APPRAISING OIL & GAS PROPERTIES

A Newsletter for Appraisal Professionals

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The Income Approach to Value in Oil Property Appraisal

Primary Method

"The Appraisal of Real Estate;" a major text[1] on appraisal methods, describes several approaches to determination of the value of real estate including the Cost Approach and the Comparative Sales Approach. A brief reading of the sections on these two methods clearly indicates that they are most useful for the appraisal of commercial and residential properties where costs of replacement and/or duplication can be readily determined or where there are a sufficient number of timely sales of similar properties that comparative analysis can be done successfully. Where the primary objective is the income that can be derived from the property, "The Appraisal of Real Estate" recommends the use of the Income Approach to value. This method can be used for commercial or residential buildings such as office buildings, storage facilities, or apartment buildings where the primary value is derived from the rental income. While other methods might be used and, in good practice, should be used to supplement the income approach, there is no question that the primary valuation is based on income analysis.

The purpose of owning a mineral interest whether it be a copper mine, gravel pit, or oil- and gas-producing lease is to remove and sell a commodity for the purpose of deriving income. Copper, gravel, oil, or gas have no intrinsic value in the ground. The ore and/or reservoir fluids must be withdrawn by some method and sold before value can be established. This dependence on an income stream for value, combined with the non-reproducibility of mineral properties and the lack of significant numbers of timely sales of copper mines and/or oil and gas properties, makes the income approach virtually the only method that is used to appraise and value mineral interests.

This discussion will be limited to oil properties where "oil" includes both oil and gas. The income approach has historically been the primary approach to valuing oil properties both within the industry and in the financial markets that deal with the oil industry. A review of the published literature of the oil industry indicates significant use of the income approach for valuing mineral properties going back to the late 1800's and increasing - particularly in the 1920's and 30's. The use of the income approach has taken many forms. The most common early approach is the un-discounted estimate of future income known as the Payback or Payout method. In this approach, the value of a property is determined by the income to be received from the property within an appropriate time period. This method can accommodate declining production and expected changes in prices and costs. While often used in an abbreviated format, it is an income approach and remains the most commonly used non-discounted cash flow valuation approach, particularly among smaller companies. When used with escalated prices and costs and/or carried out over longer periods, say

to the economic limit of the property, the approach becomes more of an un-discounted cash flow method and may embrace more intricate production projections and future investment planning.

The addition of the present value concept results in a discounted cash flow (DCF). The DCF approach has been the primary method in the oil industry since the 1940's, particularly among larger companies and, today, with the spread of personal computers and software, is rapidly supplanting all other methods of valuation. This is not to suggest that the discounted cash flow approach is used to the exclusion of other forms of the income approach. The Payout method and other methods based on the income stream are quite often used to complement the DC approach by providing a "check" on the DC results by comparing these results in a more familiar framework. The same can be said of certain widely recognized rules-of-thumb. Indeed, Payout and rule-of-thumb values such as $/Bbl are often included in computer software to allow checks and comparisons of more abstract DCF results. Whether a simple Payout or sophisticated DCF calculation is done, it is the Income Approach that is used virtually to the exclusion of any other approach for oil property appraisal.

Major Components

The Income Approach to value consists of two main components; an Income Stream and a Discount Rate. The income stream is the income that is anticipated to be derived from a property under a set of expected economic and other conditions over a period of time. The size, shape and duration of this income stream is very much dependent on (1) the characteristics of the property and (2) the economic conditions which are expected to apply to the property. In the appraisal of an office complex, a relatively simple income stream might assume a fixed rental per sq.ft. over 10 years with a vacancy rate of 15%. The appraisal can be made more complex by introducing inflation, rent increases, future investment, neighborhood deterioration, increased government regulation, and taxes as deemed necessary to achieve an accurate appraisal. In this form the income stream can be used in a Payout approach to value by determining that the value of the property is equivalent to the income that would be received in say, three years.

Oil properties (and other extractive properties for that matter) tend to be more complex than office and apartment buildings and may require more sophisticated analysis.

The addition of a discount rate would change this form of appraisal to a discounted cash flow approach. The purpose of the discount rate is to convert the income stream (cash flow) to a present value. In real estate appraisal, the term that is used is capitalization rate or "cap" rate which is not a present value factor and does not reduce the cash flow to present value. It is, rather, a percentage reduction in the total income stream to achieve an equivalent of the property value.

The Income Stream

The purpose of the income stream is an attempt to model the flow of income that may be anticipated from a given oil property with certain geologic, reservoir, and production characteristics under specific operating and economic conditions. In attempting to place a value on a property, the appraiser must try to determine how the geologic characteristics of the property may effect the volume of oil in the reservoir, and how the characteristics of the reservoir may effect the ability of

the property to produce oil and/or gas, and at what rate. The appraiser must also determine how the rates of production can be achieved and the costs of producing, gathering, and processing produced fluids. Such costs may include future investments and extraordinary expenditures to meet regulatory and other requirements. Finally the appraiser must determine the price(s) that may be expected for the oil and gas in the future. This information must be formed into a coherent income stream.

It is not the purpose of this discussion to go into a detailed analysis of the construction of an income stream for an oil property. However, we will review some of the main points. The construction of the income stream is a step-by-step function which forms an integrated whole. Information or an assumption used in one part of the income stream may effect another section and require a change somewhere else in the cash flow.

Production Stream - The projection of a reasonable production schedule may be the most difficult part of any oil property appraisal. Depending on the purpose of the appraisal, the appraiser may be able to work with existing production, based on prior history of the property (decline curves), or may be required to anticipate additional production to be obtained through further drilling, changes in the operation of the wells (property), introduction of enhanced recovery, or other reasonably likely changes that could occur. The latter circumstances may require sophisticated geologic analysis and reservoir engineering studies, complex computer modeling, or other approaches that provide information for the appraisal. However, projections that include expanded production also broaden the range of uncertainty that may attach to the appraisal.

The best source of data is the performance of the property itself - such as shown in the production "decline curves." Where sufficient reliable history is available, the past performance of the property is the best indicator of the future performance provided that the general circumstances remain the same. The next best source is the performance of a very similar property under the same general operating conditions. No two properties are exactly alike so care is necessary when using other properties as models.

Where conditions have changed or are expected to change, the appraiser may have to rely on other sources such as:

(a) the performance of similar properties under similar conditions, or

(b) reservoir and/or production studies performed by the operator, or by third parties, or

(c) original reservoir and production studies done by the appraiser

The latter is not uncommon but, for most appraisal usage such as ad valorem tax, the cost and time may be prohibitive. Source (b) almost always includes some referral to source (a) and can be very helpful to the appraiser who has sufficient experience is able to assess the quality and utility of the work done and is able to integrate it into the appraisal. Similar property performance can be determined by the appraiser with access to sufficient data and with enough experience to be able to evaluate the influence of the differences between the properties on the performance of the respective properties.

Product Prices - Depending on the purpose of the appraisal, selection of initial product prices may be relatively easy. In many circumstances the price may be defined as the price paid or offered on a certain date. Or it may be the average of prices offered or paid over a certain proceeding period. Or it may be left to the judgement of the appraiser to estimate an initial price for oil and gas for the property being appraised. The selection of initial prices may be one of the easier decisions, but it is also subject to more bias than are other parts of the appraisal. The best source(s) of data for this selection is the price actually paid for production from the property over a period and the prices offered for similar production in nearby fields. (See "News and Comment" is this issue.)

Operating Costs - Determination of appropriate operating costs for a property is an essential part of the appraisal. An oil property has value only so long as it can produce oil economically; that is, so long as revenue from production exceeds costs. Once the economic limit is reached, the property ceases to have value. An erroneous determination of operating costs can significantly alter the value of an oil property.

The best source of data is the cost incurred by the current operator, if there is one, or the costs incurred on similar properties if the data is available. The appraiser must determine if these costs are reasonable. He must also analyze the costs to determine how to most appropriately apply them to the future production. Some costs are relatively fixed, changing little (if any) with production or well count while other costs may be direct functions of the volume of produced fluid (gross or net) or the number of producing wells. If all costs are applied as fixed or variable, there is a good chance of under- or over-valuing the property. The author is aware of several cases where actual operating costs, which contained significant fixed costs, were applied entirely as a function of produced oil ($/Bbl) and were allowed to decline along with production resulting in a property appraisal that never reached an economic limit and, in theory, had value down to less than 1 barrel of oil per day of production.

Other Deductions - Royalties, production and severance taxes, ad valorem taxes and other interests, such as net profits, should also be considered depending on the purpose of the appraisal.

Capital Investment - The appraiser of an oil property must consider and include future capital expenditures if such investments will be necessary to achieve the projected production, maintain existing production and/or efficient operations, and comply with reasonably foreseeable regulatory requirements. If additional production and reserves are included in the appraisal due to new drilling, remedial work, or enhanced recovery of some form, there must be sufficient capital scheduled to effect the changes in production. If installation of new pumping equipment is needed to handle increasing water production, or if electrification is necessary to reduce operating costs or to free up more gas for sale, then these costs must be included in the appraisal.

Regulatory compliance is an area where serious consideration must be given to future costs. While some compliance costs become absorbed in operating expenses and overhead, the rebuilding of treating facilities and storage tanks to comply with air emissions rules, or lining sumps are major investments. In many jurisdictions, noncompliance can result in shut-down of the property, thus terminating production and income. A realistic appraisal must consider and include the appropriate costs of regulatory compliance.

Abandonment - When I started work as a petroleum engineer (some time ago), abandonment was rarely mentioned and was never included as a cost. The wells were always going to be needed for the next project and, besides, the cost would be covered by salvage whenever abandonment did occur. The 1986 price drop and increasing environmental and other regulation has made "whenever" into today - or at least tomorrow. Particularly in urban areas, competition for surface land use has pushed many properties to the point where abandonment is imminent. The appraiser must develop and include a reasonable abandonment schedule for the wells on the property and allow for either actual expenditures or the set aside of funds from current revenue to provide for eventual abandonment - or both. For marginal properties these are very significant costs. Depending on the purpose of the appraisal, it should not be assumed that the funds will be available from some other source when plugging time arrives.

The selection of a production projection and the application of appropriate prices, operating costs, and future investment result in an income stream that should describe the expected economic life of the property from appraisal date to economic limit.

To Escalate or Not to Escalate - To paraphrase, "that is the question" or at least one that has to be answered by the appraiser. Do you hold prices and costs at the current level; or escalate both at the same or differing rates; escalate one and not the other? And if so, at what rates? Do you cap the escalation at some predetermined price? Depending on circumstances, the decision can have significant impact on the appraisal. There is a lot of room for judgement here, but it must be informed judgement and the appraiser must be aware of the historic relationships between oil prices, gas prices, and inflation.

As noted in our last issue, the real price of oil has been negative for a large part of the period from 1926 to the present with only occasional spikes. While history does not always repeat, the underlying conditions in the oil industry (excess supply over demand) have not changed. Therefore, escalations where oil price increases exceed cost/inflation increases over long periods should be reviewed and corrected. Recent experience has also shown that when oil price gets too high, market forces act to increase supply and create competition that effectively caps the price and may cause the price to drop as additional supplies and energy sources come on stream. The experience of 1986 demonstrates the effect of excess supply over demand particularly when some suppliers have more control than others.

Risk Adjustment - Some parts of the income stream carry more uncertainty or risk than others. That risk can be addressed directly. The degree of risk in the production projection is often addressed by applying a risk adjustment directly to the production projection. For example, an appraiser might make a well-reasoned projection of future production but determine that there was only a 50% chance that it would occur. The appraiser then might apply a 50% reduction directly to the production projection to account for this risk. The risk in price and cost projections can be assessed by running multiple cases to determine the degree of variation in the appraised value. Multiple cases based on differing price and/or cost premises may yield little difference in property value so that the risk may be considered low.

Such adjustments are not uncommon and are a reasonably good way of directly expressing risk; however, the approach relies heavily on appraiser experience and judgement. Further, use of this approach requires that there be consistency in all other parts of the appraisal, particularly the discount rate.

The Discount Rate

The purpose of the discount rate is to reduce the future income stream (cash flow) to a present value; that is, the value of the income stream as if it were received in a lump sum today. Conversely, the present value is the amount that would have to invested today at an interest rate equal to the discount rate in order to earn the future income stream. All discount rates are present value factors. Some present value factors (discount rates), if derived and selected correctly, can be used to estimate specific values such as fair market values.

The discount rate for a specific appraisal must be selected with care. A difference of a few percentage points in a discount rate can make a great deal of difference in taxes paid or properties acquired. Correct discount rate selection requires a considerable amount of judgement by the appraiser but, fortunately, there are ways to narrow the range of choices.

The discount rate is a rate of return. In oil property appraisal, the discount rate must be one that equates to a return of and return on capital. This is necessary because oil is a depleting asset and has no residual value. Therefore all return must come from the cash flow. It follows then that discount rates expressed as simple functions of an interest rate are not sufficient for appraisal purposes.

Appraisal practice generally recognizes two sources for a discount rate: derivation from market sales, and the so called band-of-investment method. Deriving discount rates ". . . from comparable sales is preferred when sufficient data on sales of similar, competitive properties are available."[2] The lack of availability of such data is a major problem in the oil industry. With the exception of the annual study of California property sales[3] there is no publically available market sales study that derives discount rates. The California data is applicable to other markets and, at a minimum, provides a guideline for selection of market discount rates for oil property appraisal. When combined with other sources of information, such as the SPEE annual survey[4] of valuation parameters, the appraiser has an opportunity to select a discount rate based on comparable properties and similar risk.

The Band-of-Investment method is a cost-of-capital approach to discount rate derivation. The approach assumes that the discount used to value the property will satisfy the required returns of the holders of the debt and equity portions of the capital that would be employed to acquire the property. In residential or commercial real estate appraisal, this assumes a large mortgage (debt) component; whereas, in oil property acquisition, the large majority of funds are equity investments. The cost of capital approach also does not usually recognize specific property or project risk. For both reasons, the cost of capital discount rate may under-estimate the correct discount rate. However, it can function as a minimum and prevent the selection of a discount rate that would be less than the cost of the invested funds.

The relative merits of the two methods are echoed in some appraisal regulations such as California SBE Rule 8[5], which prefers the sales-derived method but will accept the cost-of-capital-derived discount rate.

In our experience of analyzing market sales, the fair market value discount rate for Proved Producing reserves is about 19-20%; the discount rate increases as the percentage of Proved Producing reserves in the total reserves decreases. This range corresponds well with the SPEE survey results from year to year. The low end of the range is about 4-5% above the pre-tax cost of capital of oil companies.

The appraiser must be careful when selecting an appropriate discount rate that the risk issue be fully addressed. All oil property appraisals are estimates of future events - some estimates are better than others. Each element in the projected cash flow carries some degree of risk or chance that it will not occur as expected. Some of these risks can be included in the cash flow by adjusting production projections (as noted above) while others are accommodated by running multiple cases at, for instance, different oil prices. To the extent that risk is not reflected in the cash flow, it should be included in the discount rate. Such a risk-inclusive discount rate would necessarily be higher than a discount rate that was essentially risk-less.

Finally, it must be remembered that the discount rate is a financial and economic parameter whose primary purpose is to guide investment decisions. It follows then that discount rates must have broad application among properties in widely differing locations and circumstances. Some idea of the relative relation of oil property discount rates to other market returns is shown in Figure 1. This depiction is relative not quantitative. The appropriate return rate (discount rate) exceeds the cost of capital because of all investors' desire to earn something on his investment and not simply swap dollars. It exceeds the returns on stocks and bonds (in general) because of the additional risk of along-term, - investment which has no residual value.

Footnotes and References

1. The Appraisal of Real Estate, Ninth Edition, American Institute of Real Estate Appraisers, Chicago, Ill.
2. Ibid, pg. 427
3. Analysis of Oil and Gas Property Transfers; Western States Petroleum Assn., March 1, 1993 (available from RJM&A)
4. Society of Petroleum Evaluation Engineers, Twelfth Annual Survey, June, 1993, Houston, TX.5. California Administrative Code Title 18, Rule 8

News and Comment

Austin, TX (May, 1993) - The Texas Legislature has passed (6/19/93) House Bill 925 (Craddick) which amends Section 23.175 of the Tax Code and relates directly to the appraisal of oil and gas properties for ad valorem tax purposes. The bill states that:

(1) The oil price and gas prices used in an appraisal must be the average oil price (weighted daily) for oil produced from the subject property in the preceding year. If there is no production, the price from a similar property may be used. The price must be held constant in the first year and may be escalated in the second and/or succeeding year but the annual escalation rate for any one year may not exceed the percentage increase projected for that year by the Comptroller of Public Accounts. The maximum price cannot exceed 150% of the current year price.

(2) The Comptroller's office shall develop and distribute appraisal manuals that specify methods and procedures for discounting future income to present value. The bill does not require that the Comptroller set discount rates. (The manual is due out soon.)

(3) Each appraisal office shall use the methods and procedures specified.

The specification of the oil and gas price takes a lot of the uncertainty out of what price to use; and the boundaries drawn around the escalation rates should corral some of the more imaginative escalation schedules that have been used in past years by some ad valorem tax appraisers. Presumably, the Comptroller receives knowledgeable advice about the direction of future prices and the 50% cap on future price is probably useful in curbing runaway oil prices. I cannot help but have two concerns. First, there is no mention of operating cost escalation rates or inflation rates and no mention of limits on the real price escalation rate. Fixing the starting price and price escalation rate is only half the equation. Second, is it Fair Market Value? In the absence of price and cost projections actually used in property acquisitions, there is no way of knowing if the price projections based on Craddick would emulate Fair Market Value appraisal. However, I understand that the Comptroller's Office takes this issue seriously and expect that it will be addressed.

The development of methods and procedures for discounting future income is in good hands. On August 13, 1993, the property tax staff of the Comptroller office presented an outline of the approach that they expect to take in the manual. Again, given the lack of a database of Texas property transactions from which derive discount rates, considerable importance falls on the weighted average cost-of-capital approach. This is perfectly valid so long as the risk element is not ignored. As noted above, the cost-of-capital discount rate can serve as a minimum and, if adhered to, should curtail the use of below market discount rates.

Fresno, CA (July 12, 1993) - County of Kern v. Oryx Energy Company

The California Court of Appeal (Fifth District) has reversed a Superior Court decision regarding the validity of a claim by the county for ad valorem tax on the value of 100% of the value of certain Federal leases in Kern County on which Oryx paid a royalty of about 13%. The lower court had ruled that Oryx could not be taxed on the government royalty interest ("GRI") and had caused the county to refund taxes plus interest. The Appeals Court, in overturning the lower court, essentially said that (a) the Oryx leases were subject to renegotiation to reduce the royalty to compensate for ad valorem tax, (b) Oryx had opportunity to apply for and obtain reduction in the royalty based on the likelihood that there would be ad valorem taxes, and (c) Oryx had not done so,

therefore Oryx was responsible for the tax on the value including the GRI.

I am not about to argue the merits of this one. That is for the high-priced guys. The courts logic in its decision is interesting. While the decision applies only to Federal leases, it probably won't be long before royalties on State leases become at issue. As I read it, the decision draws a line at 1955, based on another decision (DeLuz), and essentially says that if you renewed or renegotiated a lease since then and did not adjust the royalty at that time to compensate for ad valorem you are out of luck - pay the tax. Of course, during most of that period oil property values and royalty revenues were increasing and ad valorem tax was not a major issue. Since 1986 however, property values have been declining while county budgets and tax assessments have been going up. So an issue that was not important 20 years ago comes around now, with 20/20 hindsight, to bite industry at a time when it is least affordable.

Reports and Studies

"Current Investment Practices and Procedures: Results of a Survey of U.S. Oil and Gas Producers;" by Dr. E. L. Dougherty and Ms. Jayati Sarkar, University of Southern California, January 1993.

This detailed survey and report is based on responses by108 companies and 25 consultants to a series of questions regarding (1) capital availability, (2) investment analysis techniques, (3) cost of capital, risk analysis and inflation, (4) impact of environmental regulations, (5) valuation of property acquisitions, and (6) miscellaneous investment considerations.

Some of the more interesting results are:

a. 97.2% of respondents use discounted cash flow as their primary valuation method, either internal rate of return or net present value.

b. Small firms use pre-tax cash flow analysis; large firms use after-tax.

c. 91.3% of respondents escalate cash flows.

d. The average after-tax discount rate reported is 14%. The average pre-tax rate reported is 17.6%.

e. The most common method accounting for risk is to increase the discount.

The information in the report is very useful both in general oil property appraisal and in determining how the industry goes about appraising properties. The study was also published as SPE #25824, Hydrocarbon Economics and Evaluation Symposium, Society of Petroleum Engineers, Dallas, TX, March, 1993.

"An Overview of Ad Valorem Taxes;' SPE #26390 by D.R. Olds, Coopers & Lybrand, Houston, TX. (To be presented at SPE Annual Meeting in October.)

This is an excellent survey paper which presents the approaches used to tax oil and gas properties in the several states. The methods of appraisal used in some states are very curious and raise questions about fair market value. There also seem to be some differences in some jurisdictions between the rules on the books and actual practice.

In June, 1993 the Society of Petroleum Evaluation Engineers (SPEE) published the Twelfth Annual Survey of Economic Parameters Used in Property Evaluation. The SPEE survey is a very useful study that is becoming a more and more authoritative source of information about evaluation methods. While not a fair market value survey, it probably comes closer to providing FMV parameters than any other survey.

The results of the survey suggest the following:

1. An average 1993 starting price of $19.59 escalating at 4.31% per year.

2. Average 1993 gas price of $1.84 escalating at 5.44% per year.

3. Operating and drilling costs are escalated at an average of 4.27% per year. (Note: the real oil price increase is 0.04% per year.)

4. The minimum discount rate (defined as Cost of Money plus Return) is 17.88%. The risk adjustment for Proved Producing reserves is 94.65% so the discount rate for Proved Producing including risk is 18.9%.

The survey report is well documented and supported by tables and graphs (some in color) that allow the reader to draw his own conclusions. SPEE, 1201 Louisiana, Ste. 312, Houston, TX 77002 (713) 651-1639

"Measuring the Effects of Hazardous Materials Contamination on Real Estate Values: Techniques and Applications;" Technical Report, Appraisal Institute, Chicago, IL.

The issue of environmental damage and cleanup of oil field sites is assuming major proportions - particularly in urban and developed areas and where properties are near to abandonment. How much does potential cleanup liability diminish property value? How are such costs included in an appraisal?

The new Technical Report by AI is a very useful source of information on this topic. While it leans toward the effects of contamination of buildings and surface sites, the methods and procedures discussed are adaptable to oil field appraisal. This is a very detailed text with many examples. The report includes a several-page reference list to other publications on the same topic.

There is also a video that is available from AI covering much of the same material. The video is informative and useful - but drink plenty of coffee.

POP QUIZ:

The Pop Quiz!! section Is a new addition to the newsletter that will appear irregularly (somewhat like the newsletter) and provide a place for feedback on topics of interest. It will probably function more like a survey than a quiz but you never know.

The Pop Quiz!! question for today is:

When he had almost completed an Income Approach appraisal of an oil property, our friend Rocky was pondering the choice of a discount rate to get to an estimate of Fair Market Value. While in mid thought Rocky remembered that this county assessor, Bill, had told him, "Rocky, that is a QUALITY property and should deserve a low discount rate like 12 or 13%" Rocky remained puzzled, however, because he could not remember what about the property had caused it to have the "quality" that would attract a 12-13% discount rate. He made a list of the factors that he could think of and wants you to help. Here is Rocky's list. If you were in Rocky's place, which of these factors would represent "quality" such that you would use a low discount rate?

_____ Field Location
_____ Volume of Reserves
_____ Oil Price
_____ Gas Price
_____ Depth of Production
_____ Production Rate
_____ Reservoir Permeability
_____ Gas BTU Content
_____ Proximity to _____(Input your own town or other location.)
_____ API Gravity
_____ Decline Rate
_____ Number of Wells
_____ Long or Short Production History
_____ Add any other factors you feel are important

We would like to collect your responses to Rocky's problem so we can help others in the same quandary. Please send a copy of you quiz to our Huntington Beach address. Answers will be In our next Issue.

Richard J. Miller & Associates is a petroleum engineering and economic evaluation firm specializing in the appraisal of oil, gas, and geothermal properties. The firm provides traditional reservoir and production engineering evaluation services for operators and investors, financial institutions, and for forensic purposes. RJM&A provides clients with evaluation and appraisal services for project planning and development, financing, trust and estate management and taxes, and other purposes throughout the United States and Canada. Clients includes major oil companies, financial institutions, and individuals. The firm does not do appraisals for acquisition of properties. RJM&A is a division of Pacific Resources Management, Inc., a California corporation founded in 1977.

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