if available. Bracketing risked income approach values with comparable sales can sometimes avoid errors in risk estimates.

The following factors are analyzed in estimating combined risk:

a. Past History of Basin

(1) Drilling statistics from AAPG

(2) Federal and State Reports

(3) Specific studies by geologic societies

b. Past History of Lease and Area of Consideration

(1) Sources of Data:

(a) Dwights Energydata, Inc.

(b) Petroleum Information.

(c) State Oil and Gas Commissions

(d) Individual Well Records (IWR's)

(e) Operators

(2) Formation Tests

(3) Number of Completions and Dry Holes

c. Selection of Risk Factor

(1) Geologic:

(a) Log data

(b) Core data

(c) Drillstem tests

(d) Specific reservoir reports

(e) Depositional environment

(f) Type of trap

(2) Reservoir:

(a) Porosity, distribution, and uniformity

(b) Permeability, horizontal, and vertical uniformity

(c) Oil and water saturations

(d) Thickness, uniformity, etc.

(e) Fractures and cementation

(f) Type of driving mechanism

(g) Depletion status of reservoir

(3) Engineering:

(a) Cement bond problems

(b) Casing failures

(c) Water encroachment

(d) H2S or acid waters problems

(e) Decline

(f) Fracturing success

(g) Unusual costs

(h) Oil, gas and water separation problems

(i) Re-entry success

(4) Other Zones:

(a) Tested but not producing

(b) Log calculations

(c) Drillstem tests

(d) Old KGS Studies

(5) Economic:

(a) Resource is too small or poor to develop profitably

(b) Resource is too small or poor to market or build transport

(6) Total Adjusted Risk

When the tract's producibility and minimum profitability are both at risk, an appropriate combined dry and non commercial risk factor must be estimated. They must be consistently measured on a combined basis to avoid double counting.

5. DCF Discount Rate

DCF analyses can be run correctly with or without general price inflation. For BLM analyses without price inflation a 10 percent real discount rate should be used. In this case no general inflation should be added to oil or gas prices and costs. For BLM analyses with an expected general inflation rate, the rate in percent per year is applied annually to oil or gas prices and to production costs. It is also added to the real discount rate. For example one might add the real discount rate of 10 percent to the current expected inflation rate of 4 percent to obtain a 14 percent rate.

The 10 percent real rate is based on an estimate of the cost of the capital invested and the 4 percent inflation is based on typical forecasts. Moreover, the 10 percent real rate is the rate required by the Financial Accounting Standards Board for valuing oil and gas reserves (F.A.S.B. #69 Nov. 82 P. 10) and is widely used. Escalation of prices and or costs over and above the general inflation can also be input. However, such escalation can severely and arbitrarily distort the analyses and it is usually unjustified without a substantial rationale.

Examples of consistent inputs for 1992 are shown below for both types of analyses, i.e., real, nominal:

Real Analysis with no General Inflation

a. Oil price: $20/barrel in 1992

b. Oil real price escalation over and above general inflation: 0 percent

c. Oil development and production real cost escalation over and above general inflation: 0 percent

d. General inflation: 0 percent

e. Real Discount rate: 10 percent

Nominal Analysis with General Inflation

a. Oil price: $20 bbl in 1992

b. No price or cost escalation

c. Oil price general inflation: (4 percent)

d. Oil cost general inflation: (4 percent)

e. Expected long term general inflation: 4 percent

f. Nominal discount rate including inflation:

(10+4 percent=14 percent)

6. Minimum Value Tracts

Based on the area geologic and engineering information, the DCF analysis and other information, parcels with little or no apparent hydrocarbon potential can be identified as minimum valued tracts. Minimum value tracts require little further evaluation and, in general, the highest bid submitted is recommended for acceptance if it equals or exceeds any specified administrative minimum bid per acre. However, for exchanges, conveyances and some Indian sales, the minimum value is not specified and the minimum can often be set on the basis of rough comparable sales information for similar low value tracts. If there is no indication the tract has value it should be

valued at zero.

D. Examples of the Comparable Sales and Income Approaches

Illustration 8 provides an example of a comparable sales appraisal and Illustration 9 provides an example of an income or DCF appraisal.

## CHAPTER IV - SCENARIO METHODS FOR INCORPORATING UNCERTAINTY IN THE OIL AND GAS TRACT ECONOMIC EVALUATION PROCESS

Estimates of fair market value are inherently uncertain. The valuation of a property using DCF techniques or comparable sales depends on estimates for past and future events. These events cannot be known with certainty. For example, in the DCF technique, uncertainty exists about the production and market potential for oil and gas under lease. This uncertainty affects estimates of future oil and gas prices and the timing and amount of production. There is uncertainty in costs that affect the income stream from which DCF value is estimated.

Uncertainty may be incorporated in the valuation process through a number of scenario based analytical techniques. These techniques are often used in combination with the basic risk adjustment described in the prior chapter. These techniques include a sensitivity analysis that evaluates the effect on value of input parameter variation. Three scenario techniques that can be used to incorporate scenario uncertainty in the analysis (assuming the information in question has first been diligently researched) are as follows:

Probability Weighted Comparable or DCF Scenarios. A procedure by which the likelihoods of expected outcomes (comparable sales or DCF scenarios) are combined by multiplying by their probabilities to yield an expected value. This is a general version of the risk adjustment method used in the last chapter.

Monte Carlo DCF Analysis. A probabilistic form of sensitivity analysis in which the probabilistic variation into input parameters is systematically incorporated in the DCF analysis to yield a weighted average expected value.

Timing of Development. A procedure that incorporates development timing variation in the analysis to adjust for market uncertainties.

An additional technique is to incorporate a risk premium in the discount rate to account for riskier ventures. Increases in the rate serve as a proxy for the potential buyer's uncertainty of future events. The use of a higher discount rate adjustment to account for risk is not recommended for BLM evaluations because of the overwhelming subjectivity involved in selecting the risk premium and because of the danger of risk double counting. Risk in BLM evaluations should be accounted for in the dry hole risk factor and other elements of the DCF.

## CHAPTER V - PREPARATION AND REVIEW OF ECONOMIC EVALUATION REPORT

A. FORMAT

The appraisal report should contain clear concise language describing the high points of the evaluation. The report must show that the evaluation is based on accurate data, logical reasoning and full documentation. Short summary reports usually suffice for competitive lease sale parcels while standard reports may be required for land exchanges, IBLA or IBIA appeals, and other situations. Estimates of value cannot be based on unsupported opinions, personal beliefs, or nonreplicable calculations. Also, the report files must contain sufficient data and supporting analysis to completely justify the estimate of fair market value as well as the date to which it applies.

B. ECONOMIC EVALUATION SUMMARY REPORT

An evaluation summary report summarizes the information, analyses and conclusions in the evaluation. The information included in the summary report is as follows:

1. Tract name and location. Identify the tract and list the county and State in which it is located, including township, range, meridian, section, subdivision and acreage.

2. Purpose of evaluation and the effective date of the estimate.

3. Evaluation Method and the rationale for selecting that method.

4. Summarize the evaluation analysis and provide the presale estimate of value for the tract(s). The estimated value (s) should be presented in dollars/acre and as total parcel values.

C. SUMMARY ECONOMIC EVALUATION FILES

Information fully supporting the Summary Economic Report must be contained in the tract economic evaluation file.

1. File Tract Data

All pertinent information about the tract(s) to be valued and its valuation should be provided and explained. At a minimum, include the items listed below. Document all sources of data.

a. Tract Plat

b. Previous lease sales data

c. Geologic and engineering data (Dwights, PI data, etc.)

d. Geologic and engineering assessment and narrative

e. Comparable sales selection, if any

f. DCF input data (if applicable)

g. DCF outputs,if any

h. Evaluation summary report

D. SIGNATURE

The qualified mineral appraiser will indicate their approval, by signature, of the appraisal summary report, documentation and value estimate.

E. STANDARD APPRAISAL REPORTS

Standard evaluation reports may be required for oil and gas property exchanges, Indian lease, sale or gift valuations, IBLA appeals, and other actions. Detailed guidance for standard valuation reports can be found in the BLM Economic Evaluation of Coal Properties Handbook. In general they involve a much more detailed written report on the evaluation than the summary report above. In general they require the following:

1. Summary page

2. Table of contents

3. Introduction

4. Legal description

5. Tract geologic, engineering and economic data and assessment

6. Evaluation method selection

7. Comparable sales data and analysis or

8. Income approach data and analysis

9. Exhibits

10. Signature and date

F. CONFIDENTIALITY OF DATA

The presale estimate of value and related information is sensitive and confidential and any proprietary data used in the estimation of FMV is also confidential. Both must be properly safeguarded. Only those persons with a "need to know" shall have access to the sensitive or proprietary data. The presale appraisal and estimate of value may be released after the sale of a tract is completed, but excluding any proprietary data. Nonproprietary information on exchange appraisals may be released to the applicant in negotiations prior to exchange and shall be released after exchange in a nonproprietary form. Indian tract appraisals and estimates of value remain confidential after the sale and shall not be released. The following guidelines should be observed:

1. The estimated value shall not be discussed outside of the official BLM meetings.

2. Conversations in which confidential evaluation data are discussed shall be held in a secure office (phone) and in such a manner that non-BLM personnel and BLM personnel without a "need to know" are prohibited from attending the meetings (phone) and from having access to such data.

3. All sensitive and proprietary data shall be locked in a secure Government-approved filing cabinet or vault when the data are not actually required for analysis and discussion purposes.

4. All draft and final reports relating to FMV presale estimates shall be treated as confidential information prior to the sale. After the sale, evaluation of tracts that are leased are no longer confidential. All Indian appraisals and proprietary data are confidential at all times.

G. REVIEW OF EVALUATION REPORT

A qualified review mineral appraiser shall review appraisal reports for conformance to evaluation guidelines. The purpose of the review is to ensure that the evaluation is consistent with the BLM and national guidelines and that the estimation of value is sound, technically based, and fully supported and documented in the files. The review shall be based on the principles explained in the Mineral Economic Evaluation Manual Section 3070. A written review determination is signed by the qualified review mineral appraiser after completion of the review and after incorporation of any agreed on changes.

H. OPTIONAL POSTSALE PROCEDURES FOR INDIAN LEASE SALES

It is suggested that for Indian lease sales, the evaluators follow the following postsale procedures. Within 10 days of receiving the lease sale results, the BLM reviews the bids received. As a first step in that review process, verify that no consequential data existed prior to the sale that was not available to the BLM at the time the appraisals were completed. If this data does become available, a new presale estimate of value should be calculated and then compared to the high bid received. Recommendations are made to the Superintendent and to the Tribal Chair to accept those high bids that are equal or greater than the appraisal value for the respective tracts. High bids that

are less than the appraisal value are recommended for rejection and the corresponding tracts are offered at the next sale.

I. ADMINISTRATIVE RECORD OF THE TRACT EVALUATION PROCESS

All data relating to each parcel in a sale, disposal or exchange should be retained in files and include the evaluations, the supporting data and any related material. Filing the evaluation data in this manner keeps all information relating to the appraisal together and makes it easy to reference for subsequent actions or for possible IBLA or IBIA hearings.

## CHAPTER VI - OIL AND GAS PROPERTY LAND EXCHANGE PROCESS

A Federal oil and gas property may be exchanged through the authority of the Secretary of the Interior under authorizing legislation contained in Section 206 of the Federal Land Policy and Management Act of 1976 (FLPMA) and properties may also be exchanged under special legislation. Exchanges are conducted under the Code of Federal Regulations (CFR) 43 2200 and 3100.

In exercising the exchange, the FLPMA requires that the exchange must be in the public interest and the value of the property accepted by the Government must be of equal value to those given in exchange. In other Federal oil and gas exchanges, conducted under legislation specific to each exchange, the legislation generally also requires that the lands be of equal market value, and that the exchange be in the public interest. The (at least equal) value determination required for BLM exchanges is measured in market values. If the properties themselves are not directly of equal value, financial compensation may be provided to offset the differences in value as long as payment does not exceed 25 percent of the value of the lands transferred out of Federal ownership.

The exchange of Federal oil and gas property is accomplished through negotiations between the affected parties to achieve a realistic appraisal of market values. The negotiation process is directed toward achieving realistic estimates of property value through information exchange between the Government and the applicant.

An appraisal is usually made by the BLM evaluators or its contractor so that the Government has an independent estimate of value. The BLM evaluators should prepare an appraisal using its own information and any additional information provided by the other party. An appraisal may also be made by the applicant or its contractor and the BLM evaluators should review such an appraisal. Any applicant appraisal or information should be independently verified in detail as to its accuracy and appropriateness, and this should be documented. The procedure for estimating the market value used by the appraisers should follow the economic evaluation procedures discussed above in this Handbook.

After completing and reviewing its appraisal and any applicant appraisal the BLM evaluators should recommend an appraised value of the property(s) to the State Director through the State Director for Minerals.

The evaluation and exchange process should be as follows:

A. An oil and gas right or property exchange proposal is provided to the District or State BLM office.

B. The proposed exchange is examined by the State Office to determine if it is in the public's interest to proceed with the exchange. The evaluation team is consulted to see if it might be in the neighborhood of an equal value exchange.

C. If it appears that the selected property exchange for the non-Federal right or property could be in the public interest, the exchange process can proceed to the next step or BLM can make a counter proposal (for example, offer a different property in exchange).

D. If BLM and the applicant agree on rights or properties that might be exchanged, BLM must perform the following activities before it can proceed with the evaluation process:

1. Examine alternatives to the proposed exchange.

2. Develop an environmental assessment (EA) and, if necessary, an environmental impact statement (EIS) for the proposed exchange.

3. Through the EA/EIS, land report, and public meetings, determine if the exchange is in the public interest.

4. Informally consult with the State Government and other interests for their views concerning the proposed exchange.

E. If BLM decides to proceed with the exchange process, the BLM evaluation team and the applicant (optional) shall independently collect the information required to evaluate the exchange rights or properties and to prepare preliminary evaluations. For exchanges, the applicant normally is responsible for providing geologic information.

F. The Deputy State Director, Minerals, the evaluation team, and a State BLM Office management representative should meet with the applicant's technical staff or contractor and its management representative to review the available data and to discuss appropriate methods.

Usually, the BLM evaluation team will next prepare a draft appraisal using the best and most realistic data available. The draft appraisal should conform to the guidelines set forth in this Handbook. An applicant may also wish to develop a preliminary appraisal and this may form the basis for a BLM draft appraisal, provided it is checked for accuracy, lack of bias, completeness, and conformance to the appraisal guidelines.

Alternatively the applicant or a contractor may wish to independently prepare a separate appraisal. Usually, this appraisal will be in addition to the BLM appraisal because BLM will want its own estimate in order to know what is going on.

G. The evaluation team and State BLM Office representative shall discuss with the applicant the results of the BLM draft appraisal. The applicant may provide comments and information on the draft appraisal methods and data.

H. The BLM evaluation team performs a final appraisal on the exchange tracts as now delineated if directed by the State Director. The final appraisal can include improvements to the data or methods that are developed by the evaluation team or that result from the discussion of preliminary results with the applicant. Tracts that may be added or deleted from the exchange properties achieve equal value. The applicant's final appraisal may also be prepared and it also needs be reviewed in writing by the BLM evaluations staff. The evaluations staff recommends a single appraised value for each property.

I. The State Director and their staff examine the final BLM appraisal, any appraisal submitted by the applicant and the evaluator recommendation in order to determine what would be an appraised equal value in exchange. They also examine the proposed exchange to ensure that the exchange is in the public's interest.

J. The State Director and the applicant discuss the exchange to determine whether the proposed exchange and a set of exchange appraised values will be satisfactory to both parties. If agreement cannot be reached, the specific exchange appraisals may be, as explained in the BLM regulation CFR Part 2200, abandoned, negotiated or sent to voluntary arbitration within 180 days of the final estimates.

Note however, that there is no requirement that BLM agree to any appraised value that it does not believe is a realistic and accurate fair market value estimate.

K. The final decision concerning the exchange is made by the State Director after public hearings and comment.

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# Oil and Gas Evaluation References

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10. F. J. Stermole, and J. M. Stermole, Economic Evaluation and Investment Decision Methods, Golden, Colorado 1993


## MODELS

Advanced Reserves Information and Evaluation System (ARIES), Munro Garrett Int'l, 2828 Routh St, Suite 500, Dallas, Tx, 75201, 214-871-7117

## Acronyms

AAPG..... American Association of Petroleum Geologists

AEOT..... Average Evaluation of Tract

API..... American Petroleum Institute

BHP/Z..... Bottom Hole Pressure over the Gas Compressibility Factor

BLM. ..... Bureau of Land Management

CFR.....Code of Federal Regulations

DCF.....Discounted Cash Flow

EA .....Environmental Assessment

EIS. .....Environmental Impact Statement

FLPMA.....Federal Land Policy and Management Act of 1976

FMV. .....Fair Market Value

IBLA ..... Interior Board of Land Appeals

IBIA..... Interior Board of Indian Appeals

IWR. ..... Individual Well Records

KGS. ..... Known Geologic Structures

NOPR.....Notice of Probable Rejection

OC .....Operating Cost

PEV.....Presale Estimate of Value

PI ..... ..Petroleum Information Inc.

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F. Departmental Manual, 235-DM 1.IL.

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H. A-24514 of the Department of the Interior, Volume 60,p,62.

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N. BLM Manual Section 3070 Mineral Economic Evaluation.

## LARGE PROSPECT / TRACT VALUE ESTIMATE METHODS

Contents



## Chart I

GEOLOGIC PREPARATION

1. Data Acquisition

2. Regional Geologic Studies

Geologic and Geophysical Analysis Engineering and Economic Analysis

3. Automated Mapping

4. Basin Analogs

Prospect Identification and Evaluation

Development and Production Models

5. Area Attributes

Hydrocarbon Source

Hydrocarbon Timing

Hydrocarbon Migration

Reservoir Lithology

Reservoir Facies

6. Sub Areas Attributes

Hydrocarbon Source

Hydrocarbon Timing

Hydrocarbon Migration

Reservoir Lithology

Reservoir Facies

Subareas Interdependence

7. Prospect Attributes

Trap Occurrence

Effective Porosity

Hydrocarbon Accumulation

Prospect Interdependence

8. Prospect Zone Attributes

Trap Occurrence

Effective Porosity

Hydrocarbon Accumulation

Zone Interdependence

Chart II

RESOURCE ESTIMATE INPUTS

1. Unconditional area or subarea hydrocarbon probability

2. Unconditional prospect hydrocarbon probability

3. Unconditional zone existence and/or hydrocarbon probability by prospect

4. Reconciliation of #1, #2, and #3 with each other and to

consistency with all available geologic information including

expected conditional probabilities. This would Include determination of the likely interdependence of subareas, prospects within area and determination of Interdependence zones within a prospect.

5. Prospect resource volume estimates by zone

Each zone area extent range (acres)

Each zone pay thickness range (feet)

Each zone oil recovery factor (bbl/acre foot)

Each zone non associated gas recovery factor (ft3/acre foot)

Each zone oil share (%)

Each zone gas to oil ratio ft3/bbl

Each zone condensate yield bbl/ft3

6. Minimum Economic Oil and Gas Field Size

Discounted cash flow oil and gas inputs

Run Discounted cash flow model

Estimate minimum stand alone oil and gas prospect size

Estimate minimum combined field oil and gas prospect size

Estimate minimum prospect size gas - if any

Chart III

MODEL ESTIMATED RANGE RECOVERABLE ECONOMIC RESERVE

1. Sampling Prospect Resources Inputs

Sample: Unconditional Area, (or Subarea) Risk for:

Dry-(Stop, Record, Start New Run)

Wet-(Proceed)

Sample: Conditional Prospect Risk for:

Dry-(Stop Record, Start New Run) Wet-(Proceed)

Sample Conditional Zone 1 Risk

Dry-(Stop Sample Next Zone)

Wet-(Proceed)

Sample Zone 1 Recoverable Resource Volume Input Ranges for: Volume oil (bbls)

Volume non-associated gas (ft3)

Volume condensate (bbls

Volume solution gas (ft3 )

Sample Conditional Zone II Risk

Dry-(Stop sample next zone)

Wet-(Proceed)

Sample Zone II Resource Volume Input Ranges for:

Volume Oil

Volume Associated Non-Associated Gas

Volume Condensate

Volume Solution Gas

2. Add Zone Recoverable Resources for: Prospect Recoverable Oil

Prospect Recoverable Gas

Prospect Recoverable Condensate

Prospect Recoverable Solution Gas

Chart III

MODEL ESTIMATED RANGE RECOVERABLE ECONOMIC RESERVES (CONTINUED)

3. Compare Prospect Recoverable Oil To Minimum Economic Prospect Size

Not Economic (Stop, Record, Start New Run)

Economic (Record Amount, Start New Run)

4. Many Run Prospect Oil, (Gas), and Condensate Reserve Distribution

Number Dry, (Gas) and Non-economic Runs

Number Prospect Economic Runs

Recoverable Prospect Economic Oil Reserve Distribution Mean Conditional Recoverable Economic Prospect Reserves

5. Many Run Tract Reserve Share Distribution

Each Runs Tract Reserves for Each Zone

Each Runs Tract Sum Zones Reserves

Sum Tract Zones Reserves All Runs

Tract Share of Prospect Reserves (AII Runs)

Chart IV

INPUTS TO PROSPECT NET CASH FLOW

1. Unconditional Prospect Dry, (Gas) or Uneconomic Risk

2. Mean Prospect Economic Oil, (Gas) and Condensate Reserves

3. Exploration and Development Schedule

First Year: Lease Sale , Okayed

Fifth Year: Complete Exploration, Delineation, Development

Plan

Ninth Year: Complete facilities Construction, Development

Drilling and Pipeline Design and Development (nearly)

Tenth Year: Start Production

4. Expected Production Characteristics

Recoverable bbls per Acre

Per Well Production

Peak Production

Production Decline

Production Shut Down

Number Production Wells and Spacing

5. Expected Yearly Project Costs

Exploration Well Cost

Development Well Cost

Facilities Costs

Production Costs (Inc. gas)

Pipeline Cost to TAPS (East 150m vrs. West 85m)

TAPS Cost

Tanker to Market Costs (West, Gulf)

Costs Escalation

6. Expected Tax and Royalty Cost

Royalty

Federal Tax

State Income Tax

State Severance Tax

State Property Tax

7. Expected Project Revenues (if Oil)

World Crude Oil Price 2000

West Coast Crude Price 2000

Gulf Coast Crude Price 2000

ANWR Crude Types Price/Quality Differential

Annual Crude Price Escalation Rate

8. General Input

Discount Rate or Cost of Capital (Annual)

General Inflation Rate (Annual)

Base Year Price Index

Year of Lease

Chart V

CALCULATION OF PROSPECT'S PROJECTED DISCOUNTED NET CASH FLOW

1. Yearly Prospect Oil Netback per bbl as:

Lower 48 Oil Price/bbl

Minus, Transport costs/bbl to Lower 48

2. Yearly Prospect Gross Revenue

Yearly Production

Times, prospect Netback/bbl North Slope

3. Yearly Prospect Net Revenue

Yearly Gross Revenue

Minus, Severance Taxes and Royalty

4. Yearly Prospect Cash Costs

Exploration

Development

Operations

Shutdown

5. Yearly prospect cash income tax cost

Net Revenues

Minus Tax Accounting Costs

Times, Federal and State Income Tax Rate

6. Yearly Prospect Net Cash Income Flow Yearly

Prospect Net Revenue

Minus Yearly Cash Costs

7. Yearly Discounted Prospect Net Cash Flow

Yearly Net Cash Flow

Times Yearly Compound Discount Factors

8. Prospect Base Year Discounted Net Cash Flow

Discounted Yearly Net Cash Flows

Sum of Above

9. Prospect Sale Year Net Cash Flow

Base Year Net Cash Flow

Adjust to Sale Year Transaction Basis

Adjust to Sale Year Price Basis

10. Prospect Value Estimate

Prospect Discounted Net Cash flow

Times Probability Economic Reserve Found

Minus Probability Non-economic Resource

Times Exploration Costs.

CALCULATION OF NET CASH FLOW - CONTINUED

11. Prospect Value Estimate Adjusted For Bonus Tax Impact

Prospect Value

Plus Tax Saving From Bonus Right Off on Tax Accounts

12. Tract Value Estimate

Tract Economic Reserves Range Share

Times Prospect Value Estimate Adjusted for Bonus