

Appendices

Appendix A: Category Definitions of 1P, 2P and 3P

For further details on the definitions and guidelines, please see the original document (SPE, 2007).

Figure A-1 (from the World Petroleum Council) presents 1P 2P and 3P category definitions. Furthermore, it provides guidelines designed to promote consistency in resource assessments. The following summarizes the definitions for each Reserves category in terms of both the deterministic incremental approach and scenario approach and provides the probability criteria if probabilistic methods are applied.

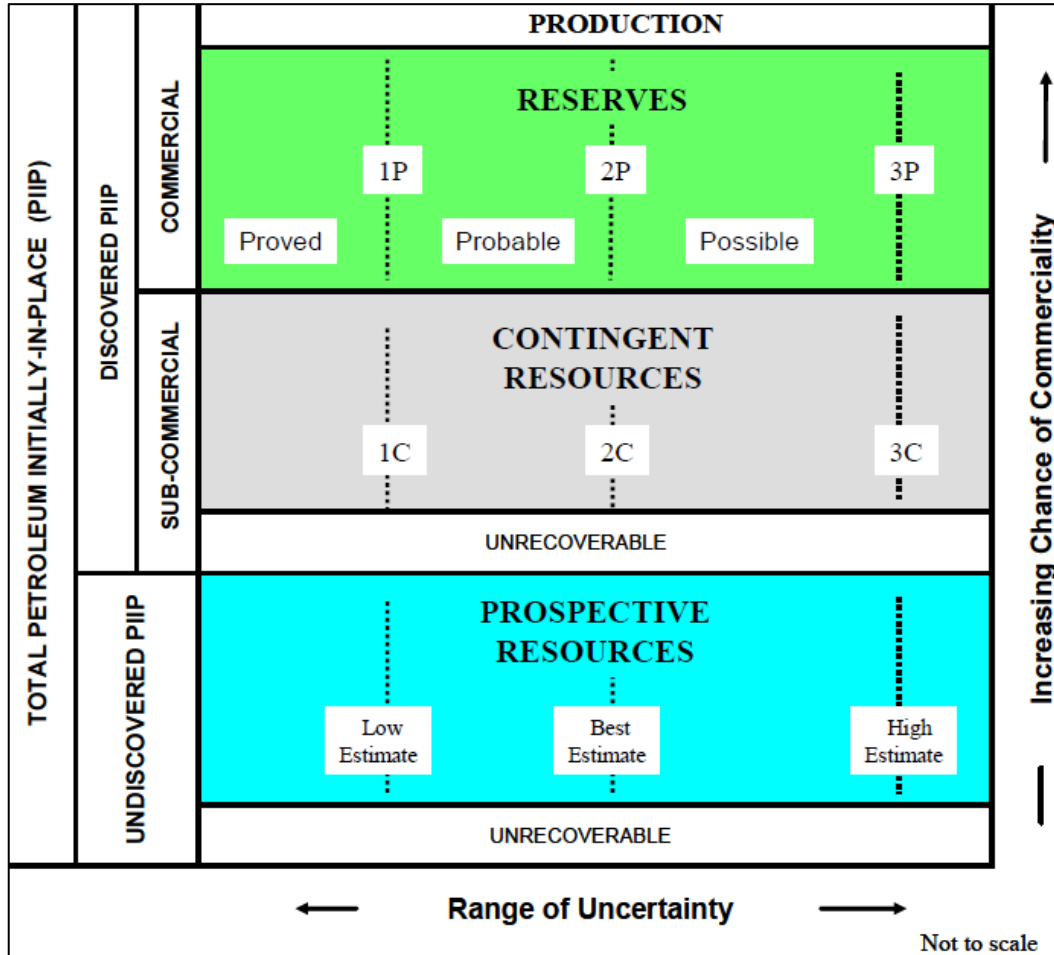


Figure A-1: Resources Classification Framework

Proved Reserves are those quantities of petroleum, which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under defined economic conditions, operating methods, and government regulations. If deterministic methods are used, the term reasonable certainty is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate.

Probable Reserves are those additional Reserves which analysis of geoscience and engineering data indicate are less likely to be recovered than Proved Reserves but more certain to be recovered than Possible Reserves. It is equally likely that actual remaining quantities recovered will be greater than or less than the sum of the estimated Proved plus Probable Reserves (2P). In this context, when probabilistic methods are used, there should be at least a 50% probability that the actual quantities recovered will equal or exceed the 2P estimate.

Possible Reserves are those additional reserves which analysis of geoscience and engineering data suggest are less likely to be recoverable than Probable Reserves. The total quantities ultimately recovered from the project have a low probability to exceed the sum of Proved plus Probable plus Possible (3P) Reserves, which is equivalent to the high estimate scenario. In this context, when probabilistic methods are used, there should be at least a 10% probability that the actual quantities recovered will equal or exceed the 3P estimate.

The “**Range of Uncertainty**” reflects a range of estimated quantities potentially recoverable from an accumulation by a project, while the vertical axis represents the “Chance of Commerciality”, that is, the chance that the project that will be developed and reach commercial producing status.

The following definitions apply to the major subdivisions within the resources classification:

TOTAL PETROLEUM INITIALLY-IN-PLACE is that quantity of petroleum that is estimated to exist originally in naturally occurring accumulations. It includes that quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations prior to production plus those estimated quantities in accumulations yet to be discovered (equivalent to “total resources”).

DISCOVERED PETROLEUM INITIALLY-IN-PLACE is that quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations prior to production.

PRODUCTION is the cumulative quantity of petroleum that has been recovered at a given date. While all recoverable resources are estimated and production is measured in terms of the sales product specifications, raw production (sales plus non-sales) quantities are also measured and required to support engineering analyses based on reservoir voidage.

Multiple development projects may be applied to each known accumulation, and each project will recover an estimated portion of the initially-in-place quantities. The projects shall be subdivided into Commercial and Sub-Commercial, with the estimated recoverable quantities being classified as Reserves and Contingent Resources respectively, as defined below.

RESERVES are those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions. Reserves must further satisfy four criteria's: they must be discovered, recoverable, commercial, and remaining (as of the evaluation date) based on the development project(s) applied. Reserves are further categorized in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterized by development and production status.

CONTINGENT RESOURCES are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, but the applied project(s) are not yet considered mature enough for commercial development due to one or more contingencies. Contingent Resources may include, for example, projects for which there are currently no viable markets, or where commercial recovery is dependent on technology under development, or where evaluation of the accumulation is insufficient to clearly assess commerciality. Contingent Resources are further categorized in accordance with the level of certainty associated with the estimates and may be sub-classified based on project maturity and/or characterized by their economic status.

UNDISCOVERED PETROLEUM INITIALLY-IN-PLACE is that quantity of petroleum estimated, as of a given date, to be contained within accumulations yet to be discovered.

PROSPECTIVE RESOURCES are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects. Prospective Resources have both an associated chance of discovery and a chance of development. Prospective Resources are further subdivided in accordance with the level of certainty associated with recoverable estimates assuming their discovery and development and may be sub-classified based on project maturity.

UNRECOVERABLE is that portion of Discovered or Undiscovered Petroleum Initially-in-Place quantities which is estimated, as of a given date, not to be recoverable by future development projects. A portion of these quantities may become recoverable in the future as commercial circumstances change or technological developments occur, the remaining portion may never be recovered due to physical/chemical constraints represented by subsurface interaction of fluids and reservoir rocks.

ESTIMATED ULTIMATE RECOVERY (EUR) is not a resources category, but a term that may be applied to any accumulation or group of accumulations (discovered or undiscovered) to define those quantities of petroleum estimated, as of a given date, to be potentially recoverable under defined technical and commercial conditions plus those quantities already produced (total of recoverable resources).

In specialized areas, such as basin potential studies, where alternative terminology has been used, the total resources may be referred to as Total Resource Base or Hydrocarbon Endowment. Total recoverable or EUR may be termed Basin Potential. The sum of Reserves, Contingent Resources and Prospective Resources may be referred to as “remaining recoverable resources”. When such terms are used, it is important that each classification component of the summation also be provided. Moreover, these quantities should not be aggregated without due consideration of the varying degrees of technical and commercial risk involved with their classification.

Project-Based Resources Evaluations

The resources evaluation process consists of identifying a recovery project, or projects, associated with a petroleum accumulation(s), estimating the quantities of Petroleum Initially-in-Place, estimating that portion of those in-place quantities that can be recovered by each project, and classifying the project(s) based on its maturity status or chance of commerciality.

This concept of a project-based classification system is further clarified by examining the primary data sources contributing to an evaluation of net recoverable resources (**Figure A-2**) that may be described as follows:

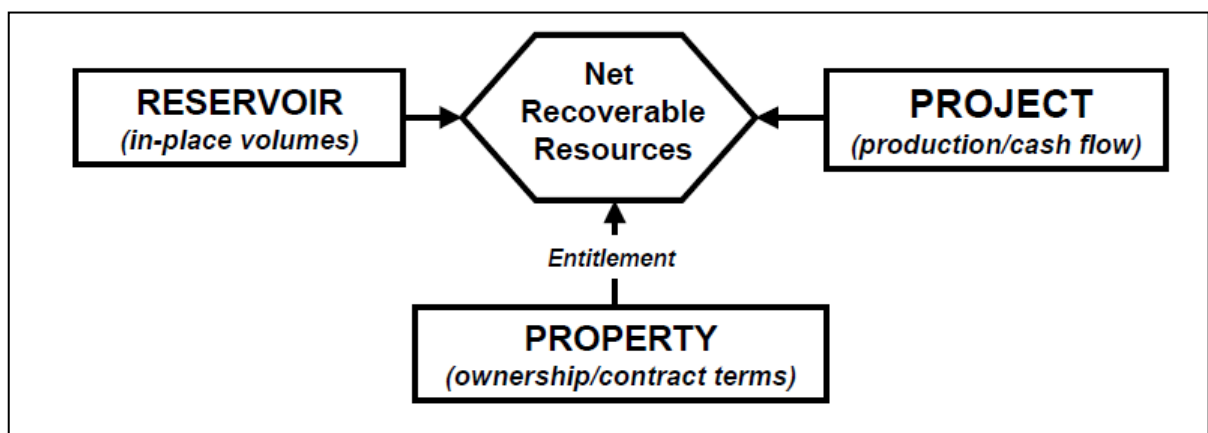


Figure A-2: Resources Evaluation Data Sources

Resources Classification

The basic classification requires establishment of criteria for a petroleum discovery and thereafter the distinction between commercial and sub-commercial projects in known accumulations (and hence between Reserves and Contingent Resources).

Determination of Discovery Status

A discovery is one petroleum accumulation, or several petroleum accumulations collectively, for which one or several exploratory wells have established through testing, sampling, and/or logging the existence of a significant quantity of potentially moveable hydrocarbons.

In this context, "significant" implies that there is evidence of a sufficient quantity of petroleum to justify estimating the in-place volume demonstrated by the well(s) and for evaluating the potential for economic recovery. Estimated recoverable quantities within such a discovered (known) accumulation(s) shall initially be classified as Contingent Resources pending definition of projects with sufficient chance of commercial development to reclassify all, or a portion, as Reserves.

Where in-place hydrocarbons are identified but are not considered currently recoverable, such quantities may be classified as Discovered Unrecoverable, if considered appropriate for resource management purposes, a portion of these quantities may become recoverable resources in the future as commercial circumstances change or technological developments occur.

Determination of Commerciality

Discovered recoverable volumes (Contingent Resources) may be considered commercially producible, and thus Reserves, if the entity claiming commerciality has demonstrated firm intention to proceed with development and such intention is based upon all of the following criteria:

Evidence to support a reasonable timetable for development.

- A reasonable assessment of the future economics of such development projects meeting defined investment and operating criteria.
- A reasonable expectation that there will be a market for all or at least the expected sales quantities of production required justifying development.
- Evidence that the necessary production and transportation facilities are available or can be made available.
- Evidence that legal, contractual, environmental and other social and economic concerns will allow for the actual implementation of the recovery project being evaluated.

To be included in the Reserves class, a project must be sufficiently defined to establish its commercial viability. There must be a reasonable expectation that all required internal and external approvals will be forthcoming, and there is evidence of firm intention to proceed with development within a reasonable period. A reasonable period for the initiation of development depends on the specific circumstances and varies according to the scope of the project. While 5 years is recommended as a benchmark, a longer time frame could be applied where, for example, development of economic projects are deferred at the option of the producer for, among other things, market-related reasons, or to meet contractual or strategic objectives. In all cases, the justification for classification as Reserves should be clearly documented.

To be included in the Reserves class, there must be a high confidence in the commercial producibility of the reservoir as supported by actual production or formation tests. In certain cases, Reserves may be assigned based on well logs and/or core analysis that indicate that the subject reservoir is hydrocarbon bearing and is analogous to reservoirs in the same area that are producing or have demonstrated the ability to produce on formation tests.

Project Status and Commercial Risk

Evaluators have the option to establish a more detailed resources classification reporting system that can also provide the basis for portfolio management by subdividing the chance of commerciality axis according to project maturity. Such sub-classes may be characterized by standard project maturity level descriptions (qualitative) and/or by their associated chance of reaching producing status (quantitative).

As a project moves to a higher level of maturity, there will be an increasing chance that the accumulation will be commercially developed. For Contingent and Prospective Resources, this can further be expressed as a quantitative chance estimate that incorporates two key underlying risk components:

The chance that the potential accumulation will result in the discovery of petroleum. This is referred to as the “chance of discovery”

Once discovered, the chance that the accumulation will be commercially developed is referred to as the “chance of development”.

Thus, for an undiscovered accumulation, the “chance of commerciality” is the product of these two risk components. For a discovered accumulation where the “chance of discovery” is 100%, the “chance of commerciality” becomes equivalent to the “chance of development”.

Project Maturity Sub-Classes

As illustrated in **Figure A-3** development projects (and their associated recoverable quantities) may be sub-classified according to project maturity levels and the associated actions (business decisions) required to move a project toward commercial production.

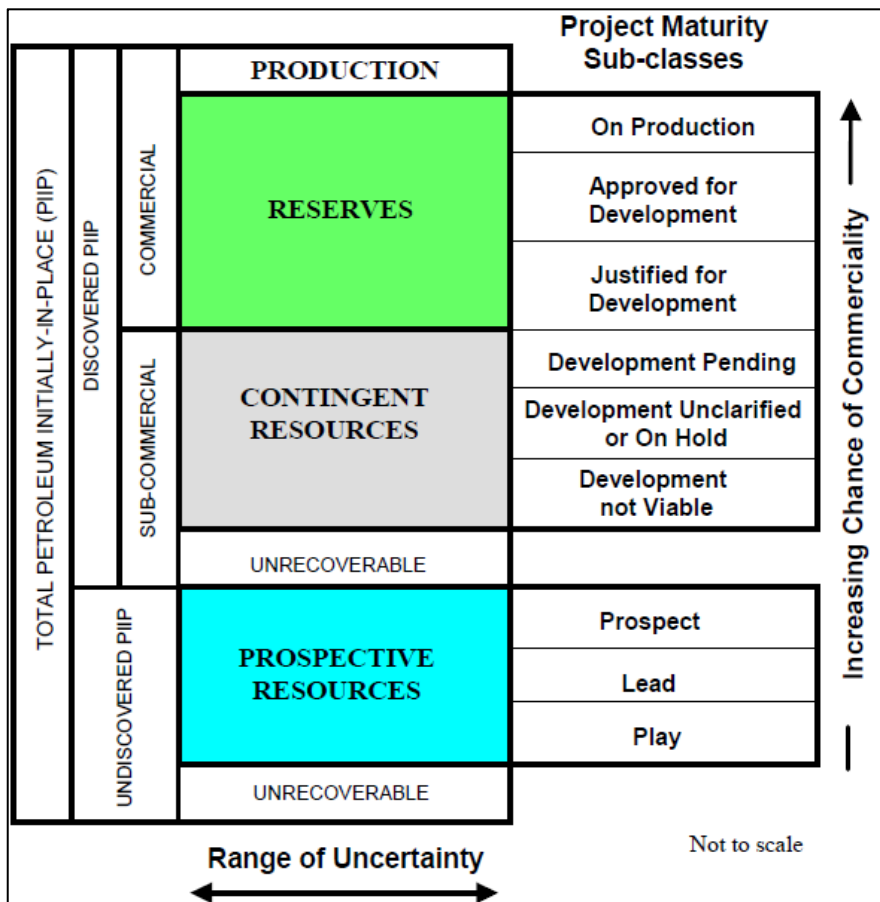


Figure A-3: Project Maturity Sub-Classes

Project Maturity terminology and definitions have been modified from the example provided in the 2001 Supplemental Guidelines, Chapter 2. Detailed definitions and guidelines for each Project maturity sub-class are provided in Table I. This approach supports managing portfolios of opportunities at various stages of exploration and development and may be supplemented by associated quantitative estimates of chance of commerciality. The boundaries between different levels of project maturity may be referred to as “decision gates”.

Decisions within the Reserves class are based on those actions that progress a project through final approvals to implementation and initiation of production and product sales. For Contingent Resources, supporting analysis should focus on gathering data and performing analyses to clarify and then mitigate those key conditions, or contingencies that prevent commercial development.

For Prospective Resources, these potential accumulations are evaluated according to their chance of discovery and, assuming a discovery, the estimated quantities that would be recoverable under appropriate development projects. The decision at each phase is to undertake further data acquisition and/or studies designed to move the project to a level of technical and commercial maturity where a decision can be made to proceed with exploration drilling.

Evaluators may adopt alternative sub-classes and project maturity modifiers, but the concept of increasing chance of commerciality should be a key enabler in applying the overall classification system and supporting portfolio management.

Reserves Status

Once projects satisfy commercial risk criteria, the associated quantities are classified as Reserves. These quantities may be allocated to the following subdivisions based on the funding and operational status of wells and associated facilities within the reservoir development plan (detailed definitions and guidelines are provided in **Figure A-3**):

- Developed Reserves are expected quantities to be recovered from existing wells and facilities
- Developed Producing Reserves are expected to be recovered from completion intervals that are open and producing at the time of the estimate
- Developed Non-Producing Reserves include shut-in and behind-pipe Reserves
- Undeveloped Reserves are quantities expected to be recovered through future investments.

Where Reserves remain undeveloped beyond a reasonable timeframe, or have remained undeveloped due to repeated postponements, evaluations should be critically reviewed to document reasons for the delay in initiating development and justify retaining these quantities within the Reserves class. While there are specific circumstances where a longer delay (see Determination of Commerciality, section 2.1.2) is justified, a reasonable period is generally considered less than 5 years.

Development and production status are of significant importance for project management. While Reserves Status has traditionally only been applied to Proved Reserves, the same concept of Developed and Undeveloped Status based on the funding and operational status of wells and producing facilities within the development project are applicable throughout the full range of Reserves uncertainty categories (Proved, Probable and Possible).

Quantities may be subdivided by Reserves Status independent of sub-classification by Project Maturity. If applied in combination, Developed and/or Undeveloped Reserves quantities may be identified separately within each Reserves sub-class (On Production, Approved for Development, and Justified for Development).

Economic Status

Projects may be further characterized by their Economic Status. All projects classified as Reserves must be economic under defined conditions.

Based on assumptions regarding future conditions and their impact on ultimate economic viability, projects currently classified as Contingent Resources may be broadly divided into two groups:

Marginal Contingent Resources are those quantities associated with technically feasible projects that are either currently economic or projected to be economic under reasonably forecasted improvements in commercial conditions but are not committed for development because of one or more contingencies.

Sub-Marginal Contingent Resources are those quantities associated with discoveries for which analysis indicates that technically feasible development projects would not be economic and/or other contingencies would not be satisfied under current or reasonably forecasted improvements in commercial conditions. These projects nonetheless should be retained in the inventory of discovered resources pending unforeseen major changes in commercial conditions.

Where evaluations are incomplete such that it is premature to clearly define ultimate chance of commerciality, it is acceptable to note that project economic status is “undetermined.” Additional economic status modifiers may be applied to further characterize recoverable quantities; for example, non-sales (lease fuel, flare, and losses) may be separately identified and documented in addition to sales quantities for both production and recoverable resource estimates (see also Reference Point, section 3.2.1). Those discovered in-place volumes for which a feasible development project cannot be defined using current or reasonably forecast improvements in, technology are classified as Unrecoverable.

Economic Status may be identified independently of, or applied in combination with, Project Maturity sub-classification to more completely describe the project and its associated resources.

Appendix B: Glossary of Terms

Assessment - The geosciences, engineering, and associated studies conducted on a petroleum exploration, development, or producing project resulting in estimates of the quantities that can be recovered and sold and the associated cash flow under defined forward conditions. Projects are classified and estimates of derived quantities are categorized according to applicable guidelines.

Basis of value – a statement of the fundamental measurement assumptions of a valuation.

Best Estimate - This is considered the best estimate of the quantity that will actually be recovered from the accumulation by the project. It is the most realistic assessment of recoverable quantities if only a single result were reported. If probabilistic methods are used, there should be at least a 50% probability (P50) that the quantities actually recovered will equal or exceed the best estimate. For prospective resources estimates, this estimate is dependent on a discovery being made. For contingent resources, this estimate is dependent on economic contingencies being successfully addressed.

BOE – Barrels of oil equivalent to a gas volume (see Crude Oil equivalent)

Capital Costs - Monies spent in drilling and completing a well that cannot be deducted under federal income tax law. The monies are recovered by the slower and less desirable depletion or depreciation methods. Capital expenditures also include geological and geophysical costs, equipment costs, and lease bonuses.

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

Condensate - Condensates are a portion of natural gas of such composition that are in the gaseous phase at temperature and pressure of the reservoirs, but that, when produced, are in the liquid phase at surface pressure and temperature.

Contingent Resources - Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by application of development projects but which are not currently considered commercially recoverable due to one or more commercial contingencies.

Cost approach – provides an indication of value using the economic principle that a buyer will pay no more for an asset than the cost to obtain an asset of equal utility, whether by purchase or by construction.

Cost Recovery - Under a typical production-sharing agreement, the contractor is responsible for the field development and all exploration and development expenses. In return, the contractor recovers costs (investments and operating expenses) out of the gross production stream. The contractor normally receives payment in oil production and is exposed to both technical and market risks.

Crude Oil - Crude Oil is the portion of petroleum that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric conditions of pressure and temperature. Crude Oil may include small amounts of non-hydrocarbons produced with the liquids. Crude Oil has a viscosity of less than or equal to 10,000 centipoises at original reservoir temperature and atmospheric pressure, on a gas free basis.

Crude Oil Equivalent - Converting gas volumes to the oil equivalent is customarily done based on the heating content or calorific value of the fuel. There are a number of methodologies in common use. Before aggregating, the gas volumes first must be converted to the same temperature and pressure. Common industry gas conversion factors usually range between 1.0 barrel of oil equivalent (boe) = 5.6 thousand standard cubic feet of gas (mscf) to 1.0 boe = 6.0 mscf.

Density - Mass per unit of volume. Density is typically reported in g/cc (for example, rocks) or pounds per barrel (drilling mud) in the oil field.

Estimated Ultimate Recovery - Those quantities of petroleum, which are estimated, on a given date, to be potentially recoverable from an accumulation, plus those quantities already produced.

Exploration Well - A well drilled in order to locate an undiscovered petroleum reservoir, either by discovering a new field or a new shallower or deeper reservoir in a previously discovered field.

Fair Market Value - The amount of money (or the cash equivalent of some other consideration) determined by the expert in accordance with the provisions of the VALMIN Code for which the mineral or petroleum asset or security should change hands on the valuation date in an open and unrestricted market between a willing buyer and a willing seller in an "arm's length" transaction, with each party acting knowledgeably, prudently and without compulsion. Value is usually comprised of two components, the underlying or 'technical value' of the mineral or petroleum asset or security and a premium or discount relating to market, strategic, or other considerations. Value should be selected as the most likely figure from within a range after taking account of risk and the possible variation in ore grade, metallurgical recovery, capital and operating costs, commodity prices, exchange rates and the like.

Field - An area consisting of a single reservoir or multiple reservoirs all grouped on, or related to, the same individual geological structural feature and/or stratigraphic condition. There may be two or more reservoirs in a field that are separated vertically by intervening impermeable rock, laterally by local geologic barriers, or both. It could be defined differently by regulatory authorities.

Flare Gas - Total volume of vented or flared gas.

Flow Test - An operation on a well designed to demonstrate the existence of moveable petroleum in a reservoir by establishing flow to the surface and/or to provide an indication of the potential productivity of that reservoir. Some flow tests, such as drill stem tests (DSTs), are performed in the open hole. A DST is used to obtain reservoir fluid samples, static bottomhole pressure measurements, indications of productivity and short-term flow and pressure buildup tests to estimate permeability and damage extent. Other flow tests, such as single-point tests and multi-point tests, are performed after the well has been cased. Single-point tests typically involve a measurement or estimate of initial or average reservoir pressure and a flow rate and flowing bottomhole pressure measurement. Multi-point tests are used to establish gas well deliverability and absolute open flow potential.

Fluid Contacts - Typically defined as Oil/Water Contact, Gas/Oil Contact, and Gas/Water Contact.

Formation - A strata of rock that is sufficiently distinctive and continuous that it can be mapped.

Forward Sales - There are a variety of forms of transactions that involve the advance of funds to the owner of an interest in an oil and gas property in exchange for the right to receive the cash proceeds of production, or the production itself, arising from the future operation of the property. In such transactions, the owner almost invariably has a future performance obligation, the outcome of which is uncertain to some degree. Determination as to whether the transaction represents a sale or financing rests on the particular circumstances of each case.

Fuel Gas - Gas used for field and plant operations. Substantial savings can be achieved to the operating cost of a project by avoiding the purchase of alternative supplies of gas or refined fuels such as diesel. SPE guidance allows the option to include fuel gas as part of the reserves estimate as long as an appropriate expense for the gas is included in the cash flow analysis.

High Estimate - This is considered an optimistic estimate of the quantity that will actually be recovered from an accumulation by a project. If probabilistic methods are used, there should be at least a 10% probability (P10) that the quantities actually recovered will equal or exceed the high estimate. For prospective resources estimates, this estimate is dependent on a discovery being made. For contingent resources, this estimate is dependent on contingencies being successfully addressed.

Horizontal Well - A well that is drilled by deviation drilling and tracks the dip of a subsurface reservoir. A horizontal well traditionally consists of a vertical section and a lateral horizontal section, which penetrates the target reservoir.

Income approach – provides an indication of value by converting future cash flows to a single current capital value.

Investment value – the value of an asset to the owner or a prospective owner for individual investment or operational objectives.

Low Estimate - This is considered a conservative estimate of the quantity that will actually be recovered from the accumulation by a project. If probabilistic methods are used, there should be at least a 90% probability (P90) that the quantities actually recovered will equal or exceed the low estimate. For prospective resources estimates, this estimate is dependent on a discovery being made. For contingent resources, this estimate is dependent on contingencies being successfully addressed.

Market approach – provides an indication of value by comparing the subject asset with identical or similar assets for which price information is available.

Net Thickness - The net thickness of the reservoir excluding tight non-pay rock. Total reservoir thickness is the gross.

Operating Costs - The direct operating costs plus district overhead plus employee benefits for a specific producing property.

Original Gas-in-Place (OGIP) - The total quantity of natural gas that is estimated to exist originally in naturally occurring reservoirs.

Overburden Thickness - The thickness of the overburden rock above top of the coal seam. The distance between ground level and the top of the coal seam.

Permeability - The measurement of a rock's ability to transmit fluids, typically measured in darcies or millidarcies.

Pilot - A small development project to validate the petroleum engineering estimates of recovery, rates, and spacing before the operator commits to commercial development.

Probabilistic Methods - The method of estimation of resources is called probabilistic when the known geoscience, engineering, and economic data are used to generate a continuous range of estimates and their associated probabilities.

Probability - The extent to which an event is likely to occur, measured by the ratio of the favourable cases to the whole number of cases possible. SPE convention is to quote cumulative probability of exceeding or equalling a quantity where P90 is the small estimate and P10 is the large estimate.

Production Sharing Contract (PSC) - An agreement between the parties to a well and a host country regarding the percentage of production each party will receive after the participating parties have recovered a specified amount of costs and expenses.

Prospect - A project associated with a potential accumulation that is sufficiently well defined to present a viable drilling target.