PRMS 2007	PRMS 2018
Petroleum resources are the estimated quantities of hydrocarbons naturally occurring on or within the Earth's crust. Resource assessments estimate total quantities in known and yet-to-be discovered accumulations; resources evaluations are focused on those quantities that can potentially be recovered and marketed by commercial projects. A petroleum resources management system provides a consistent approach to estimating petroleum quantities, evaluating development projects, and presenting results within a comprehensive classification framework.	Petroleum resources are the quantities of hydrocarbons naturally occurring on or within the Earth's crust. Resources assessments estimate quantities in known and yet-to-be-discovered accumulations. Resources evaluations are focused on those quantities that can potentially be recovered and marketed by commercial projects. A petroleum resources management system provides a consistent approach to estimating petroleum quantities, evaluating projects, and presenting results within a comprehensive classification framework.
International efforts to standardize the definitions of petroleum resources and how they are estimated began in the 1930s. Early guidance focused on Proved Reserves. Building on work initiated by the Society of Petroleum Evaluation Engineers (SPEE), SPE published definitions for all Reserves categories in 1987. In the same year, the World Petroleum Council (WPC, then known as the World Petroleum Congress), working independently, published Reserves definitions that were strikingly similar. In 1997, the two organizations jointly released a single set of definitions for Reserves that could be used worldwide. In 2000, the American Association of Petroleum Geologists (AAPG), SPE, and WPC jointly developed a classification system for all petroleum resources. This was followed by additional supporting documents: supplemental application evaluation guidelines (2001) and a glossary of terms utilized in resources definitions (2005). SPE also published standards for estimating and auditing reserves information (revised 2007).	International efforts to standardize the definitions of petroleum resources and how resources volumes are estimated began in the 1930s. Early guidance focused on Proved Reserves. Building on work initiated by the Society of Petroleum Evaluation Engineers (SPEE), the Society of Petroleum Engineers (SPE) published definitions for all reserves categories in 1987. In the same year, the World Petroleum Council (WPC), then known as the World Petroleum Congress, independently published reserves definitions that were strikingly similar. In 1997, the two organizations jointly released a single set of definitions for reserves that could be used worldwide. In 2000, the American Association of Petroleum Geologists (AAPG), SPE, and WPC jointly developed a classification system for all petroleum resources. This was followed by supplemental application evaluation guidelines (2001), standards for estimating and auditing reserves information (2001, revised 2007), and a glossary of terms used in resources definitions (2005). In 2007, the SPE/WPC/AAPG/SPEE Petroleum Resources Management System (PRMS) was issued and subsequently supported by the Society of Exploration Geophysicists (SEG). The document is referred to by the abbreviated term SPE-PRMS, with the caveat that the full title, including clear recognition of the co-sponsoring organizations, has been initially stated. In 2011, the SPE/WPC/AAPG/SPEE/SEG published Guidelines for the Application of the PRMS (referred to as Application Guidelines).
These definitions and the related classification system are now in common use internationally within the petroleum industry. They provide a measure of comparability and reduce the subjective nature of resources estimation. However, the technologies employed in petroleum exploration, development, production, and processing continue to evolve and improve. The SPE Oil and Gas Reserves Committee works closely with other organizations to maintain the definitions and issues periodic revisions to keep current with evolving technologies and changing commercial opportunities.	The PRMS definitions and the related classification system are now in common use internationally to support petroleum project and portfolio management requirements. PRMS is referenced for national reporting and regulatory disclosures in many jurisdictions and provides the commodity-specific specifications for petroleum under the United Nations Framework Classification for Resources (UNFC) to support petroleum project and portfolio management requirements. The definitions provide a measure of comparability, reduce the subjective nature of resources estimation, and are intended to improve clarity in global communications regarding petroleum resources.
	Technologies employed in petroleum exploration, development, production, and processing continue to evolve and improve. The SPE Oil and Gas Reserves Committee works closely with related organizations to maintain the definitions and guidelines to keep current with evolving technology and industry requirements.
This document consolidates, builds on, and replaces guidance previously contained in the 1997 Petroleum Reserves Definitions, the 2000 Petroleum Resources Classification and Definitions publications, and the 2001 "Guidelines for the Evaluation of Petroleum Reserves and Resources"; the latter document remains a valuable source of more detailed background information, and specific chapters are referenced herein. Appendix A is a consolidated glossary of terms used in resources evaluations and replaces those published in 2005.	This document consolidates, builds on, and replaces prior guidance. Appendix A is a glossary of terms used in the PRMS and replaces those published in 2007. It is expected that this document will be supplemented with industry education programs, best practice reporting standards, and future updates to the 2011 Application Guidelines.
These definitions and guidelines are designed to provide a common reference for the international petroleum industry, including national reporting and regulatory disclosure agencies, and to support petroleum project and portfolio management requirements. They are intended to improve clarity in global communications regarding petroleum resources. It is expected that this document will be supplemented with industry education programs and application guides addressing their implementation in a wide spectrum of technical and/or commercial settings.	

It is understood that these definitions and guidelines allow flexibility for users and agencies to tailor application for their particular needs; however, any modifications to the guidance contained herein should be clearly identified. The definitions and guidelines contained in this document must not be construed as modifying the interpretation or application of any existing regulatory reporting requirements.	
This SPE/WPC/AAPG/SPEE Petroleum Resources Management System document, including its Appendix, may be referred to by the abbreviated term “SPE-PRMS” with the caveat that the full title, including clear recognition of the co-sponsoring organizations, has been initially stated.	
	This updated PRMS provides fundamental principles for the evaluation and classification of petroleum reserves and resources. If there is any conflict with prior SPE and PRMS guidance, approved training, or the Application Guidelines, the current PRMS shall prevail. It is understood that these definitions and guidelines allow flexibility for entities, governments, and regulatory agencies to tailor application for their particular needs; however, any modifications to the guidance contained herein must be clearly identified. The terms “shall” or “must” indicate that a provision herein is mandatory for PRMS compliance, while “should” indicates a recommended practice and “may” indicates that a course of action is permissible. The definitions and guidelines contained in this document must not be construed as modifying the interpretation or application of any existing regulatory reporting requirements.
1.0 Basic Principles and Definitions The estimation of petroleum resource quantities involves the interpretation of volumes and values that have an inherent degree of uncertainty. These quantities are associated with development projects at various stages of design and implementation. Use of a consistent classification system enhances comparisons between projects, groups of projects, and total company portfolios according to forecast production profiles and recoveries. Such a system must consider both technical and commercial factors that impact the project’s economic feasibility, its productive life, and its related cash flows.	**1.0 Basic Principles and Definitions** 1.0.0.1 A classification system of petroleum resources is a fundamental element that provides a common language for communicating both the confidence of a project’s resources maturation status and the range of potential outcomes to the various entities. The PRMS provides transparency by requiring the assessment of various criteria that allow for the classification and categorization of a project’s resources. The evaluation elements consider the risk of geologic discovery and the technical uncertainties together with a determination of the chance of achieving the commercial maturation status of a petroleum project.
	1.0.0.2 The technical estimation of petroleum resources quantities involves the assessment of quantities and values that have an inherent degree of uncertainty. Quantities of petroleum and associated products can be reported in terms of volumes (e.g., barrels or cubic meters), mass (e.g., metric tonnes) or energy (e.g., Btu or Joule). These quantities are associated with exploration, appraisal, and development projects at various stages of design and implementation. The commercial aspects considered will relate the project’s maturity status (e.g., technical, economical, regulatory, and legal) to the chance of project implementation.
	1.0.0.3 The use of a consistent classification system enhances comparisons between projects, groups of projects, and total company portfolios. The application of PRMS must consider both technical and commercial factors that impact the project’s feasibility, its productive life, and its related cash flows.
Petroleum is defined as a naturally occurring mixture consisting of hydrocarbons in the gaseous, liquid, or solid phase. Petroleum may also contain non-hydrocarbons, common examples of which are carbon dioxide, nitrogen, hydrogen sulfide and sulfur. In rare cases, non-hydrocarbon content could be greater than 50%.	**1.1 Petroleum Resources Classification Framework** **1.1.0.1 Petroleum is defined as a naturally occurring mixture consisting of hydrocarbons in the gaseous, liquid, or solid state. Petroleum may also contain non-hydrocarbons, common examples of which are carbon dioxide, nitrogen, hydrogen sulfide, and sulfur. In rare cases, non-hydrocarbon content can be greater than 50%.**
The term “resources” as used herein is intended to encompass all quantities of petroleum naturally occurring on or within the Earth’s crust, discovered and undiscovered (recoverable and unrecoverable), plus those quantities already produced. Further, it includes all types of petroleum whether currently considered “conventional” or “unconventional.”	1.1.0.2 The term resources as used herein is intended to encompass all quantities of petroleum naturally occurring within the Earth’s crust, both discovered and undiscovered (whether recoverable or unrecoverable), plus those quantities already produced. Further, it includes all types of petroleum whether currently considered as conventional or unconventional resources.
Figure 1-1 is a graphical representation of the SPE/WPC/AAPG/SPEE resources classification system. The system defines the major recoverable resources classes: Production, Reserves, Contingent Resources, and Prospective Resources, as well as Unrecoverable petroleum.	1.1.0.3 Figure 1.1 graphically represents the PRMS resources classification system. The system classifies resources into discovered and undiscovered and defines the recoverable resources classes: Production, Reserves, Contingent Resources, and Prospective Resources, as well as Unrecoverable Petroleum.

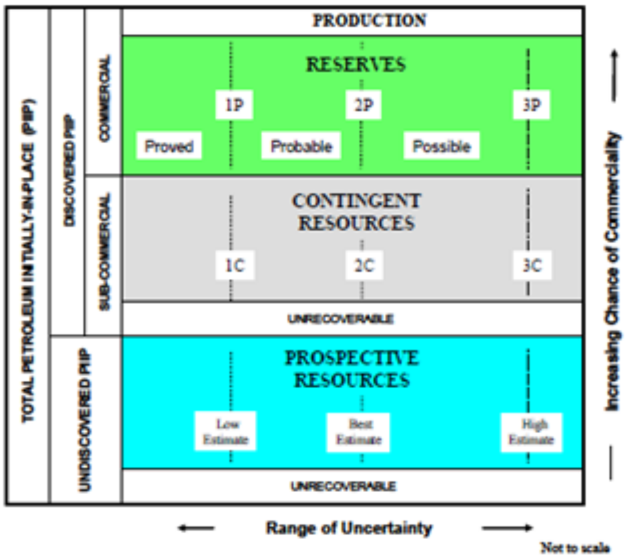


Figure 1-1: Resources Classification Framework.

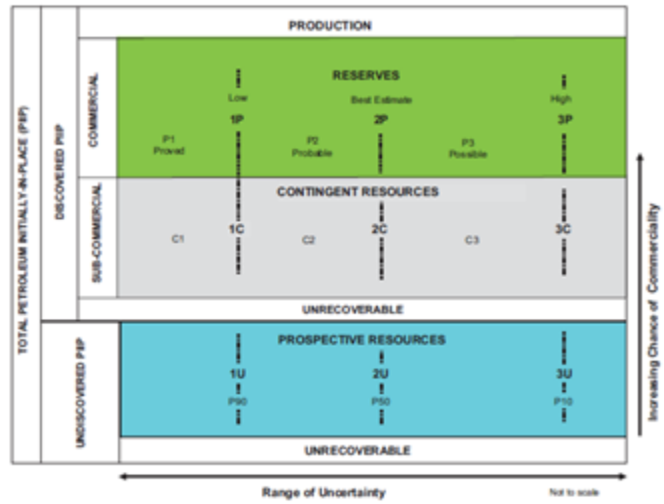
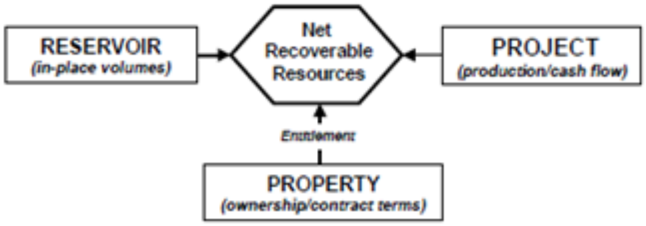
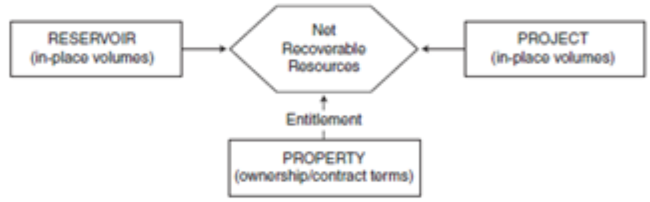


Figure 1.1—Resources classification framework

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.	1.1.0.4 The horizontal axis reflects the range of uncertainty of estimated quantities potentially recoverable from an accumulation by a project, while the vertical axis represents the chance of commerciality, Pc, which is the chance that a project will be committed for development and reach commercial producing status.
The following definitions apply to the major subdivisions within the resources classification:	1.1.0.5 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”).	A. **Total Petroleum Initially-In-Place (PIIP)** is all quantities of petroleum that are estimated to exist originally in naturally occurring accumulations, discovered and undiscovered, before production.
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.	B. **Discovered PIIP** is the quantity of petroleum that is estimated, as of a given date, to be contained in known accumulations before 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 (see Production Measurement, section 3.2).	C. **Production** is the cumulative quantities of petroleum that have 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 (see Section 3.2, Production Measurement).
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.	1.1.0.6 Multiple development projects may be applied to each known or unknown accumulation, and each project will be forecast to recover an estimated portion of the initially-in-place quantities. The projects shall be subdivided into commercial, sub-commercial, and undiscovered, with the estimated recoverable quantities being classified as Reserves, Contingent Resources, or Prospective 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: they must be discovered, recoverable, commercial, and remaining (as of the evaluation date) based on the development project(s) applied.	A. 1. **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 satisfy four criteria: discovered, recoverable, commercial, and remaining (as of the evaluation’s effective date) based on the development project(s) applied.
	2. Reserves are recommended as sales quantities as metered at the reference point. Where the entity also recognizes quantities consumed in operations (CiO) (see Section 3.2.2), as Reserves these quantities must be recorded separately. Non-hydrocarbon quantities are recognized as Reserves only when sold together with hydrocarbons or CiO associated with petroleum production. If the non-hydrocarbon is separated before sales, it is excluded from Reserves.

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.	3. Reserves are further categorized in accordance with the range of uncertainty and should be subclassified 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.	B. **Contingent Resources** are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, by the application of development project(s) not currently considered to be commercial owing to one or more contingencies.Contingent Resources have an associated chance of development. 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 range of uncertainty associated with the estimates and should be subclassified based on project maturity and/or 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.	C. **Undiscovered PIIP** 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.	D. **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 geologic discovery and a chance of development. Prospective Resources are further categorized in accordance with the range of uncertainty associated with recoverable estimates, assuming 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.	E. **Unrecoverable Resources** are that portion of either discovered or undiscovered PIIP evaluated, as of a given date, to be unrecoverable by the currently defined project(s). A portion of these quantities may become recoverable in the future as commercial circumstances change, technology is developed, or additional data are acquired. The remaining portion may never be recovered because of 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, 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.	1.1.0.7 The sum of Reserves, Contingent Resources, and Prospective Resources may be referred to as "remaining recoverable resources." Importantly, these quantities should not be aggregated without due consideration of the technical and commercial risk involved with their classification. When such terms are used, each classification component of the summation must be provided. 1.1.0.8 Other terms used in resource assessments include the following: A. Estimated Ultimate Recovery (EUR) is not a resources category or class, but a term that can be applied to an accumulation or group of accumulations (discovered or undiscovered) to define those quantities of petroleum estimated, as of a given date, to be potentially recoverable plus those quantities already produced from the accumulation or group of accumulations. For clarity, EUR must reference the associated technical and commercial conditions for the resources; for example, proved EUR is Proved Reserves plus prior production. B. Technically Recoverable Resources (TRR) are those quantities of petroleum producible using currently available technology and industry practices, regardless of commercial considerations. TRR may be used for specific Projects or for groups of Projects, or, can be an undifferentiated estimate within an area (often basin-wide) of recovery potential. 1.1.0.9 Whenever these terms are used, the conditions associated with their usage must be clearly noted and documented.
1.2 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.	**1.2 Project-Based Resources Evaluations** 1.2.0.1 The resources evaluation process consists of identifying a recovery project or projects associated with one or more petroleum accumulations, estimating the quantities of PIIP, estimating that portion of those in-place quantities that can be recovered by each project, and classifying the project(s) based on 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 (see Figure 1-2) that may be described as follows:	1.2.0.2 The concept of a project-based classification system is further clarified by examining the elements contributing to an evaluation of net recoverable resources (see Figure 1.2).
 Figure 1-2: Resources Evaluation Data Sources.	 Figure 1.2—Resources evaluation
The Reservoir (accumulation): Key attributes include the types and quantities of Petroleum Initially-in-Place and the fluid and rock properties that affect petroleum recovery.	1.2.0.3 The reservoir (contains the petroleum accumulation): Key attributes include the types and quantities of PIIP and the fluid and rock properties that affect petroleum recovery.
The Project: Each project applied to a specific reservoir development generates a unique production and cash flow schedule. The time integration of these schedules taken to the project's technical, economic, or contractual limit defines the estimated recoverable resources and associated future net cash flow projections for each project. The ratio of EUR to Total Initially-in-Place quantities defines the ultimate recovery efficiency for the development project(s). A project may be defined at various levels and stages of maturity; it may include one or many wells and associated production and processing facilities. One project may develop many reservoirs, or many projects may be applied to one reservoir.	1.2.0.4 The project: A project may constitute the development of a well, a single reservoir, or a small field; an incremental development in a producing field; or the integrated development of a field or several fields together with the associated processing facilities (e.g., compression). Within a project, a specific reservoir's development generates a unique production and cash-flow schedule at each level of certainty. The integration of these schedules taken to the project's earliest truncation caused by technical, economic, or the contractual limit defines the estimated recoverable resources and associated future net cash flow projections for each project. The ratio of EUR to total PIIP quantities defines the project's recovery efficiency. Each project should have an associated recoverable resources range (low, best, and high estimate).
The Property (lease or license area): Each property may have unique associated contractual rights and obligations including the fiscal terms. Such information allows definition of each participant's share of produced quantities (entitlement) and share of investments, expenses, and revenues for each recovery project and the reservoir to which it is applied. One property may encompass many reservoirs, or one reservoir may span several different properties. A property may contain both discovered and undiscovered accumulations.	1.2.0.5 The property (lease or license area): Each property may have unique associated contractual rights and obligations, including the fiscal terms. This information allows definition of each participating entity's share of produced quantities (entitlement) and share of investments, expenses, and revenues for each recovery project and the reservoir to which it is applied. One property may encompass many reservoirs, or one reservoir may span several different properties. A property may contain both discovered and undiscovered accumulations that may be spatially unrelated to a potential single field designation.
	1.2.0.6 An entity's net recoverable resources are the entitlement share of future production legally accruing under the terms of the development and production contract or license.
In context of this data relationship, "project" is the primary element considered in this resources classification, and net recoverable resources are the incremental quantities derived from each project. Project represents the link between the petroleum accumulation and the decision-making process. A project may, for example, constitute the development of a single reservoir or field, or an incremental development for a producing field, or the integrated development of several fields and associated facilities with a common ownership. In general, an individual project will represent the level at which a decision is made whether or not to proceed (i.e., spend more money) and there should be an associated range of estimated recoverable quantities for that project.	1.2.0.7 In the context of this relationship, the project is the primary element considered in the resources classification, and the net recoverable resources are the quantities derived from each project. A project represents a defined activity or set of activities to develop the petroleum accumulation(s) and the decisions taken to mature the resources to reserves. In general, it is recommended that an individual project has assigned to it a specific maturity level sub-class (See Section 2.1.3.5, Project Maturity Sub-Classes) at which a decision is made whether or not to proceed (i.e., spend more money) and there should be an associated range of estimated recoverable quantities for the project (See Section 2.2.1, Range of Uncertainty). For completeness, a developed field is also considered to be a project.

An accumulation or potential accumulation of petroleum may be subject to several separate and distinct projects that are at different stages of exploration or development. Thus, an accumulation may have recoverable quantities in several resource classes simultaneously. In order to assign recoverable resources of any class, a development plan needs to be defined consisting of one or more projects. Even for Prospective Resources, the estimates of recoverable quantities must be stated in terms of the sales products derived from a development program assuming successful discovery and commercial development. Given the major uncertainties involved at this early stage, the development program will not be of the detail expected in later stages of maturity. In most cases, recovery efficiency may be largely based on analogous projects. In-place quantities for which a feasible project cannot be defined using current, or reasonably forecast improvements in, technology are classified as Unrecoverable.	1.2.0.8 An accumulation or potential accumulation of petroleum is often subject to several separate and distinct projects that are at different stages of exploration or development. Thus, an accumulation may have recoverable quantities in several resources classes simultaneously. When multiple options for development exist early in project maturity, these options should be reflected as competing project alternatives to avoid double counting until decisions further refine the project scope and timing. Once the scope is described and the timing of decisions on future activities established, the decision steps will generally align with the project's classification. To assign recoverable resources of any class, a project's development plan, with detail that supports the resource commercial classification claimed, is needed. 1.2.0.9 The estimates of recoverable quantities must be stated in terms of the production derived from the potential development program even for Prospective Resources. Given the major uncertainties involved at this early stage, the development program will not be of the detail expected in later stages of maturity. In most cases, recovery efficiency may be based largely on analogous projects. In-place quantities for which a feasible project cannot be defined using current or reasonably forecast improvements in technology are classified as Unrecoverable.
Not all technically feasible development plans will be commercial. The commercial viability of a development project is dependent on a forecast of the conditions that will exist during the time period encompassed by the project's activities (see Commercial Evaluations, section 3.1). "Conditions" include technological, economic, legal, environmental, social, and governmental factors. While economic factors can be summarized as forecast costs and product prices, the underlying influences include, but are not limited to, market conditions, transportation and processing infrastructure, fiscal terms, and taxes.	1.2.0.10 Not all technically feasible development projects will be commercial. The commercial viability of a development project within a field's development plan is dependent on a forecast of the conditions that will exist during the time period encompassed by the project (see Section 3.1, Assessment of Commerciality). Conditions include technical, economic (e.g., hurdle rates, commodity prices), operating and capital costs, marketing, sales route(s), and legal, environmental, social, and governmental factors forecast to exist and impact the project during the time period being evaluated. While economic factors can be summarized as forecast costs and product prices, the underlying influences include, but are not limited to, market conditions (e.g., inflation, market factors, and contingencies), exchange rates, transportation and processing infrastructure, fiscal terms, and taxes.
The resource quantities being estimated are those volumes producible from a project as measured according to delivery specifications at the point of sale or custody transfer (see Reference Point, section 3.2.1). The cumulative production from the evaluation date forward to cessation of production is the remaining recoverable quantity. The sum of the associated annual net cash flows yields the estimated future net revenue. When the cash flows are discounted according to a defined discount rate and time period, the summation of the discounted cash flows is termed net present value (NPV) of the project (see Evaluation and Reporting Guidelines, section 3.0).	1.2.0.11 The resources being estimated are those quantities producible from a project as measured according to delivery specifications at the point of sale or custody transfer (see Section 3.2.1, Reference Point) and may permit forecasts of CiO quantities (see Section 3.2.2., Consumed in Operations). The cumulative production forecast from the effective date forward to cessation of production is the remaining recoverable resources quantity (see Section 3.1.1, Net Cash-Flow Evaluation).
The supporting data, analytical processes, and assumptions used in an evaluation should be documented in sufficient detail to allow an independent evaluator or auditor to clearly understand the basis for estimation and categorization of recoverable quantities and their classification.	1.2.0.12 The supporting data, analytical processes, and assumptions describing the technical and commercial basis used in an evaluation must be documented in sufficient detail to allow, as needed, a qualified reserves evaluator or qualified reserves auditor to clearly understand each project's basis for the estimation, categorization, and classification of recoverable resources quantities and, if appropriate, associated commercial assessment.
2.0 Classification and Categorization Guidelines To consistently characterize petroleum projects, evaluations of all resources should be conducted in the context of the full classification system as shown in Figure 1-1. These guidelines reference this classification system and support an evaluation in which projects are "classified" based on their chance of commerciality (the vertical axis) and estimates of recoverable and marketable quantities associated with each project are "categorized" to reflect uncertainty (the horizontal axis). The actual workflow of classification vs. categorization varies with individual projects and is often an iterative analysis process leading to a final report. "Report," as used herein, refers to the presentation of evaluation results within the business entity conducting the assessment and should not be construed as replacing guidelines for public disclosures under guidelines established by regulatory and/or other government agencies.	**2.0 Classification and Categorization Guidelines** 2.0.0.1 To consistently characterize petroleum projects, evaluations of all resources should be conducted in the context of the full classification system shown in Figure 1.1. These guidelines reference this classification system and support an evaluation in which projects are "classified" based on their chance of commerciality, Pc (the vertical axis labeled Chance of Commerciality), and estimates of recoverable and marketable quantities associated with each project are "categorized" to reflect uncertainty (the horizontal axis). The actual workflow of classification versus categorization varies with individual projects and is often an iterative analysis leading to a final report. Report here refers to the presentation of evaluation results within the entity conducting the assessment and should not be construed as replacing requirements for public disclosures under guidelines established by regulatory and/or other government agencies.

Additional background information on resources classification issues can be found in Chapter 2 of the 2001 SPE/WPC/AAPG publication: "Guidelines for the Evaluation of Petroleum Reserves and Resources," hereafter referred to as the "2001 Supplemental Guidelines."	
2.1 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).	**2.1 Resources Classification** 2.1.0.1 The PRMS classification establishes criteria for the classification of the total PIIP. A determination of a discovery differentiates between discovered and undiscovered PIIP. The application of a project further differentiates the recoverable from unrecoverable resources. The project is then evaluated to determine its maturity status to allow the classification distinction between commercial and sub-commercial projects. PRMS requires the project's recoverable resources quantities to be classified as either Reserves, Contingent Resources, or Prospective Resources.
2.1.1 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.	**2.1.1 Determination of Discovery Status** 2.1.1.1 A discovered petroleum accumulation is determined to exist when one or more exploratory wells have established through testing, sampling, and/or logging the existence of a significant quantity of potentially recoverable hydrocarbons and thus have established a known accumulation. In the absence of a flow test or sampling, the discovery determination requires confidence in the presence of hydrocarbons and evidence of producibility, which may be supported by suitable producing analogs (see Section 4.1.1, Analogs). In this context, "significant" implies that there is evidence of a sufficient quantity of petroleum to justify estimating the in-place quantity demonstrated by the well(s) and for evaluating the potential for commercial recovery.
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.	2.1.1.2 Where a discovery has identified recoverable hydrocarbons, but is not considered viable to apply a project with established technology or with technology under development, such quantities may be classified as Discovered Unrecoverable with no Contingent Resources. In future evaluations, as appropriate for petroleum resources management purposes, a portion of these unrecoverable quantities may become recoverable resources as either commercial circumstances change or technological developments occur.
2.1.2 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:	**2.1.2 Determination of Commerciality** **2**.1.2.1 Discovered recoverable quantities (Contingent Resources) may be considered commercially mature, and thus attain Reserves classification, if the entity claiming commerciality has demonstrated a firm intention to proceed with development. This means the entity has satisfied the internal decision criteria (typically rate of return at or above the weighted average cost-of-capital or the hurdle rate). Commerciality is achieved with the entity's commitment to the project and all of the following criteria:
	A. Evidence of a technically mature, feasible development plan.
	B. Evidence of financial appropriations either being in place or having a high likelihood of being secured to implement the project.
• Evidence to support a reasonable timetable for development.	C. Evidence to support a reasonable time-frame for development.
• A reasonable assessment of the future economics of such development projects meeting defined investment and operating criteria.	D. A reasonable assessment that the development projects will have positive economics and meet defined investment and operating criteria. This assessment is performed on the estimated entitlement forecast quantities and associated cash flow on which the investment decision is made (see Section 3.1.1, Net Cash-Flow Evaluation).
• A reasonable expectation that there will be a market for all or at least the expected sales quantities of production required to justify development.	E. A reasonable expectation that there will be a market for forecast sales quantities of the production required to justify development. There should also be similar confidence that all produced streams (e.g., oil, gas, water, CO2) can be sold, stored, re-injected, or otherwise appropriately disposed.
• Evidence that the necessary production and transportation facilities are available or can be made available:	F. 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.	G. Evidence that legal, contractual, environmental, regulatory, and government approvals are in place or will be forthcoming, together with resolving any social and economic concerns.

	2.1.2.2 The commerciality test for Reserves determination is applied to the best estimate (P50) forecast quantities, which upon qualifying all commercial and technical maturity criteria and constraints become the 2P Reserves. Stricter cases [e.g., low estimate (P90)] may be used for decision purposes or to investigate the range of commerciality (see Section 3.1.2, Economic Criteria). Typically, the low- and high-case project scenarios may be evaluated for sensitivities when considering project risk and upside opportunity.
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 time frame. A reasonable time frame 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.	2.1.2.3 To be included in the Reserves class, a project must be sufficiently defined to establish both its technical and commercial viability as noted in Section 2.1.2.1. There must be a reasonable expectation that all required internal and external approvals will be forthcoming and evidence of firm intention to proceed with development within a reasonable time-frame. A reasonable time-frame for the initiation of development depends on the specific circumstances and varies according to the scope of the project. While five years is recommended as a benchmark, a longer time-frame could be applied where justifiable; for example, development of economic projects that take longer than five years to be developed or are deferred 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 on the basis of 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.	
	2.1.2.4 While PRMS guidelines require financial appropriations evidence, they do not require that project financing be confirmed before classifying projects as Reserves. However, this may be another external reporting requirement. In many cases, financing is conditional upon the same criteria as above. In general, if there is not a reasonable expectation that financing or other forms of commitment (e.g., farm-outs) can be arranged so that the development will be initiated within a reasonable time-frame, then the project should be classified as Contingent Resources. If financing is reasonably expected to be in place at the time of the final investment decision (FID), the project's resources may be classified as Reserves.
2.1.3 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).	**2.1.3 Project Status and Chance of Commerciality** 2.1.3.1 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 qualitatively by the project maturity level descriptions and associated quantitative chance of reaching commercial status and being placed on production.
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:	2.1.3.2 As a project moves to a higher level of commercial maturity in the classification (see Figure 1.1 vertical axis), there will be an increasing chance that the accumulation will be commercially developed and the project quantities move to Reserves. For Contingent and Prospective Resources, this is further expressed as a chance of commerciality, Pc, which incorporates the following underlying chance component(s):
• The chance that the potential accumulation will result in the discovery of petroleum. This is referred to as the "chance of discovery."	A. The chance that the potential accumulation will result in the discovery of a significant quantity of petroleum, which is called the "chance of geologic discovery," Pg.
• Once discovered, the chance that the accumulation will be commercially developed is referred to as the "chance of development."	B. Once discovered, the chance that the known accumulation will be commercially developed is called the "chance of development," Pd.
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."	2.1.3.3 There must be a high degree of certainty in the chance of commerciality, Pc, for Reserves to be assigned; for Contingent Resources, Pc = Pd; and for Prospective Resources, Pc is the product of Pg and Pd.
	2.1.3.4 Contingent and Prospective Resources can have different project scopes (e.g., well count, development spacing, and facility size) as development uncertainties and project definition mature.

2.1.3.1 Project Maturity Sub-Classes As illustrated in Figure 2-1, 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.	**2.1.3.5 Project Maturity Sub-Classes** 2.1.3.5.1 As Figure 2.1 illustrates, development projects and associated recoverable quantities may be subclassified according to project maturity levels and the associated actions (i.e., business decisions) required to move a project toward commercial production.

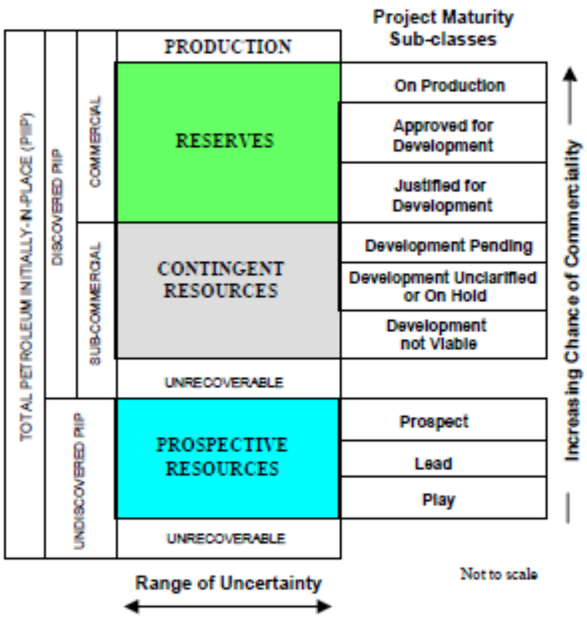


Figure 2-1: Sub-classes based on Project Maturity.

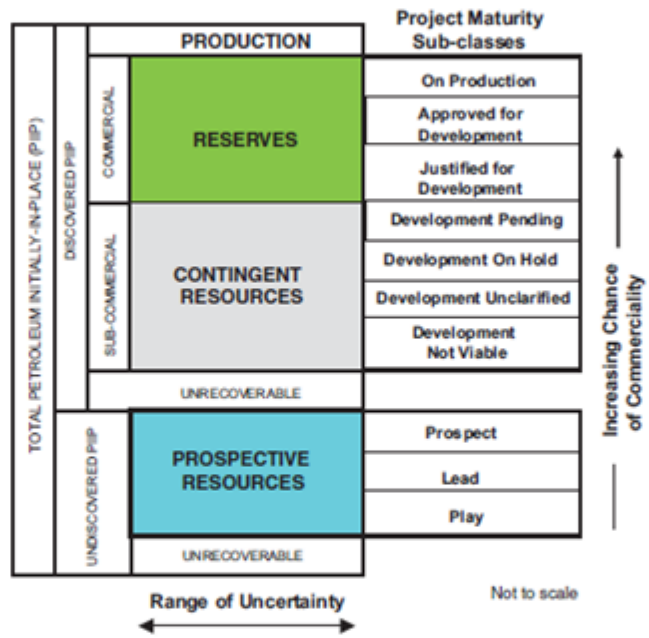


Figure 2.1—Sub-classes based on project maturity

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."	2.1.3.5.2. Maturity terminology and definitions for each project maturity class and sub-class are provided in Table I. This approach supports the management of portfolios of opportunities at various stages of exploration, appraisal, and development. Reserve sub-classes must achieve commerciality while Contingent and Prospective Resources sub-classes may be supplemented by associated quantitative estimates of chance of commerciality to mature.
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.	2.1.3.5.3 Resources sub-class maturation is based on those actions that progress a project through final approvals to implementation and initiation of production and product sales. The boundaries between different levels of project maturity are frequently referred to as project "decision gates."
	2.1.3.5.4 Projects that are classified as Reserves must meet the criteria as listed in Section 2.1.2, Determination of Commerciality. Projects sub-classified as Justified for Development are agreed upon by the managing entity and partners as commercially viable and have support to advance the project, which includes a firm intent to proceed with development. All participating entities have agreed to the project and there are no known contingencies to the project from any official entity that will have to formally approve the project.
	2.1.3.5.5 Justified for Development Reserves are reclassified to Approved for Development after a FID has been made. Projects should not remain in the Justified for Development sub-class for extended time periods without positive indications that all required approvals are expected to be obtained without undue delay. If there is no longer the reasonable expectation of project execution (i.e., historical track record of execution, project progress), the project shall be reclassified as Contingent Resources.

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.	2.1.3.5.6 Projects classified as Contingent Resources have their sub-classes aligned with the entity's plan to manage its portfolio of projects. Thus, projects on known accumulations that are actively being studied, undergoing feasibility review, and have planned near-term operations (e.g., drilling) are placed in Contingent Resources Development Pending, while those that do not meet this test are placed into either Contingent Resources On Hold, Unclarified, or Not Viable. 2.1.3.5.7 Where commercial factors change and there is a significant risk that a project with Reserves will no longer proceed, the project shall be reclassified as Contingent Resources. 2.1.3.5.8 For Contingent Resources, evaluators should focus on gathering data and performing analyses to clarify and then mitigate those key conditions or contingencies that prevent commercial development. Note that the Contingent Resources sub-classes described above and shown in Figure 2.1 are recommended; however, entities are at liberty to introduce additional sub-classes that align with project management goals.
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.	2.1.3.5.9 For Prospective Resources, potential accumulations may mature from Play, to Lead and then to Prospect based on the ability to identify potentially commercially viable exploration projects. The Prospective Resources are evaluated according to chance of geologic discovery, Pg, and chance of development, Pd, which together determine the chance of commerciality, Pc. Commercially recoverable quantities under appropriate development projects are then estimated. The decision at each exploration phase is whether to undertake further data acquisition and/or studies designed to move the Play through to a drillable Prospect with a project description range commensurate with the Prospective Resources subclass.
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.	
2.1.3.2 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 Table 2): • 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.	**2.1.3.6 Reserves Status** 2.1.3.6.1 Once projects satisfy commercial maturity (criteria given in Table 1), 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 (Table 2 provides detailed definitions and guidelines): A. Developed Reserves are quantities expected to be recovered from existing wells and facilities. 1. Developed Producing Reserves are expected to be recovered from completion intervals that are open and producing at the time of the estimate. 2. Developed Non-Producing Reserves include shut-in and behind-pipe reserves with minor costs to access. B. Undeveloped Reserves are quantities expected to be recovered through future significant investments.
	2.1.3.6.2 The distinction between the "minor costs to access" Developed Non-Producing Reserves and the "significant investment" needed to develop Undeveloped Reserves requires the judgment of the evaluator taking into account the cost environment. A significant investment would be a relatively large expenditure when compared to the cost of drilling and completing a new well. A minor cost would be a lower expenditure when compared to the cost of drilling and completing a new well.
	2.1.3.6.3 Once a project passes the commercial assessment and achieves Reserves status, it is then included with all other Reserves projects of the same category in the same field for estimating combined future production and applying the economic limit test (see Section 3.1, Assessment of Commerciality).

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 time frame is generally considered to be less than 5 years.	2.1.3.6.4 Where Reserves remain Undeveloped beyond a reasonable time-frame or have remained Undeveloped owing to postponements, evaluations should be critically reviewed to document reasons for the delay in initiating development and to justify retaining these quantities within the Reserves class. While there are specific circumstances where a longer delay (see Section 2.1.2, Determination of Commerciality) is justified, a reasonable time-frame to commence the project is generally considered to be less than five years from the initial classification date.
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).	2.1.3.6.5 Development and Production status are of significant importance for project portfolio management and financials. The Reserves status concept of Developed and Undeveloped status is based on the funding and operational status of wells and producing facilities within the development project. These status designations are applicable throughout the full range of Reserves uncertainty categories (1P, 2P, and 3P or Proved, Probable, and Possible). Even those projects that are Developed and On Production should have remaining uncertainty in recoverable quantities.
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).	
2.1.3.3 Economic Status Projects may be further characterized by their Economic Status. All projects classified as Reserves must be economic under defined conditions (see Commercial Evaluations, section 3.1). 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:	2.1.3.7.1 Projects may be further characterized by economic status. All projects classified as Reserves must be commercial under defined conditions (see Section 3.1, Assessment of Commerciality Assessment). Based on assumptions regarding future conditions and the 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.	A. Economically Viable Contingent Resources are those quantities associated with technically feasible projects where cash flows are positive under reasonably forecasted conditions but are not Reserves because it does not meet the commercial criteria defined in Section 2.1.2.
• 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.	B. Economically Not Viable Contingent Resources are those quantities for which development projects are not expected to yield positive cash flows under reasonable forecast conditions.
	2.1.3.7.2 The best estimate (or P50) production forecast is typically used for the economic evaluation for the commercial assessment of the project. The low case, when used as the primary case for a project decision, may be used to determine project economics. The economic evaluation of the project high case alone is not permitted to be used in the determination of the project's commerciality.
	2.1.3.7.3 For Reserves, the best estimate production forecast reflects a specific development scenario recovery process, a certain number and type of wells, facilities, and infrastructure.
	2.1.3.7.4 The project's low-case scenario is tested to ensure it is economic, which is required for Proved Reserves to exist (see Section 2.2.2, Category Definitions and Guidelines). It is recommended to evaluate the low case and the high case (which will quantify the 3P Reserves) to convey the project downside risk and upside potential. The project development scenarios may vary in the number and type of wells, facilities, and infrastructure in Contingent Resources, but to recognize Reserves, there must exist the reasonable expectation to develop the project for the best estimate case.

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.	2.1.3.7.5 The economic status may be identified independently of, or applied in combination with, project maturity sub-classification to more completely describe the project. Economic status is not the only qualifier that allows defining Contingent or Prospective Resources sub-classes. Within Contingent Resources, applying the project status to decision gates (and/or incorporating them in a plan to execute) more appropriately defines whether the project is placed into the sub-class of either Development Pending versus On Hold, Not Viable, or Unclarified. 2.1.3.7.6 Where evaluations are incomplete and it is premature to clearly define the associated cash flows, it is acceptable to note that the project economic status is "undetermined."
2.2 Resources Categorization The horizontal axis in the Resources Classification (Figure 1.1) defines the range of uncertainty in estimates of the quantities of recoverable, or potentially recoverable, petroleum associated with a project. These estimates include both technical and commercial uncertainty components as follows:	**2.2 Resources Categorization** 2.2.0.1 The horizontal axis in the resources classification in Figure 1.1 defines the range of uncertainty in estimates of the quantities of recoverable, or potentially recoverable, petroleum associated with a project or group of projects. These estimates include the uncertainty components as follows:
• The total petroleum remaining within the accumulation (in-place resources).	A. The total petroleum remaining within the accumulation (in-place resources).
• That portion of the in-place petroleum that can be recovered by applying a defined development project or projects.	B. The technical uncertainty in the portion of the total petroleum that can be recovered by applying a defined development project or projects (i.e., the technology applied).
• Variations in the commercial conditions that may impact the quantities recovered and sold (e.g., market availability, contractual changes).	C. Known variations in the commercial terms that may impact the quantities recovered and sold (e.g., market availability; contractual changes, such as production rate tiers or product quality specifications) are part of project's scope and are included in the horizontal axis, while the chance of satisfying the commercial terms is reflected in the classification (vertical axis).
Where commercial uncertainties are such that there is significant risk that the complete project (as initially defined) will not proceed, it is advised to create a separate project classified as Contingent Resources with an appropriate chance of commerciality.	
	2.2.0.2 The uncertainty in a project's recoverable quantities is reflected by the 1P, 2P, 3P, Proved (P1), Probable (P2), Possible (P3), 1C, 2C, 3C, C1, C2, and C3; or 1U, 2U, and 3U resources categories. The commercial chance of success is associated with resources classes or sub-classes and not with the resources categories reflecting the range of recoverable quantities.
	2.2.0.3 There must be a single set of defined conditions applied for resource categorization. Use of different commercial assumptions for categorizing quantities is referred to as "split conditions" and are not allowed. Frequently, an entity will conduct project evaluation sensitivities to understand potential implications when making project selection decisions. Such sensitivities may be fully aligned to resource categories or may use single parameters, groups of parameters, or variances in the defined conditions.
	2.2.0.4 Moreover, a single project is uniquely assigned to a sub-class along with its uncertainty range. For example, a project cannot have quantities classified in both Contingent Resources and Reserves, for instance as 1C, 2P, and 3P. This is referred to as "split classification."
2.2.1 Range of Uncertainty The range of uncertainty of the recoverable and/or potentially recoverable volumes may be represented by either deterministic scenarios or by a probability distribution (see Deterministic and Probabilistic Methods, section 4.2).	**2.2.1 Range of Uncertainty** 2.2.1.1 Uncertainty is inherent in a project's resources estimation and is communicated in PRMS by reporting a range of category outcomes. The range of uncertainty of the recoverable and/or potentially recoverable quantities may be represented by either deterministic scenarios or by a probability distribution (see Section 4.2, Resources Assessment Methods).

When the range of uncertainty is represented by a probability distribution, a low, best, and high estimate shall be provided such that: • There should be at least a 90% probability (P90) that the quantities actually recovered will equal or exceed the low estimate. • There should be at least a 50% probability (P50) that the quantities actually recovered will equal or exceed the best estimate. • There should be at least a 10% probability (P10) that the quantities actually recovered will equal or exceed the high estimate.	2.2.1.2 When the range of uncertainty is represented by a probability distribution, a low, best, and high estimate shall be provided such that: A. There should be at least a 90% probability (P90) that the quantities actually recovered will equal or exceed the low estimate. B. There should be at least a 50% probability (P50) that the quantities actually recovered will equal or exceed the best estimate. C. There should be at least a 10% probability (P10) that the quantities actually recovered will equal or exceed the high estimate.
	2.2.1.3 In some projects, the range of uncertainty may be limited, and the three scenarios may result in resources estimates that are not significantly different. In these situations, a single value estimate may be appropriate to describe the expected result.
When using the deterministic scenario method, typically there should also be low, best, and high estimates, where such estimates are based on qualitative assessments of relative uncertainty using consistent interpretation guidelines. Under the deterministic incremental (risk-based) approach, quantities at each level of uncertainty are estimated discretely and separately (see Category Definitions and Guidelines, section 2.2.2).	2.2.1.4 When using the deterministic scenario method, typically there should also be low, best, and high estimates, where such estimates are based on qualitative assessments of relative uncertainty using consistent interpretation guidelines. Under the deterministic incremental method, quantities for each confidence segment are estimated discretely (see Section 2.2.2, Category Definitions and Guidelines).
	2.2.1.5 Project resources are initially estimated using the above uncertainty range forecasts that incorporate the subsurface elements together with technical constraints related to wells and facilities. The technical forecasts then have additional commercial criteria applied (e.g., economics and license cutoffs are the most common) to estimate the entitlement quantities attributed and the resources classification status: Reserves, Contingent Resources, and Prospective Resources.
These same approaches to describing uncertainty may be applied to Reserves, Contingent Resources, and Prospective Resources. While there may be significant risk that sub-commercial and undiscovered accumulations will not achieve commercial production, it useful to consider the range of potentially recoverable quantities independently of such a risk or consideration of the resource class to which the quantities will be assigned.	2.2.1.6 While there may be significant chance that sub-commercial and undiscovered accumulations will not achieve commercial production, it is useful to consider the range of potentially recoverable quantities independent of such likelihood when considering what resources class to assign the project quantities.
2.2.2 Category Definitions and Guidelines Evaluators may assess recoverable quantities and categorize results by uncertainty using the deterministic incremental (risk-based) approach, the deterministic scenario (cumulative) approach, or probabilistic methods. (see "2001 Supplemental Guidelines," Chapter 2.5). In many cases, a combination of approaches is used.	**2.2.2 Category Definitions and Guidelines** 2.2.2.1 Evaluators may assess recoverable quantities and categorize results by uncertainty using the deterministic incremental method, the deterministic scenario (cumulative) method, geostatistical methods, or probabilistic methods (see Section 4.2, Resources Assessment Methods). Also, combinations of these methods may be used.
Use of consistent terminology (Figure 1.1) promotes clarity in communication of evaluation results. For Reserves, the general cumulative terms low/best/high estimates are denoted as 1P/2P/3P, respectively. The associated incremental quantities are termed Proved, Probable and Possible. Reserves are a subset of, and must be viewed within context of, the complete resources classification system. While the categorization criteria are proposed specifically for Reserves, in most cases, they can be equally applied to Contingent and Prospective Resources conditional upon their satisfying the criteria for discovery and/or development.	2.2.2.2 Use of consistent terminology (Figures 1.1 and 2.1) promotes clarity in communication of evaluation results. For Reserves, the general cumulative terms low/best/high forecasts are used to estimate the resulting 1P/2P/3P quantities, respectively. The associated incremental quantities are termed Proved (P1), Probable (P2) and Possible (P3). Reserves are a subset of, and must be viewed within the context of, the complete resources classification system. While the categorization criteria are proposed specifically for Reserves, in most cases, the criteria can be equally applied to Contingent and Prospective Resources. Upon satisfying the commercial maturity criteria for discovery and/or development, the project quantities will then move to the appropriate resources sub-class. Table 3 provides criteria for the Reserves categories determination.
For Contingent Resources, the general cumulative terms low/best/high estimates are denoted as 1C/2C/3C respectively. For Prospective Resources, the general cumulative terms low/best/high estimates still apply. No specific terms are defined for incremental quantities within Contingent and Prospective Resources.	2.2.2.3 For Contingent Resources, the general cumulative terms low/best/high estimates are used to estimate the resulting 1C/2C/3C quantities, respectively. The terms C1, C2, and C3 are defined for incremental quantities of Contingent Resources. 2.2.2.4 For Prospective Resources, the general cumulative terms low/best/high estimates also apply and are used to estimate the resulting 1U/2U/3U quantities. No specific terms are defined for incremental quantities within Prospective Resources.

	2.2.2.5 Quantities in different classes and sub-classes cannot be aggregated without considering the varying degrees of technical uncertainty and commercial likelihood involved with the classification(s) and without considering the degree of dependency between them (see Section 4.2.1, Aggregating Resources Classes).
Without new technical information, there should be no change in the distribution of technically recoverable volumes and their categorization boundaries when conditions are satisfied sufficiently to reclassify a project from Contingent Resources to Reserves. All evaluations require application of a consistent set of forecast conditions, including assumed future costs and prices, for both classification of projects and categorization of estimated quantities recovered by each project (see Commercial Evaluations, section 3.1).	2.2.2.6 Without new technical information, there should be no change in the distribution of technically recoverable resources and the categorization boundaries when conditions are satisfied to reclassify a project from Contingent Resources to Reserves. 2.2.2.7 All evaluations require application of a consistent set of forecast conditions, including assumed future costs and prices, for both classification of projects and categorization of estimated quantities recovered by each project (see Section 3.1, Assessment of Commerciality).
Table III presents category definitions and 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 also provides the probability criteria if probabilistic methods are applied.	2.2.2.8 Tables 1, 2, and 3 present category definitions and provide guidelines designed to promote consistency in resources assessments. The following summarize the definitions for each Reserves category in terms of both the deterministic incremental method and the deterministic scenario method, and also provides the criteria if probabilistic methods are applied. For all methods (incremental, scenario, or probabilistic), low, best and high estimate technical forecasts are prepared at an effective date (unless justified otherwise), then tested to validate the commercial criteria, and truncated as applicable for determination of Reserves quantities.
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.	A. Proved Reserves are those quantities of Petroleum that, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable from known reservoirs and under defined technical and commercial conditions. 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	B. 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.	C. Possible Reserves are those additional Reserves that 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. 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. Possible Reserves that are located outside of the 2P area (not upside quantities to the 2P scenario) may exist only when the commercial and technical maturity criteria have been met (that incorporate the Possible development scope). Standalone Possible Reserves must reference a commercial 2P project (e.g., a lease adjacent to the commercial project that may be owned by a separate entity), otherwise stand-alone Possible is not permitted.
Based on additional data and updated interpretations that indicate increased certainty, portions of Possible and Probable Reserves may be re-categorized as Probable and Proved Reserves.	
	2.2.2.9 One, but not the sole, criterion for qualifying discovered resources and to categorize the project's range of its low/best/high or P90/P50/P10 estimates to either 1C/2C/3C or 1P/2P/3P is the distance away from known productive area(s) defined by the geoscience confidence in the subsurface.

Uncertainty in resource estimates is best communicated by reporting a range of potential results. However, if it is required to report a single representative result, the "best estimate" is considered the most realistic assessment of recoverable quantities. It is generally considered to represent the sum of Proved and Probable estimates (2P) when using the deterministic scenario or the probabilistic assessment methods. It should be noted that under the deterministic incremental (risk-based) approach, discrete estimates are made for each category, and they should not be aggregated without due consideration of their associated risk (see "2001 Supplemental Guidelines," Chapter 2.5).	2.2.2.10 A conservative (low-case) estimate may be required to support financing. However, for project justification, it is generally the best-estimate Reserves or Resources quantity that passes qualification because it is considered the most realistic assessment of a project's recoverable quantities. The best estimate is generally considered to represent the sum of Proved and Probable estimates (2P) for Reserves, or 2C when Contingent Resources are cited, when aggregating a field, multiple fields, or an entity's resources.
	2.2.2.11 It should be noted that under the deterministic incremental method, discrete estimates are made for each category and should not be aggregated without due consideration of associated confidence. Results from the deterministic scenario, deterministic incremental, geostatistical and probabilistic methods applied to the same project should give comparable results (see Section 4.2, Resources Assessment Methods). If material differences exist between the results of different methods, the evaluator should be prepared to explain these differences.
2.3 Incremental Projects The initial resource assessment is based on application of a defined initial development project. Incremental projects are designed to increase recovery efficiency and/or to accelerate production through making changes to wells or facilities, infill drilling, or improved recovery. Such projects should be classified according to the same criteria as initial projects. Related incremental quantities are similarly categorized on certainty of recovery. The projected increased recovery can be included in estimated Reserves if the degree of commitment is such that the project will be developed and placed on production within a reasonable timeframe.	**2.3 Incremental Projects** 2.3.0.1 The initial resources assessment is based on application of a defined initial development project, even extending into Prospective Resources. Incremental projects are designed to either increase recovery efficiency, reduce costs, or accelerate production through either maintenance of or changes to wells, completions, or facilities or through infill drilling or by means of improved recovery. Such projects are classified according to the resources classification framework (Figure 1.1), with preference for applying project maturity sub-classes (Figure 2.1). Related incremental quantities are similarly categorized on the range of uncertainty of recovery. The projected recovery change can be included in Reserves if the degree of commitment is such that the project has achieved commercial maturity (See Section 2.1.2, Determination of Commerciality). The quantity of such incremental recovery must be supported by technical evidence to justify the relative confidence in the resources category assigned.
	2.3.0.2 An incremental project must have a defined development plan. A development plan may include projects targeting the entire field (or even multiple, linked fields), reservoirs, or single wells. Each incremental project will have its own planned timing for execution and resource quantities attributed to the project. Development plans may also include appraisal projects that will lead to subsequent project decisions based on appraisal outcomes.
Circumstances where development will be significantly delayed should be clearly documented. If there is significant project risk, forecast incremental recoveries may be similarly categorized but should be classified as Contingent Resources (see Determination of Commerciality, section 2.1.2).	2.3.0.3 Circumstances when development will be significantly delayed and where it is considered that Reserves are still justified should be clearly documented. If there is no longer the reasonable expectation of project execution (i.e., historical track record of execution, project progress), forecast project incremental recoveries are to be reclassified as Contingent Resources (see Section 2.1.2, Determination of Commerciality).
2.3.1 Workovers, Treatments, and Changes of Equipment Incremental recovery associated with future workover, treatment (including hydraulic fracturing), re-treatment, changes of equipment, or other mechanical procedures where such projects have routinely been successful in analogous reservoirs may be classified as Developed or Undeveloped Reserves depending on the magnitude of associated costs required (see Reserves Status, section 2.1.3.2).	**2.3.1 Workovers, Treatments, and Changes of Equipment** 2.3.1.1 Incremental recovery associated with a future workover, treatment (including hydraulic fracturing stimulation), re-treatment, changes to existing equipment, or other mechanical procedures where such projects have routinely been successful in analogous reservoirs may be classified as Developed Reserves, Undeveloped Reserves, or Contingent Resources, depending on the associated costs required (see Section 2.1.3.2, Reserves Status) and the status of the project's commercial maturity elements.
	2.3.1.2 Facilities that are either beyond their operational life, placed out of service, or removed from service cannot be associated with Reserves recognition. When required facilities become unavailable or out of service for longer than a year, it may be necessary to reclassify the Developed Reserves to either Undeveloped Reserves or Contingent Resources. A project that includes facility replacement or restoration of operational usefulness must be identified, commensurate with the resources classification.

2.3.2 Compression Reduction in the backpressure through compression can increase the portion of in-place gas that can be commercially produced and thus included in Reserves estimates. If the eventual installation of compression was planned and approved as part of the original development plan, incremental recovery is included in Undeveloped Reserves. However, if the cost to implement compression is not significant (relative to the cost of a new well), the incremental quantities may be classified as Developed Reserves. If compression facilities were not part of the original approved development plan and such costs are significant, it should be treated as a separate project subject to normal project maturity criteria.	**2.3.2 Compression** 2.3.2.1 Reduction in the backpressure through compression can increase the portion of in-place gas that can be commercially produced and thus included in resources estimates. If the eventual installation of compression meets commercial maturity requirements, the incremental recovery is included in either Undeveloped Reserves or Developed Reserves, depending on the investment on meeting the Developed or Undeveloped classification criteria. However, if the cost to implement compression is not significant, relative to the cost of one new well in the field, or there is reasonable expectation that compression will be implemented by a third party in a common sales line beyond the reference point, the incremental quantities may be classified as Developed Reserves. If compression facilities were not part of the original approved development plan and such costs are significant, it should be treated as a separate project subject to normal project maturity criteria.
2.3.3 Infill Drilling Technical and commercial analyses may support drilling additional producing wells to reduce the spacing beyond that utilized within the initial development plan, subject to government regulations (if such approvals are required). Infill drilling may have the combined effect of increasing recovery efficiency and accelerating production. Only the incremental recovery can be considered as additional Reserves; this additional recovery may need to be reallocated to individual wells with different interest ownerships.	**2.3.3 Infill Drilling** 2.3.3.1 Technical and commercial analyses may support drilling additional producing wells to reduce the well spacing of the initial development plan, subject to government regulations. Infill drilling may have the combined effect of increasing recovery and accelerating production. Only the incremental recovery (i.e. recovery from infill wells less the recovery difference in earlier wells) can be considered as additional Reserves for the project; this incremental recovery may need to be reallocated.
2.3.4 Improved Recovery Improved recovery is the additional petroleum obtained, beyond primary recovery, from naturally occurring reservoirs by supplementing the natural reservoir performance. It includes waterflooding, secondary or tertiary recovery processes, and any other means of supplementing natural reservoir recovery processes.	**2.3.4 Improved Recovery** 2.3.4.1 Improved recovery is the additional petroleum obtained, beyond primary recovery, from naturally occurring reservoirs by supplementing the natural reservoir energy. It includes secondary recovery (e.g., waterflooding and pressure maintenance), tertiary recovery processes (thermal, miscible gas injection, chemical injection, and other types), and any other means of supplementing natural reservoir recovery processes.
Improved recovery projects must meet the same Reserves commerciality criteria as primary recovery projects. There should be an expectation that the project will be economic and that the entity has committed to implement the project in a reasonable time frame (generally within 5 years; further delays should be clearly justified).	2.3.4.2 Improved recovery projects must meet the same Reserves technical and commercial maturity criteria as primary recovery projects.
The judgment on commerciality is based on pilot testing within the subject reservoir or by comparison to a reservoir with analogous rock and fluid properties and where a similar established improved recovery project has been successfully applied.	2.3.4.3 The judgment on commerciality is based on pilot project results within the subject reservoir or by comparison to a reservoir with analogous rock and fluid properties and where a similar established improved recovery project has been successfully applied.
Incremental recoveries through improved recovery methods that have yet to be established through routine, commercially successful applications are included as Reserves only after a favorable production response from the subject reservoir from either (a) a representative pilot or (b) an installed program, where the response provides support for the analysis on which the project is based.	2.3.4.4 Incremental recoveries through improved recovery methods that have yet to be established through routine, commercially successful applications are included as Reserves only after a favorable production response from the subject reservoir from either (a) a representative pilot or (b) an installed portion of the project, where the response provides support for the analysis on which the project is based. The improved recovery project's resources will remain classified as Contingent Resources Development Pending until the pilot has demonstrated both technical and commercial feasibility and the full project passes the Justified for Development "decision gate."
These incremental recoveries in commercial projects are categorized into Proved, Probable, and Possible Reserves based on certainty derived from engineering analysis and analogous applications in similar reservoirs.	
2.4 Unconventional Resources Two types of petroleum resources have been defined that may require different approaches for their evaluations:	**2.4 Unconventional Resources** 2.4.0.1 The types of in-place petroleum resources defined as conventional and unconventional may require different evaluation approaches and/or extraction methods. However, the PRMS resources definitions, together with the classification system, apply to all types of petroleum accumulations regardless of the in-place characteristics, extraction method applied, or degree of processing required.
• Conventional resources exist in discrete petroleum accumulations related to a localized geological structural feature and/or stratigraphic condition, typically with each accumulation bounded by a downdip contact with an aquifer, and which is significantly affected by hydrodynamic influences such as buoyancy of petroleum in water. The petroleum is recovered through wellbores and typically requires minimal processing prior to sale.	A. Conventional resources exist in porous and permeable rock with pressure equilibrium. The PIIP is trapped in discrete accumulations related to a local geological structure feature and/or stratigraphic condition. Each conventional accumulation is typically bounded by a down dip contact with an aquifer, as its position is controlled by hydrodynamic interactions between buoyancy of petroleum in water versus capillary force. The petroleum is recovered through wellbores and typically requires minimal processing before sale.

•Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and that are not significantly affected by hydrodynamic influences (also called “continuous-type deposits”). Examples include coalbed methane (CBM), basin-centered gas, shale gas, gas hydrates, natural bitumen, and oil shale deposits. Typically, such accumulations require specialized extraction technology (e.g., dewatering of CBM, massive fracturing programs for shale gas, steam and/or solvents to mobilize bitumen for in-situ recovery, and, in some cases, mining activities). Moreover, the extracted petroleum may require significant processing prior to sale (e.g., bitumen upgraders).	B. Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and are not significantly affected by hydrodynamic influences (also called “continuous-type deposit”). Usually there is not an obvious structural or stratigraphic trap. Examples include coalbed methane (CBM), basin-centered gas (low permeability), tight gas and tight oil (low permeability), gas hydrates, natural bitumen (very high viscosity oil), and oil shale (kerogen) deposits. Note that shale gas and shale oil are sub-types of tight gas and tight oil where the lithologies are predominantly shales or siltstones. These accumulations lack the porosity and permeability of conventional reservoirs required to flow without stimulation at economic rates. Typically, such accumulations require specialized extraction technology (e.g., dewatering of CBM, hydraulic fracturing stimulation for tight gas and tight oil, steam and/or solvents to mobilize natural bitumen for in-situ recovery, and in some cases, surface mining of oil sands). Moreover, the extracted petroleum may require significant processing before sale (e.g., bitumen upgraders).
For these petroleum accumulations that are not significantly affected by hydrodynamic influences, reliance on continuous water contacts and pressure gradient analysis to interpret the extent of recoverable petroleum may not be possible. Thus, there typically is a need for increased sampling density to define uncertainty of in-place volumes, variations in quality of reservoir and hydrocarbons, and their detailed spatial distribution to support detailed design of specialized mining or in-situ extraction programs.	2.4.0.2 For unconventional petroleum accumulations, reliance on continuous water contacts and pressure gradient analysis to interpret the extent of recoverable petroleum is not possible. Thus, there is typically a need for increased spatial sampling density to define uncertainty of in-place quantities, variations in reservoir and hydrocarbon quality, and to support design of specialized mining or in-situ extraction programs. In addition, unconventional resources typically require different evaluation techniques than conventional resources.
	2.4.0.3 Extrapolation of reservoir presence or productivity beyond a control point within a resources accumulation must not be assumed unless there is technical evidence to support it. Therefore, extrapolation beyond the immediate vicinity of a control point should be limited unless there is clear engineering and/or geoscience evidence to show otherwise.
	2.4.0.4 The extent of the discovery within a pervasive accumulation is based on the evaluator’s reasonable confidence based on distances from existing experience, otherwise quantities remain as undiscovered. Where log and core data and nearby producing analogs provide evidence of potential economic viability, a successful well test may not be required to assign Contingent Resources. Pilot projects may be needed to define Reserves, which requires further evaluation of technical and commercial viability.
	2.4.0.5 A fundamental characteristic of engagement in a repetitive task is that it may improve performance over time. Attempts to quantify this improvement gave rise to the concept of the manufacturing progress function commonly called the “learning curve.” The learning curve is characterized by a decrease in time and/or costs, usually in the early stages of a project when processes are being optimized. At that time, each new improvement may be significant. As the project matures, further improvements in time or cost savings are typically less substantial. In oil and gas developments with high well counts and a continuous program of activity (multi-year), the use of a learning curve within a resources evaluation may be justified to predict improvements in either the time taken to carry out the activity, the cost to do so, or both. While each development project is unique, review of analogs can provide guidance on such predictions and the range of associated uncertainty in the resulting recoverable resources estimates (see also Section 3.1.2 Economic Criteria).
It is intended that the resources definitions, together with the classification system, will be appropriate for all types of petroleum accumulations regardless of their in-place characteristics, extraction method applied, or degree of processing required.	
Similar to improved recovery projects applied to conventional reservoirs, successful pilots or operating projects in the subject reservoir or successful projects in analogous reservoirs may be required to establish a distribution of recovery efficiencies for non-conventional accumulations. Such pilot projects may evaluate both extraction efficiency and the efficiency of unconventional processing facilities to derive sales products prior to custody transfer.	

3.0 Evaluation and Reporting Guidelines The following guidelines are provided to promote consistency in project evaluations and reporting. “Reporting” refers to the presentation of evaluation results within the business entity conducting the evaluation and should not be construed as replacing guidelines for subsequent public disclosures under guidelines established by regulatory and/or other government agencies, or any current or future associated accounting standards.	**3.0 Evaluation and Reporting Guidelines** 3.0.0.1 The following guidelines are provided to promote consistency in project evaluations and reporting. “Reporting” in this document refers to the presentation of evaluation results within the entity conducting the evaluation and should not be construed as replacing requirements for public disclosures established by regulatory and/or other government agencies or any current or future associated accounting standards.
	3.0.0.2 Reserves and resources evaluations are based on a set of defined conditions that are used to classify and categorize a project’s expected recoverable quantities. The defined conditions include the factors that impact commerciality, such as decision hurdle rates; commodity prices; operating and capital costs; technical subsurface parameters; marketing, sales route(s); environmental, governmental, legal, and social factors; and timing issues. These factors are forecast for the project over time, and evaluators must clearly identify and document the assumptions used in the evaluation because these assumptions can directly impact the project quantities eligible for classification as Reserves or Resources. A project with Contingent Resources may not yet have all defined conditions addressed, and reasonable assumptions should be made and documented.
	3.0.0.3 Hydrocarbon evaluations recognize production and transportation practices that involve methods of extraction other than through the flow of fluids from wells to surface facilities, such as surface mining of bitumen or in-situ conversion processes.
3.1 Commercial Evaluations Investment decisions are based on the entity’s view of future commercial conditions that may impact the development feasibility (commitment to develop) and production/cash flow schedule of oil and gas projects. Commercial conditions include, but are not limited to, assumptions of financial conditions (costs, prices, fiscal terms, taxes), marketing, legal, environmental, social, and governmental factors. Project value may be assessed in several ways (e.g., historical costs, comparative market values); the guidelines herein apply only to evaluations based on cash flow analysis. Moreover, modifying factors such contractual or political risks that may additionally influence investment decisions are not addressed. (Additional detail on commercial issues can be found in the “2001 Supplemental Guidelines,” Chapter 4.)	**3.1 Assessment of Commerciality** 3.1.0.1 Commercial assessments are conducted on a project basis and are based on the entity’s view of future conditions. The forecast commercial conditions, technical feasibility, and the entity’s decision to commit to the project are several of the key elements that underpin the project’s resources classification. Commercial conditions include, but are not limited to, assumptions of an entity’s investment hurdle criteria; financial conditions (e.g., costs, prices, fiscal terms, taxes); partners’ investment decision(s); organization capabilities; and marketing, legal, environmental, social, and governmental factors. Project value may be assessed in several ways (e.g., cash flow analysis, historical costs, comparative market values, key economic parameters) (see Section 2.1.2, Determination of Commerciality). The guidelines herein apply only to assessments based on cash-flow analysis. Moreover, modifying factors that may additionally influence investment decisions, such as contractual or political risks, should be recognized so the entity may address these factors if they are not included in the project analysis.
3.1.1 Cash-Flow-Based Resources Evaluations Resources evaluations are based on estimates of future production and the associated cash flow schedules for each development project. The sum of the associated annual net cash flows yields the estimated future net revenue. When the cash flows are discounted according to a defined discount rate and time period, the summation of the discounted cash flows is termed net present value (NPV) of the project. The calculation shall reflect:	**3.1.1 Net Cash-Flow Evaluation** 3.1.1.1 Project-based resource economic evaluations are based on estimates of future production and the associated net cash-flow schedules for each project as of an effective date. These net cash flows should be discounted using a defined discount rate, and the sum of the future discounted cash flows is termed the net present value (NPV) of the project. The calculation shall be based upon an appropriately defined reference point (see Section 3.2.1, Reference Point) and should reflect the following:
• The expected quantities of production projected over identified time periods.	A. The forecast production quantities over identified time periods.
• The estimated costs associated with the project to develop, recover, and produce the quantities of production at its Reference Point (see section 3.2.1), including environmental, abandonment, and reclamation costs charged to the project, based on the evaluator’s view of the costs expected to apply in future periods.	B. The estimated costs and schedule associated with the project to develop, recover, and produce the quantities to the reference point, including abandonment, decommissioning, and restoration (ADR) costs, based on the entity’s view of the expected future costs.
• The estimated revenues from the quantities of production based on the evaluator’s view of the prices expected to apply to the respective commodities in future periods including that portion of the costs and revenues accruing to the entity.	C. The estimated revenues from the quantities of production based on the evaluator’s view of the prices expected to apply to the respective commodities in future periods, taking into account any sales contracts or price hedges specific to a property, including that portion of the costs and revenues accruing to the entity.
• Future projected production and revenue related taxes and royalties expected to be paid by the entity.	D. Future projected production- and revenue-related taxes and royalties expected to be paid by the entity.

• A project life that is limited to the period of entitlement or reasonable expectation thereof.	E. A project life that is limited to the period of economic interest or a reasonably certain estimate of the life expectancy of the project, which is typically truncated by the earliest occurrence of either technical, license, or economic limit.
• The application of an appropriate discount rate that reasonably reflects the weighted average cost of capital or the minimum acceptable rate of return applicable to the entity at the time of the evaluation.	F. The application of an appropriate discount applicable to the entity at the time of the evaluation.
While each organization may define specific investment criteria, a project is generally considered to be “economic” if its “best estimate” case has a positive net present value under the organization’s standard discount rate, or if at least has a positive undiscounted cash flow.	
3.1.2 Economic Criteria Evaluators must clearly identify the assumptions on commercial conditions utilized in the evaluation and must document the basis for these assumptions**.**	**3.1.2 Economic Criteria**
	3.1.2.1 Economic determination of a project is tested assuming a zero percent discount rate (i.e., undiscounted). A project with a positive undiscounted cumulative net cash flow is considered economic. Production from the project is economic when the revenue attributable to the entity interest from production exceeds the cost of operation. A project’s production is economically producible when the net revenue from an ongoing producing project exceeds the net expenses attributable to a certain entity’s interest. The ADR costs are excluded from the economically producibility determination. A project is commercial when it is economic and it meets the criteria discussed in Section 2.1.2.
	3.1.2.2 Economic viability is tested by applying a forecast case that evaluates cash-flow estimates based on an entity’s forecasted economic scenario conditions (including costs and product price schedules, inflation indexes, and market factors). The forecast made by the evaluator should reflect and document assumptions the entity assesses as reasonable to exist throughout the life of the project. Inflation, deflation, or market adjustments may be made to forecast costs and revenues.
The economic evaluation underlying the investment decision is based on the entity’s reasonable forecast of future conditions, including costs and prices, which will exist during the life of the project (forecast case). Such forecasts are based on projected changes to current conditions; SPE defines current conditions as the average of those existing during the previous 12 months.	3.1.2.3 Forecasts based solely on current economic conditions are estimated using an average of those conditions (including historical prices and costs) during a specified period. The default period for averaging prices and costs is one year. However, if a step change has occurred within the previous 12-month period, the use of a shorter period reflecting the step change must be justified. In developments with high well counts and a continuous program of activity, the use of a learning curve within a resources evaluation may be justified to predict improvements in either time taken to carry out the activity, the cost to do so, or both, if confirmed by operational evidence and documented by the evaluator. The confidence in the ability to deliver such savings must be considered in developing the range of uncertainty in production and NPV estimates.
	3.1.2.4 All costs, including future ADR liabilities, are included in the project economic analysis unless specifically excluded by contractual terms. ADR is not included in determining the economic producibility or for determining the point the project reaches the economic limit (see Section 3.1.3, Economic Limit). ADR costs are included for project economics but are not included in judging economic producibility or determining the economic limit (see Section 3.1.3, Economic Limit). ADR costs may also be reported for other purposes, such as for a property sale/acquisition evaluation, future field planning, accounting report of future obligations, or as appropriate to the circumstances for which the resource evaluation is conducted. The entity is responsible for providing the evaluator with documentation to ensure that funds are available to cover forecast costs and ADR liabilities in line with the contractual obligations.
	3.1.2.5 Figure 3.1 illustrates a net cash-flow profile for a simple project. The project’s cumulative net cash flow exceeds the ADR liability, thereby satisfying the economic viability required to consider a project’s quantities as Reserves. The project’s economic production (i.e., economic producibility) is truncated at the economic limit when the maximum cumulative net cash flow is achieved, before consideration of ADR.

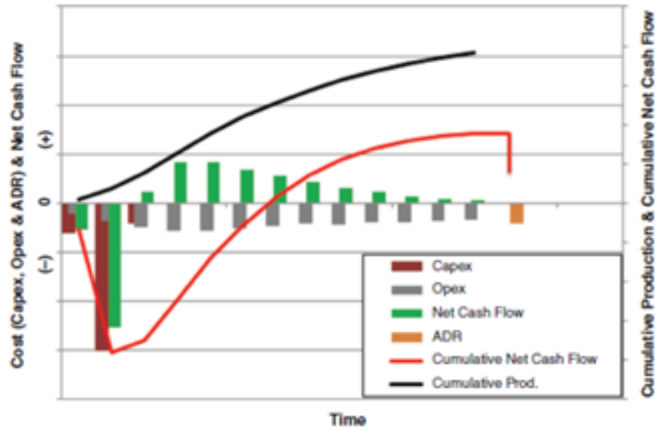


Figure 3.1—Undeveloped project economic forecast

Alternative economic scenarios are considered in the decision process and, in some cases, to supplement reporting requirements. Evaluators may examine a case in which current conditions are held constant (no inflation or deflation) throughout the project life (constant case).	3.1.2.6 Alternative economic scenarios may also be considered in the decision process and, in some cases, may supplement reporting requirements. Evaluators may examine a constant case in which current economic conditions are held constant without inflation or deflation throughout the project life.
Evaluations may be modified to accommodate criteria imposed by regulatory agencies regarding external disclosures. For example, these criteria may include a specific requirement that, if the recovery were confined to the technically Proved Reserves estimate, the constant case should still generate a positive cash flow. External reporting requirements may also specify alternative guidance on current conditions (for example, year-end costs and prices).	3.1.2.7 Evaluations may also be modified to accommodate criteria regarding external disclosures imposed by regulatory agencies. For example, these criteria may include a specific requirement that, if the recovery were confined to the Proved Reserves estimate, the constant case should still generate a positive cash flow. External reporting requirements may also specify alternative guidance on the definition of current conditions or defined criteria with which to evaluate Reserves.
There may be circumstances in which the project meets criteria to be classified as Reserves using the forecast case but does not meet the external criteria for Proved Reserves. In these specific circumstances, the entity may record 2P and 3P estimates without separately recording Proved. As costs are incurred and development proceeds, the low estimate may eventually satisfy external requirements, and Proved Reserves can then be assigned.	3.1.2.8 There may be circumstances in which the project meets criteria to be classified as Reserves using the best estimate (2P) forecast but the low case is not economic and fails to qualify for Proved Reserves. In this circumstance, the entity may record 2P and 3P estimates and no Proved Reserves. As costs are incurred in future years (i.e. become sunk costs) and development proceeds, the low estimate may eventually become economic and be reported as Proved Reserves. Some entities, according to internal policy or to satisfy regulatory reporting requirements, will defer reclassifying projects from Contingent Resources to Reserves until the low estimate case is economic.
While SPE guidelines do not require that project financing be confirmed prior to classifying projects as Reserves, this may be another external requirement. In many cases, loans are conditional upon the same criteria as above; that is, the project must be economic based on Proved Reserves only. In general, if there is not a reasonable expectation that loans or other forms of financing (e.g., farm-outs) can be arranged such that the development will be initiated within a reasonable timeframe, then the project should be classified as Contingent Resources. If financing is reasonably expected but not yet confirmed, the project may be classified as Reserves, but no Proved Reserves may be reported as above.	
3.1.3 Economic Limit Economic limit is defined as the production rate beyond which the net operating cash flows from a project, which may be an individual well, lease, or entire field, are negative, a point in time that defines the project's economic life.	**3.1.3 Economic Limit** 3.1.3.1 The economic limit is defined as the production rate at the time when the maximum cumulative net cash flow occurs for a project. The entity's entitlement production share, and thus net entitlement resources, includes those produced quantities up to the earliest truncation occurrence of either technical, license, or economic limit.

Operating costs should be based on the same type of projections as used in price forecasting. Operating costs should include only those costs that are incremental to the project for which the economic limit is being calculated (i.e., only those cash costs that will actually be eliminated if project production ceases should be considered in the calculation of economic limit). Operating costs should include fixed property-specific overhead charges if these are actual incremental costs attributable to the project and any production and property taxes but, for purposes of calculating economic limit, should exclude depreciation, abandonment and reclamation costs, and income tax, as well as any overhead above that required to operate the subject property itself. Operating costs may be reduced, and thus project life extended, by various cost-reduction and revenue-enhancement approaches, such as sharing of production facilities, pooling maintenance contracts, or marketing of associated non-hydrocarbons (see Associated Non-Hydrocarbon Components, section 3.2.4).	3.1.3.2 In this evaluation, operating costs should include only those costs that are incremental to the project for which the economic limit is being calculated (i.e., only those cash costs that will actually be eliminated if project production ceases). Operating costs should include fixed property-specific overhead charges if these are actual incremental costs attributable to the project and any production and property taxes, but for purposes of calculating the economic limit, should exclude depreciation, ADR costs, and income tax as well as any overhead that is not required to operate the subject property. Operating costs may be reduced, and thus project life extended, by various cost-reduction and revenue-enhancement approaches, such as sharing of production facilities, pooling maintenance contracts, or marketing of associated nonhydrocarbons (see Section 3.2.4, Associated Non-Hydrocarbon Components).
	3.1.3.3 For a given project, no future development costs can exist beyond the economic limit date. ADR costs are not included in the economic limit calculations, even though they may be reported for other purposes.
Interim negative project net cash flows may be accommodated in short periods of low product prices or major operational problems, provided that the longer-term forecasts must still indicate positive economics.	3.1.3.4 Interim negative project net cash flows may be accommodated in periods of development capital spending, low product prices, or major operational problems provided that the longer-term cumulative net cash flow forecast determined from the effective date becomes positive. These periods of negative cash flow will qualify as Reserves if the following positive periods more than offset the negative.
	3.1.3.5 In some situations, entities may choose to initiate production below or continue production past the economic limit. Production must be economic to be considered as Reserves, and the intent to or act of producing sub-economic resources does not confer Reserves status to those quantities. In these instances, the production represents a movement from Contingent Resources to Production. However, once produced such quantities can be shown in the reconciliation process for production and revenue accounting as a positive technical revision to Reserves. No future sub-economic production can be Reserves.
3.2 Production Measurement In general, the marketable product, as measured according to delivery specifications at a defined Reference Point, provides the basis for production quantities and resources estimates. The following operational issues should be considered in defining and measuring production. While referenced specifically to Reserves, the same logic would be applied to projects forecast to develop Contingent and Prospective Resources conditional on discovery and development. (Additional detail on operational issues that impact resources estimation can be found in the "2001 Supplemental Guidelines," Chapter 3.)	**3.2 Production Measurement** 3.2.0.1 In general, all petroleum production from the well or mine is measured to allow for the evaluation of the extracted quantities' recovery efficiency in relation to the PIIP. The marketable product, as measured according to delivery specifications at a defined reference point, provides the basis for sales production quantities. Other quantities that are not sales may not be as rigorously measured at the reference point (s) but are as important to take into account. 3.2.0.2 The operational issues in this section should be considered in defining and measuring production. While referenced specifically to Reserves, the same logic would be applied to projects forecast to develop Contingent and Prospective Resources conditional on discovery and development.
3.2.1 Reference Point Reference Point is a defined location(s) in the production chain where the produced quantities are measured or assessed. The Reference Point is typically the point of sale to third parties or where custody is transferred to the entity's downstream operations. Sales production and estimated Reserves are normally measured and reported in terms of quantities crossing this point over the period of interest.	**3.2.1 Reference Point** 3.2.1.1 Reference point is a defined location within a petroleum extraction and processing operation where the produced quantities are measured or assessed. A reference point is typically the point of sale to third parties or where custody is transferred to the entity's midstream or downstream operations. Sales production and estimated Reserves are normally measured and reported in terms of quantities crossing this point over the period of interest.
The Reference Point may be defined by relevant accounting regulations in order to ensure that the Reference Point is the same for both the measurement of reported sales quantities and for the accounting treatment of sales revenues. This ensures that sales quantities are stated according to their delivery specifications at a defined price. In integrated projects, the appropriate price at the Reference Point may need to be determined using a netback calculation.	3.2.1.2 The reference point may be defined by relevant accounting regulations to ensure that the reference point is the same for both the measurement of reported sales quantities and for the accounting treatment of sales revenues. This ensures that sales quantities are stated according to the delivery specifications at a defined price. In integrated projects, the appropriate price at the reference point may need to be determined using a netback calculation.

Sales quantities are equal to raw production less non-sales quantities, being those quantities produced at the wellhead but not available for sales at the Reference Point. Non-sales quantities include petroleum consumed as fuel, flared, or lost in processing, plus non-hydrocarbons that must be removed prior to sale; each of these may be allocated using separate Reference Points but when combined with sales, should sum to raw production. Sales quantities may need to be adjusted to exclude components added in processing but not derived from raw production. Raw production measurements are necessary and form the basis of engineering calculations (e.g., production performance analysis) based on total reservoir voidage.	3.2.1.3 Sales quantities are equal to raw production less non-sales quantities (those quantities produced at the wellhead but not available for sales at the reference point). Non-sales quantities include petroleum consumed as lease fuel, flared, or lost in processing, plus non-hydrocarbons that must be removed before sale (including water). Each of these may be allocated using separate reference points but, when combined with sales, should sum to raw production. Sales quantities may need to be adjusted to exclude components added in processing but not derived from raw production. Raw production measurements are necessary and form the basis of many engineering calculations (e.g., material balance and production performance analysis) based on total reservoir voidage. Substances added to the production stream for various reasons, such as diluents added to enhance flow properties, are not to be counted as Production, sales quantities, Reserves, or Resources.
3.2.2 Lease Fuel Lease fuel is that portion of produced natural gas, crude oil, or condensate consumed as fuel in production and lease plant operations.	**3.2.2 Consumed in Operations (CiO)** 3.2.2.1 CiO (also termed lease fuel) is that portion of produced petroleum consumed as fuel in production or plant operations before the reference point.
For consistency, lease fuel should be treated as shrinkage and is not included in sales quantities or resource estimates. However, some regulatory guidelines may allow lease fuel to be included in Reserves estimates where it replaces alternative sources of fuel and/or power that would be purchased in their absence. Where claimed as Reserves, such fuel quantities should be reported separately from sales, and their value must be included as an operating expense. Flared gas and oil and other losses are always treated as shrinkage and are not included in either product sales or Reserves.	3.2.2.2 Although Reserves are recommended to be sales quantities (see Section 1.1), the CiO quantities may be included as Reserves or Resources; when included these quantities must be stated and recorded separately from the sales portion. Entitlement rights for the fuel usage must be in place to recognize CiO as Reserves. Flared gas and oil and other petroleum losses must not be included in either product sales or Reserves but once produced are included in produced quantities to account for total reservoir voidage.
	3.2.2.3 The CiO quantities must not be included in the project economics because there is neither a cost incurred for purchase nor a revenue stream to recognize a sales quantity. The CiO fuel replaces the requirement to purchase fuel from external parties and results in lower operating costs. All actual costs for facilities-related equipment, the costs of the operations , and any purchased fuel must be included as an operating expense in the project economics.
3.2.3 Wet or Dry Natural Gas The Reserves for wet or dry natural gas should be considered in the context of the specifications of the gas at the agreed Reference Point. Thus, for gas that is sold as wet gas, the volume of the wet gas would be reported, and there would be no associated or extracted hydrocarbon liquids reported separately. It would be expected that the corresponding enhanced value of the wet gas would be reflected in the sales price achieved for such gas.	**3.2.3 Wet or Dry Natural Gas** 3.2.3.1 The Reserves for wet or dry natural gas should be considered in the context of the specifications of the gas at the agreed reference point. Thus, for gas that is sold as wet gas, the quantity of the wet gas would be reported, and there would be no reporting of any associated hydrocarbon liquids extracted downstream of the reference point. It would be expected that the corresponding enhanced value of the wet gas would be reflected in the sales price achieved for such gas.
When liquids are extracted from the gas prior to sale and the gas is sold in dry condition, then the dry gas volume and the extracted liquid volumes, whether condensate and/or natural gas liquids, should be accounted for separately in resource assessments. Any hydrocarbon liquids separated from the wet gas subsequent to the agreed Reference Point would not be reported as Reserves.	3.2.3.2 When liquids are extracted from the gas before sale and the gas is sold in dry condition, then the dry gas quantity and the extracted liquid quantities, whether condensate and/or natural gas liquids (NGLs), must be accounted for separately in resources assessments at the agreed reference point(s).
3.2.4 Associated Non-Hydrocarbon Components In the event that non-hydrocarbon components are associated with production, the reported quantities should reflect the agreed specifications of the petroleum product at the Reference Point. Correspondingly, the accounts will reflect the value of the petroleum product at the Reference Point. If it is required to remove all or a portion of non-hydrocarbons prior to delivery, the Reserves and production should reflect only the residual hydrocarbon product.	**3.2.4 Associated Non-Hydrocarbon Components** 3.2.4.1 In the event that non-hydrocarbon components are associated with production, the reported quantities should reflect the agreed specifications of the petroleum product at the reference point. Correspondingly, the accounts will reflect the value of the petroleum product at the reference point. If it is required to remove all or a portion of non-hydrocarbons before delivery, the Reserves and Production should reflect only the marketable product recognized at the reference point.
Even if the associated non-hydrocarbon component (e.g., helium, sulfur) that is removed prior to the Reference Point is subsequently and separately marketed, these quantities are not included in petroleum production or Reserves. The revenue generated by the sale of non-hydrocarbon products may be included in the economic evaluation of a project.	3.2.4.2 Even if an associated non-hydrocarbon component, such as helium or sulfur, removed before the reference point is subsequently separately marketed, these quantities are included in the voidage extraction quantities (e.g., raw production) from the reservoir but are not included in Reserves. The revenue generated by the sale of non-hydrocarbon products may be included in the project's economic evaluation.

3.2.5 Natural Gas Re-Injection Natural gas production can be re-injected into a reservoir for a number of reasons and under a variety of conditions. It can be re-injected into the same reservoir or into other reservoirs located on the same property for recycling, pressure maintenance, miscible injection, or other enhanced oil recovery processes. In such cases, assuming that the gas will eventually be produced and sold, the gas volume estimated as eventually recoverable can be included as Reserves.	**3.2.5 Natural Gas Re-Injection** 3.2.5.1 Natural gas production can be re-injected into a reservoir for a number of reasons and under a variety of conditions. Gas can be re-injected into the same reservoir or into other reservoirs located on the same property for recycling, pressure maintenance, miscible injection, or other enhanced oil recovery processes. In cases where the gas has no transfer of ownership and with a development plan that is technically and commercially mature, the gas quantity estimated to be eventually recoverable can be included as Reserves.
If gas volumes are to be included as Reserves, they must meet the normal criteria laid down in the definitions including the existence of a viable development, transportation, and sales marketing plan. Gas volumes should be reduced for losses associated with the re-injection and subsequent recovery process. Gas volumes injected into a reservoir for gas disposal with no committed plan for recovery are not classified as Reserves. Gas volumes purchased for injection and later recovered are not classified as Reserves.	3.2.5.2 If injected gas quantities are included as Reserves, these quantities must meet the criteria in the definitions, including the existence of a viable development, transportation, and sales marketing plan. Gas quantities should be reduced for losses associated with the re-injection and subsequent recovery process. Gas quantities injected into a reservoir for gas disposal with no committed plan for recovery are not classified as Reserves. Gas quantities purchased for injection and later recovered are not classified as Reserves.
3.2.6 Underground Natural Gas Storage Natural gas injected into a gas storage reservoir to be recovered at a later period (e.g., to meet peak market demand periods) should not be included as Reserves.	**3.2.6 Underground Natural Gas Storage** 3.2.6.1 Natural gas injected into a gas storage reservoir, which will be recovered later (e.g., to meet peak market demand periods) should not be included as Reserves.
The gas placed in the storage reservoir may be purchased or may originate from prior production. It is important to distinguish injected gas from any remaining native recoverable volumes in the reservoir. On commencing gas production, its allocation between native gas and injected gas may be subject to local regulatory and accounting rulings. Native gas production would be drawn against the original field Reserves. The uncertainty with respect to original field volumes remains with the native reservoir gas and not the injected gas.	3.2.6.2 The gas placed in the storage reservoir may be purchased or may originate from prior native production. It is important to distinguish injected gas from any remaining native recoverable quantities in the reservoir. On commencing gas production, allocation between native gas and injected gas may be subject to local regulatory and accounting rulings. Native gas production would be drawn against the original field Reserves. The uncertainty with respect to original field quantities remains with the native reservoir gas and not the injected gas.
There may be occasions, such as gas acquired through a production payment, in which gas is transferred from one lease or field to another without a sale or custody transfer occurring. In such cases, the re-injected gas could be included with the native reservoir gas as Reserves.	3.2.6.3 There may be occasions in which gas is transferred from one lease or field to another without a sale or custody transfer occurring. In such cases, the re-injected gas could be included with the native reservoir gas as Reserves.
The same principles regarding separation of native resources from injected quantities would apply to underground oil storage.	3.2.6.4 The same principles regarding separation of native resources from injected quantities would apply to underground liquid storage.
	3.2.7 Mineable Oil Sand 3.2.7.1 Mineable oil sands that meet the criteria listed in Section 2.1.2 can be considered as a potentially economic material and therefore Reserves. Mining operations may result in mined materials being stockpiled rather than processed. Stockpiled mined oil sands should be included in Reserves only when the project to recover and blend the stockpile has achieved technical and commercial maturity. The project's quantities are not included in Production until measured at the reference point.
3.2.7 Production Balancing Reserves estimates must be adjusted for production withdrawals. This may be a complex accounting process when the allocation of production among project participants is not aligned with their entitlement to Reserves. Production overlift or underlift can occur in oil production records because of the necessity for participants to lift their production in parcel sizes or cargo volumes to suit available shipping schedules as agreed among the parties. Similarly, an imbalance in gas deliveries can result from the participants having different operating or marketing arrangements that prevent gas volumes sold from being equal to entitlement share within a given time period.	**3.2.8 Production Balancing** 3.2.8.1 Reserves estimates must be adjusted for production withdrawals. This may be a complex accounting process when the allocation of Production among project participants is not aligned with their entitlement to Reserves. Production overlift or underlift can occur in oil production records because participants may need to lift their production in parcel sizes or cargo quantities to suit available shipping schedules agreed upon by the parties. Similarly, an imbalance in gas deliveries can result from the participants having different operating or marketing arrangements that prevent gas quantities sold from being equal to the entitlement share within a given time period.
Based on production matching the internal accounts, annual production should generally be equal to the liftings actually made by the participant and not on the production entitlement for the year. However, actual production and entitlements must be reconciled in Reserves assessments. Resulting imbalances must be monitored over time and eventually resolved before project abandonment.	3.2.8.2 Based on production matching the internal accounts, annual production should generally be equal to the liftings actually made by the entity and not on the production entitlement for the year. However, actual production and entitlements must be reconciled in Reserves assessments. Resulting imbalances must be monitored over time and eventually resolved before project abandonment.

	3.2.9 Equivalent Hydrocarbon Conversion 3.2.9.1 The industry sometimes simplifies communication of Reserves, Resources, and Production quantities with the term "barrel of oil equivalent" (BOE). The term allows for consolidation of multiple product types into a single equivalent product. In instances where natural gas is the predominate product, liquids may be converted to gas equivalence (i.e. one thousand cubic feet (MCF) volume = 1 McfGE (MCF gas equivalent)).
	3.2.9.2 Oil, condensate, bitumen and synthetic crude oil can be summed together without conversion (i.e., 1 bbl volume = 1 BOE). NGLs may need to be converted, depending on the actual composition. Natural gas must be converted to report on a BOE basis.
	3.2.9.3 The presentation of Reserve or Resources quantities should be made in the appropriate units for each individual product type reported (e.g. barrels, cubic meters, metric tonnes, joules, etc.). If BOE's or McfGE's are presented, they must be provided as supplementary information to the actual liquid or gas quantities with the conversion factor(s) clearly stated.
3.3 Resources Entitlement and Recognition While assessments are conducted to establish estimates of the total Petroleum Initially-in-Place and that portion recovered by defined projects, the allocation of sales quantities, costs, and revenues impacts the project economics and commerciality. This allocation is governed by the applicable contracts between the mineral owners (lessors) and contractors (lessees) and is generally referred to as "entitlement." For publicly traded companies, securities regulators may set criteria regarding the classes and categories that can be "recognized" in external disclosures.	**3.3 Resources Entitlement and Recognition** 3.3.0.1 While assessments are conducted to establish estimates of the total PIIP and that portion recovered by defined projects, the allocation of sales quantities, costs, and revenues impacts the project economics and commerciality. This allocation is governed by the applicable contracts between the mineral lease owners (lessors) and contractors (lessees) and is generally referred to as entitlement.
Entitlements must ensure that the recoverable resources claimed/reported by individual stakeholders sum to the total recoverable resources; that is, there are none missing or duplicated in the allocation process. (The "2001 Supplemental Guidelines," Chapter 9, addresses issues of Reserves recognition under production-sharing and non-traditional agreements.)	3.3.0.2 Evaluators must ensure that, to their knowledge, the recoverable resource entitlements from all participating entities sum to the total recoverable resources.
	3.3.0.3 The ability for an entity to recognize Reserves and Resources is subject to satisfying certain key elements. These include (a) having an economic interest through the mineral lease or concession agreement (i.e., right to proceeds from sales); (b) exposure to market and technical risk; and (c) the opportunity for reward through participation in exploration, appraisal, and development activities. Given the complexities of some agreements, there may be additional elements that must be considered in determining entitlement and the recognition of Reserves and Resources.
	3.3.0.4 For publicly traded companies, securities regulators may set criteria regarding the classes and categories that can be "recognized" in external disclosures. For national interests, the reporting of 100% quantities without concession agreement constraints is typically specified.
3.3.1 Royalty Royalty refers to payments that are due to the host government or mineral owner (lessor) in return for depletion of the reservoirs by the producer (lessee/contractor) having access to the petroleum resources. Many agreements allow for the lessee/contractor to lift the royalty volumes and sell them on behalf of, and pay the proceeds to, the royalty owner/lessor. Some agreements provide for the royalty to be taken only in-kind by the royalty owner. In either case, royalty volumes must be deducted from the lessee's entitlement to resources.	**3.3.1 Royalty** 3.3.1.1 Royalty refers to a type of entitlement interest in a resources project that is free and clear of the costs and expenses of development and production to the royalty interest owner as opposed to a working interest where an entity has cost exposure. A royalty is commonly retained by a resources owner (lessor/host) when granting rights to a producer (lessee/contractor) to develop and produce the resources. Depending on the specific terms defining the royalty, the payment obligation may be expressed in monetary terms as a portion of the proceeds of production in-cash or as a right to take a portion of production in-kind. The royalty terms may also provide the option to switch between forms of payment at the discretion of the royalty owner. In either case, royalty quantities must be deducted from the lessee's entitlement to resources so that only net revenue interest quantities are recognized.

In some agreements, royalties owned by the host government are actually treated as taxes to be paid in cash. In such cases, the equivalent royalty volumes are controlled by the contractor who may (subject to regulatory guidance) elect to report these volumes as Reserves and/or Contingent Resources with appropriate offsets (increase in operating expense) to recognize the financial liability of the royalty obligation.	3.3.1.2 In some agreements, production taxes imposed by the host government may be referred to as royalties. These payment obligations are expressed in monetary terms and are typically linked to production rates, quantities produced, cost recovery, the value of production (price sensitive), or the profits derived from it. These payments are not associated with an interest retained by the lessor/host. Thus, such payment obligations are effectively a production tax instead of a royalty. In such cases, the production and underlying resources are controlled by the lessee/contractor who may (subject to contractual terms and/or regulatory guidance) elect to report these obligations as a tax without a corresponding reduction in lessor/ contractor's entitlement.
Conversely, if a company owns a royalty or equivalent interest of any type in a project, the related quantities can be included in Resources entitlements.	3.3.1.3 Conversely, if an entity owns a royalty or equivalent interest of any type in a project, the related quantities can be included in resources entitlements and should not be included in entitlements of others.
3.3.2 Production-Sharing Contract Reserves Production-Sharing Contracts (PSCs) of various types replace conventional tax-royalty systems in many countries. Under the PSC terms, the producers have an entitlement to a portion of the production. This entitlement, often referred to as "net entitlement" or "net economic interest," is estimated using a formula based on the contract terms incorporating project costs (cost oil) and project profits (profit oil).	**3.3.2 Production-Sharing Contract Reserves** 3.3.2.1 Production-sharing contracts (PSCs) of various types are used in many countries instead of conventional tax-royalty systems. Under the PSC terms, producers have an entitlement to a portion of the production. This net entitlement, often referred to as entitlement, occurs when a net economic interest is held by an entity and is estimated using a formula based on the contract terms incorporating costs and profits. The terms of the PSC provide the remuneration to the host government/lessor that would be accomplished by the royalty in other agreements.
Although ownership of the production invariably remains with the government authority up to the export point of the project, the producers may take title to their share of the net entitlement at that point and may claim that share as their Reserves.	3.3.2.2 Ownership of the production is retained by the host government; however, the contractor may receive title to the prescribed share of the quantities when produced or at point of sale and may claim that share as their Reserves.
Risked-Service Contracts (RSCs) are similar to PSCs, but in this case, the producers are paid in cash rather than in production. As with PSCs, the Reserves claimed are based on the parties' net economic interest. Care needs to be taken to distinguish between an RSC and a "Pure Service Contract." Reserves can be claimed in an RSC on the basis that the producers are exposed to capital at risk, whereas no Reserves can be claimed for Pure Service Contracts because there are no market risks and the producers act as contractors.	3.3.2.3 Risk service contracts (RSCs) are similar to PSCs, but the producers may be paid in cash rather than in production. As with PSCs, the Reserves claimed are based on the entity's economic interest as risk is borne by the contractor. Care needs to be taken to distinguish between an RSC and a pure service contract. Reserves can be claimed in an RSC, whereas no Reserves can be claimed for pure service contracts because there is insufficient exposure to petroleum exploration, development, and market risks and the producers act as contractors.
Unlike traditional royalty-lease agreements, the cost recovery system in production-sharing, risk-service, and other related contracts typically reduce the production share and hence Reserves obtained by a contractor in periods of high price and increase volumes in periods of low price. While this ensures cost recovery, it introduces a significant price-related volatility in annual Reserves estimates under cases using "current" economic conditions. Under a defined "forecast conditions case," the future relationship of price to Reserves entitlement is known.	3.3.2.4 Unlike conventional tax-royalty agreements, the cost recovery system in production-sharing, riskservice, and other related contracts typically reduce the production share and hence Reserves entitlement to a contractor in periods of high price and increase quantities in periods of low price. While this ensures cost recovery, it also introduces significant price-related volatility in annual Reserves estimates under cases using a constant case. The terms governing cost recovery in a particular PSC may require special treatment of items such as taxes, overhead, and ADR to determine entitlement.
The treatment of taxes and the accounting procedures used can also have a significant impact on the Reserves recognized and production reported from these contracts.	3.3.2.5 The treatment of taxes and the accounting procedures used can also have a significant impact on the Reserves recognized and production reported from these contracts.
3.3.3 Contract Extensions or Renewals As production-sharing or other types of agreements approach maturity, they can be extended by negotiation for contract extensions, by the exercise of options to extend, or by other means.	**3.3.3 Contract Extensions or Renewals** 3.3.3.1 As production-sharing or other types of agreements approach the specified end date, extensions may be obtained through contract negotiation, by the exercise of options to extend, or by other means.
Reserves should not be claimed for those volumes that will be produced beyond the ending date of the current agreement unless there is reasonable expectation that an extension, a renewal, or a new contract will be granted. Such reasonable expectation may be based on the historical treatment of similar agreements by the license-issuing jurisdiction. Otherwise, forecast production beyond the contract term should be classified as Contingent Resources with an associated reduced chance of commercialization. Moreover, it may not be reasonable to assume that the fiscal terms in a negotiated extension will be similar to existing terms.	3.3.3.2 Reserves cannot be claimed for those quantities that will be produced beyond the expiration date of the current agreement unless there is reasonable expectation that an extension, a renewal, or a new contract will be granted. Such reasonable expectation may be based on the status of renewal negotiations and historical treatment of similar agreements by the license-issuing jurisdiction. Otherwise, forecast production beyond the contract term must be classified as Contingent Resources with an associated reduced chance of commercialization. Moreover, it may not be reasonable to assume that the fiscal terms in a negotiated extension will be similar to existing terms.

Similar logic should be applied where gas sales agreements are required to ensure adequate markets. Reserves should not be claimed for those quantities that will be produced beyond those specified in the current agreement or reasonably forecast to be included in future agreements.	3.3.3.3 Similar logic should be applied where gas sales agreements are required to ensure adequate markets. Reserves should not be claimed for quantities that will be produced beyond those specified in the current agreement or that do not have a reasonable expectation to be included in either contract renewals or future agreements.
In either of the above cases, where the risk of cessation of rights to produce or inability to secure gas contracts is not considered significant, evaluators may choose to incorporate the uncertainty by categorizing quantities to be recovered beyond the current contract as Probable or Possible Reserves.	
4.0 Estimating Recoverable Quantities Assuming that projects have been classified according to their project maturity, the estimation of associated recoverable quantities under a defined project and their assignment to uncertainty categories may be based on one or a combination of analytical procedures. Such procedures may be applied using an incremental (risk-based) and/or scenario approach; moreover, the method of assessing relative uncertainty in these estimates of recoverable quantities may employ both deterministic and probabilistic methods.	**4.0 Estimating Recoverable Quantities** 4.0.0.1 Assuming that projects have been classified according to project maturity, estimation of associated recoverable quantities under a defined project and assignment to uncertainty categories may be based on one or a combination of analytical procedures. Such procedures may be applied using an incremental and/or scenario approach; moreover, the method of assessing relative uncertainty in these estimates of recoverable quantities may employ both deterministic and probabilistic methods.
4.1 Analytical Procedures The analytical procedures for estimating recoverable quantities fall into three broad categories: (a) analogy, (b) volumetric estimates, and (c) performance-based estimates, which include material balance, production decline, and other production performance analyses. Reservoir simulation may be used in either volumetric or performance-based analyses. Pre- and early post-discovery assessments are typically made with analog field/project data and volumetric estimation. After production commences and production rates and pressure information become available, performance-based methods can be applied. Generally, the range of EUR estimates is expected to decrease as more information becomes available, but this is not always the case.	**4.1 Analytical Procedures** 4.1.0.1 The analytical procedures for estimating recoverable quantities fall into three broad categories: (a) analogy, (b) volumetric estimates, and (c) performance-based estimates (e.g., material balance, historymatched simulation, decline-curve analysis, and rate-transient analysis. Reservoir simulation may be used in either volumetric or performance-based analyses. Pre- and early post-discovery assessments typically are made with analog field/project data and volumetric estimation. After production commences and production rates and pressure information become available, performance-based methods can be applied. Generally, the range of EUR estimates is expected to decrease as more information (pressure, performance, and PIIP) becomes available, but this is not always the case.
In each procedural method, results are not a single quantity of remaining recoverable petroleum, but rather a range that reflects the underlying uncertainties in both the in-place volumes and the recovery efficiency of the applied development project. By applying consistent guidelines (see Resources Categorization, section 2.2.), evaluators can define remaining recoverable quantities using either the incremental or cumulative scenario approach. The confidence in assessment results generally increases when the estimates are supported by more than one analytical procedure.	4.1.0.2 In each procedure evaluated under either the deterministic scenario, deterministic incremental, geostatistical, or probabilistic methods, the results are not a single quantity of remaining recoverable petroleum, but rather a range that reflects the underlying uncertainties in both the in-place quantities and the recovery efficiency of the applied development project. By applying consistent guidelines (see Section 2.2, Resources Categorization), evaluators can define remaining recoverable quantities using the approaches listed above. The confidence in assessment results generally increases when the estimates are supported by more than one analytical procedure.
4.1.1 Analogs Analogs are widely used in resources estimation, particularly in the exploration and early development stages, when direct measurement information is limited. The methodology is based on the assumption that the analogous reservoir is comparable to the subject reservoir regarding reservoir and fluid properties that control ultimate recovery of petroleum. By selecting appropriate analogs, where performance data based on comparable development plans (including well type, well spacing and stimulation) are available, a similar production profile may be forecast.	**4.1.1 Analogs** 4.1.1.1 Analogs are widely used in resources estimation, particularly in the exploration and early development stages when direct measurement information is limited. The methodology is based on the assumption that the analogous reservoir is comparable to the subject reservoir in regard to reservoir description, fluid properties, and most likely recovery mechanism(s) applied to the project that control the ultimate recovery of petroleum. By selecting appropriate analogs, where performance data of comparable development plans are available, a similar production profile may be forecast. Analogs are frequently applied for aiding in the assessment of economic producibility, production decline characteristics, drainage area, and recovery factor (for primary, secondary, and tertiary methods).

Analogous reservoirs are defined by features and characteristics including, but not limited to, approximate depth, pressure, temperature, reservoir drive mechanism, original fluid content, reservoir fluid gravity, reservoir size, gross thickness, pay thickness, net-to-gross ratio, lithology, heterogeneity, porosity, permeability, and development plan. Analogous reservoirs are formed by the same, or very similar, processes with regard to sedimentation, diagenesis, pressure, temperature, chemical and mechanical history, and structural deformation.	4.1.1.2 Analogous reservoirs, as used in resources assessments, are defined by similarities of features and characteristics that include but are not limited to the following: A. Reservoir deposition and structure (e.g., lithology, depositional environment, diagenetic history, natural fractures, chemical/mineral composition, geometry, mechanical history, and structural deformation). B. Petrophysical properties (e.g., net pay and gross thickness, porosity, saturation, permeability, heterogeneity, and net-to-gross ratio). C. Reservoir conditions (e.g., depth, temperature and pressure, and size of the petroleum accumulation and aquifer). D. Fluid properties (e.g., original fluid type, composition, density, and viscosity). E. Drive mechanisms. F. Development plan (e.g., well spacing, well type and number, completion methods, artificial lift, development and operating costs, facility type and constraints, and processing).
	4.1.1.3 The above list is not exhaustive and the comparative analog characteristics must be relevant to the key characteristics of the project.
	4.1.1.4 It is not necessary for all parameters to match to consider a reservoir as an analog. The evaluator should consider the specifics of each application and its suitability in providing insight to assist in the estimation of recoverable resources.
Comparison to several analogs may improve the range of uncertainty in estimated recoverable quantities from the subject reservoir. While reservoirs in the same geographic area and of the same age typically provide better analogs, such proximity alone may not be the primary consideration. In all cases, evaluators should document the similarities and differences between the analog and the subject reservoir/project. Review of analog reservoir performance is useful in quality assurance of resource assessments at all stages of development.	4.1.1.5 Comparison to several analogs, rather than a single analog, often improves the understanding of the range of uncertainty in the estimated recoverable quantities from the subject reservoir. While reservoirs in the same geographic area and of the same geological age typically provide better analogs, such proximity alone may not be the primary consideration. In all cases, evaluators should document the similarities and differences between the analog and the subject reservoir/project. Review of analog reservoir performance is useful in quality assurance of resources assessments at all stages of development.
4.1.2 Volumetric Estimate This procedure uses reservoir rock and fluid properties to calculate hydrocarbons in-place and then estimate that portion that will be recovered by a specific development project(s).	**4.1.2 Volumetric Analysis** 4.1.2.1 This procedure uses reservoir rock and fluid properties to calculate PIIP and then estimate that portion that will be recovered by a specific development project. The volumetric estimate may be based on either probabilistic or deterministic approaches. A probabilistic approach is typically applied in the early development stages when data are most limited. As the project matures through development, the evaluation methodology often shifts towards deterministic estimates.
Key uncertainties affecting in-place volumes include: • Reservoir geometry and trap limits that impact gross rock volume. • Geological characteristics that define pore volume and permeability distribution. • Elevation of fluid contacts. • Combinations of reservoir quality, fluid types, and contacts that control fluid saturations.	4.1.2.2 The key uncertainties affecting in-place quantities include but are not limited to the following: A. Reservoir geometry, heterogeneity, compartmentalization, and trap limits that impact gross rock volume. B. Geological characteristics that define pore volume and petroleum saturation distribution. C. Position and nature of contacts or limits [e.g., lowest known hydrocarbons (LKH), oil/water contact, gas/water contact (GWC), gas/oil contact, and tilted contact gradient]. D. Combinations of reservoir quality, fluid types, and contacts that control saturation distributions (vertically and horizontally).
The gross rock volume of interest is that for the total reservoir. While spatial distribution and reservoir quality impact recovery efficiency, the calculation of in-place petroleum often uses average net-to-gross ratio, porosity, and fluid saturations. In more heterogeneous reservoirs, increased well density may be required to confidently assess and categorize resources.	4.1.2.3 The gross rock volume of interest is that for the total reservoir. While spatial distribution and reservoir quality impact recovery efficiency, the calculation of in-place petroleum often uses average netto- gross ratio, porosity, and fluid saturations. In more complex reservoirs, increased well density may be required to confidently evaluate, assess, and categorize resources.
Given estimates of the in-place petroleum, that portion that can be recovered by a defined set of wells and operating conditions must then be estimated based on analog field performance and/or simulation studies using available reservoir information. Key assumptions must be made regarding reservoir drive mechanisms.	4.1.2.4 Given estimates of the in-place petroleum, the portion that can be recovered by a defined set of wells and operating conditions must then be estimated based on analog field performance and/or modeling/ simulation studies using available reservoir information. Key assumptions must be made regarding reservoir drive mechanisms.
The estimates of recoverable quantities must reflect uncertainties not only in the petroleum in-place but also in the recovery efficiency of the development project(s) applied to the specific reservoir being studied.	4.1.2.5 The estimates of recoverable quantities must reflect the combined uncertainties in the petroleum in place and the recovery efficiency of the development project(s) applied to the reservoir.

Additionally, geostatistical methods can be used to preserve spatial distribution information and incorporate it in subsequent reservoir simulation applications. Such processes may yield improved estimates of the range of recoverable quantities. Incorporation of seismic analyses typically improves the underlying reservoir models and yields more reliable resource estimates. [Refer to the “2001 SPE Supplemental Guidelines” for more detailed discussion of geostatistics (Chapter 7) and seismic applications (Chapter 8)].	
4.1.3 Material Balance Material balance methods to estimate recoverable quantities involve the analysis of pressure behavior as reservoir fluids are withdrawn. In ideal situations, such as depletion-drive gas reservoirs in homogeneous, high-permeability reservoir rocks and where sufficient and high quality pressure data is available, estimation based on material balance may provide very reliable estimates of ultimate recovery at various abandonment pressures. In complex situations, such as those involving water influx, compartmentalization, multiphase behavior, and multilayered or low-permeability reservoirs, material balance estimates alone may provide erroneous results. Evaluators should take care to accommodate the complexity of the reservoir and its pressure response to depletion in developing uncertainty profiles for the applied recovery project.	**4.1.3 Material Balance Analysis** 4.1.3.1 Material balance methods used to estimate recoverable quantities involve the analysis of pressure behavior as reservoir fluids are withdrawn. In ideal situations, such as depletion-drive gas reservoirs in homogeneous, high-permeability reservoir rocks and where sufficient and high-quality pressure data are available, estimation based on material balance may provide very reliable estimates of ultimate recovery at various abandonment pressures. In complex situations, such as those involving water influx, compartmentalization, multiphase behavior, and multilayered or low-permeability reservoirs, shales or CBM, material balance estimates alone may provide erroneous results. Evaluators should take care to accommodate the complexity of the reservoir and its pressure response to depletion in developing uncertainty profiles for the applied recovery project.
Computer reservoir modeling or reservoir simulation can be considered a sophisticated form of material balance analysis. While such modeling can be a reliable predictor of reservoir behavior under a defined development program, the reliability of input rock properties, reservoir geometry, relative permeability functions, and fluid properties are critical. Predictive models are most reliable in estimating recoverable quantities when there is sufficient production history to validate the model through history matching.	4.1.3.2 Reservoir modeling or reservoir simulation can be considered a more rigorous form of material balance analysis. While such modeling can be a reliable predictor of reservoir behavior under a defined development program, the reliability of input rock properties, reservoir geometry, relative permeability functions, fluid properties, and constraints (e.g., wells, facilities, and export) are critical. Predictive models are most reliable in estimating recoverable quantities when there is sufficient production history to validate the model through history matching.
4.1.4 Production Performance Analysis Analysis of the change in production rates and production fluids ratios vs. time and vs. cumulative production as reservoir fluids are withdrawn provides valuable information to predict ultimate recoverable quantities. In some cases, before decline in production rates is apparent, trends in performance indicators such as gas/oil ratio (GOR), water/oil ratio (WOR), condensate/gas ratio (CGR), and bottomhole or flowing pressures can be extrapolated to an economic limit condition to estimate reserves.	**4.1.4 Production Performance Analysis** 4.1.4.1 Analysis of the change in production rate and production fluid ratios versus time and versus cumulative production as reservoir fluids are withdrawn provides useful information to predict ultimate recoverable quantities. In some cases, before production decline rates become apparent, trends in performance indicators such as gas/oil ratio, water/oil ratio, condensate/gas ratio, and bottomhole or flowing pressures can be extrapolated to economic limit conditions to estimate Reserves.
Reliable results require a sufficient period of stable operating conditions after wells in a reservoir have established drainage areas. In estimating recoverable quantities, evaluators must consider complicating factors affecting production performance behavior, such as variable reservoir and fluid properties, transient vs. stabilized flow, changes in operating conditions, interference effects, and depletion mechanisms. In early stages of depletion, there may be significant uncertainty in both the ultimate performance profile and the commercial factors that impact abandonment rate. Such uncertainties should be reflected in the resources categorization.	4.1.4.2 Reliable results require a sufficient period of stable operating conditions after wells in a reservoir have established drainage areas. In estimating recoverable quantities, evaluators must consider additional factors affecting production performance behavior, such as variable reservoir and fluid properties, transient versus stabilized flow, changes in operating conditions, interference effects, and depletion mechanisms. In early stages of depletion, there may be significant uncertainty in both the ultimate performance profile and the other factors (e.g., operational, regulatory, contractual) factors that impact abandonment rate. Such uncertainties should be reflected in the reserves categorization.
For very mature reservoirs, the future production forecast may be sufficiently well defined that the remaining uncertainty in the technical profile is not significant; in such cases, the “best estimate” 2P scenario may also be used for the 1P and 3P production forecasts. However, there may still be commercial uncertainties that will impact the abandonment rate, and these should be accommodated in the resources categorization.	4.1.4.3 For mature reservoirs, the future production forecast may be sufficiently well defined that the remaining uncertainty in the technical profile is not significant; in such cases, the best estimate 2P scenario may be justifiable to also use for the 1P and 3P production forecasts. Other uncertainties (e.g., operational, regulatory, contractual) that will impact the abandonment rate may still exist, however, and these should be accommodated in the reserves categorization uncertainty range.
	4.1.4.4 In very low-permeability reservoirs (e.g., unconventional reservoirs), care should be taken in the production performance analyses because the lengthy period of transient flow and complex production physics can make analyses very difficult.
4.2 Deterministic and Probabilistic Methods Regardless of the analytical procedure used, resource estimates may be prepared using either deterministic or probabilistic methods. A deterministic estimate is a single discrete scenario within a range of outcomes that could be derived by probabilistic analysis.	**4.2 Resources Assessment Methods** 4.2.0.1 Regardless of the analytical procedures used, the goal is to communicate the range of uncertainty in the recoverable resources. An underlying principle is that the reliability of the estimates depends on the quantity and quality of the source data.

4.2.0.2 In all methods, as confidence away from a known productive area decreases, the uncertainty in the ability to estimate recoverable quantities increases. In assessing the range of uncertainty in recovery from a project, the evaluator should consider the uncertainty in all components of a project, including that forecast from existing and future wells. Additionally, an increasing diversity in data sources, such as well logs, cores, seismic, or production history, will provide an increased confidence in the resources estimates.

4.2.0.3 Assessment methods may be broadly characterized as deterministic, geostatistical, and probabilistic and may be applied in combination for integrated uncertainty analysis.

In the deterministic method, a discrete value or array of values for each parameter is selected based on the estimator’s choice of the values that are most appropriate for the corresponding resource category. A single outcome of recoverable quantities is derived for each deterministic increment or scenario.

4.2.1 Deterministic Method

4.2.1.1 In the deterministic method, quantities are estimated by taking a discrete value or array of values for each input parameter to produce a discrete result. For the low-, best- and high-case estimates, the internally consistent deterministic inputs are selected to reflect the resultant confidence of the project scenario and the constraints applied for the resources category and resources class. A single outcome of recoverable quantities is derived for each deterministic increment or scenario. Two approaches are included in the deterministic method—the scenario (or cumulative) method and the incremental method—and should yield similar results.

4.2.1.2 In the deterministic scenario method, the evaluator provides three estimates of the quantities to be recovered from the project being applied to the accumulation. Estimates consider the full range of values for each input parameter based on available engineering and geoscience data, but one set is selected that is most appropriate for the corresponding resources confidence category. A single outcome of recoverable quantities is derived for each category. Thus, low, best and high estimates for the total project reflect uncertainty and consider confidence constraints of the categories. The low case should take into account specific choices for some variables (e.g., contact assumptions).

4.2.1.3 The deterministic incremental method is based on defining discrete parts or segments of the accumulation that reflect high, best, and low confidence regarding the estimates of recoverable quantities under the defined development plan. Typically, this approach is applied to different segments of the accumulation based on considerations of well spacing and/or geological knowledge (i.e., the different degrees of confidence are governed by distance from known data). The individual segment estimates reflect realistic combinations of parameters, and care is required to ensure that a reasonable range is used for the uncertainty in reservoir property averages (e. g., average porosity) and that interdependencies are accounted for (e.g., a high gross rock volume estimate may have a low average porosity).

4.2.1.4 While deterministic estimates may have broadly inferred confidence levels, these estimates do not have associated quantitatively defined probabilities. Nevertheless, the ranges of the probability guidelines established for the probabilistic method (see Section 2.2.1, Range of Uncertainty) influence the amount of uncertainty generally inferred in the estimate derived from the deterministic method.

4.2.2 Geostatistical Method

4.2.2.1 Geostatistical methods are a variety of mathematical techniques and processes dealing with the collection, methods, analysis, interpretation, and presentation of large quantities of geoscience and engineering data to (mathematically) describe the variability and uncertainties within any reservoir unit or pool. Geostatistical methods can be used to preserve spatial distribution information in the static reservoir model and to incorporate it in subsequent reservoir simulation applications. Such processes may yield improved estimates of the range of recoverable quantities. For example, incorporating seismic analyses typically improves the understanding of reservoir models and can contribute to more reliable resources estimates.

	4.2.2.2 Where large amounts of well production data and associated EUR estimates are available, statistical methods can be applied to yield distributions that underpin Reserves categorization. When this is done, the comparability of the wells and reservoirs in the historically developed area with the target area should be considered before accepting such data as appropriate.
In the probabilistic method, the estimator defines a distribution representing the full range of possible values for each input parameter. These distributions may be randomly sampled (typically using Monte Carlo simulation software) to compute a full range and distribution of potential outcome of results of recoverable quantities (see “2001 Supplemental Guidelines,” Chapter 5, for more detailed discussion of probabilistic reserves estimation procedures). This approach is most often applied to volumetric resource calculations in the early phases of an exploitation and development projects. The Resources Categorization guidelines include criteria that provide specific limits to parameters associated with each category. Moreover, the resource analysis must consider commercial uncertainties. Accordingly, when probabilistic methods are used, constraints on parameters may be required to ensure that results are not outside the range imposed by the category deterministic guidelines and commercial uncertainties.	**4.2.3 Probabilistic Method** 4.2.3.1 In the probabilistic method, the evaluator defines a distribution representing the full range of possible values for each input parameter. This includes dependencies between parameters that must also be defined and applied. These distributions are randomly sampled (e.g., using stochastic geological modelling or Monte Carlo simulation) to compute a full distribution of potential in-place or recoverable quantities. Because the outcome of the resources estimates is directly linked to the input parameter distributions (both type of distribution and range), it is critically important that the evidence for each of the input distributions is properly justified and fully documented.
	4.2.3.2 This approach is most often applied to volumetric resources calculations in the early phases of exploration, appraisal and development projects. The resources categorization includes confidence criteria that provide limits to parameters associated with each category. Moreover, the resources analysis must consider commercial uncertainties. Accordingly, when probabilistic methods are used, constraints on parameters may be required to ensure that results are not outside the range imposed by the deterministic guidelines and commercial uncertainties. Likewise, tests on alternative parameter distributions should be performed to fully consider the uncertainties.
	4.2.3.3 When using the probabilistic approach, the resultant P90, P50, and P10 scenarios should reconcile with the deterministically derived quantities for the low-, best-, and high-estimate cases, respectively. Among the key comparative inputs to the probabilistic results are the contacts, specifically for the LKH, and the areal extent.
Deterministic volumes are estimated for discrete increments and defined scenarios. While deterministic estimates may have broadly inferred confidence levels, they do not have associated quantitatively defined probabilities. Nevertheless, the ranges of the probability guidelines established for the probabilistic method (see Range of Uncertainty, section 2.2.1) influence the amount of uncertainty generally inferred in the estimate derived from the deterministic method.	
	4.2.4 Integrated Methods 4.2.4.1 Resources assessments typically employ different methods as appropriate at each stage of exploration, appraisal, and development and often integrate several methods to better define the uncertainty.
	4.2.4.2 An example of integration is the multi-scenario method, which is an extension of the deterministic scenario method. In this case, a significant number of discrete deterministic scenarios of the defined project (in the Reserves class) are developed by the user, with each scenario leading to a single deterministic outcome. Probabilities may be assigned to each discrete input assumption from which the probability of the scenario can be obtained; alternatively, each outcome may be assumed to be equally likely. Given sufficient scenarios (which may be supported through the use of experimental design techniques), it is possible to develop a full pseudo-probability distribution from which the three specific deterministic scenarios that lie close to P90, P50, and P10 probability levels may be selected for evaluation to confirm confidence levels of each of the categories. The low case must take into account specific choices for some variables (e.g., fluid contact assumptions). When the multi-scenario method is used in Contingent Resources, it allows for alternative scope of the project (e.g., range of well counts, development schemes).
Both deterministic and probabilistic methods may be used in combination to ensure that results of either method are reasonable.	4.2.4.3 Deterministic, geostatistical, and probabilistic methods may be used in combination to ensure that results of the methods are reasonable.

4.2.1 Aggregation Methods Oil and gas quantities are generally estimated and categorized according to certainty of recovery within individual reservoirs or portions of reservoirs; this is referred to as the "reservoir level" assessment. These estimates are summed to arrive at estimates for fields, properties, and projects. Further summation is applied to yield totals for areas, countries, and companies; these are generally referred to as "resource reporting levels." The uncertainty distribution of the individual estimates at each of these levels may differ widely, depending on the geological settings and the maturity of the resources. This cumulative summation process is generally referred to as "aggregation."	**4.2.5 Aggregation Methods** 4.2.5.1 Oil and gas quantities are generally estimated and categorized according to certainty of recovery within individual reservoirs or portions of reservoirs; this is referred to as a "reservoir level" assessment. These estimates are summed to arrive at estimates for fields, properties, and projects. Further summation is applied to yield totals for geographic areas, countries, and companies; these are generally referred to as "resources reporting levels." The uncertainty distribution of the individual estimates at each of these levels may differ widely, depending on the geological settings and the maturity of the resources. This cumulative summation process is generally referred to as aggregation.
Two general methods of aggregation may be applied: arithmetic summation of estimates by category and statistical aggregation of uncertainty distributions. There is typically significant divergence in results from applying these alternative methods. In statistical aggregation, except in the rare situation when all the reservoirs being aggregated are totally dependent, the P90 (high degree of certainty) quantities from the aggregate are always greater than the arithmetic sum of the reservoir level P90 quantities, and the P10 (low degree of certainty) of the aggregate is always less than the arithmetic sum P10 quantities assessed at the reservoir level. This "portfolio effect" is the result of the central limit theorem in statistical analysis. Note that the mean (arithmetic average) of the sums is equal to the sum of the means; that is, there is no portfolio effect in aggregating mean values.	4.2.5.2 Two general methods of aggregation may be applied: arithmetic summation of estimates by category and statistical aggregation of probability distributions. There are typically significant differences in results from these alternative methods. In statistical aggregation, except in the rare situation when all the reservoirs being aggregated are totally dependent, the P90 (high degree of certainty) quantities from the aggregate are always greater than the arithmetic sum of the reservoir level P90 quantities, and the P10 (low degree of certainty) of the aggregate is always less than the arithmetic sum of P10 quantities assessed at the reservoir level. This "portfolio effect" is the result of the central limit theorem in statistical analysis. Note that the mean (arithmetic average) of the sums is equal to the sum of the means; that is, there is no portfolio effect in aggregating mean values.
In practice, there is likely to be a large degree of dependence between reservoirs in the same field, and such dependencies must be incorporated in the probabilistic calculation. When dependency is present and not accounted for, probabilistic aggregation will overestimate the low estimate result and underestimate the high estimate result. (Aggregation of Reserves is discussed in Chapter 6 of the "2001 Supplemental Guidelines.")	4.2.5.3 In practice, there may be a large degree of dependence between reservoirs in the same field, and such dependencies must be incorporated in the probabilistic calculation. When dependency is present and not accounted for, aggregation will overestimate the low estimate and underestimate the high estimate.
The aggregation methods utilized depends on the business purpose. It is recommended that for reporting purposes, assessment results should not incorporate statistical aggregation beyond the field, property, or project level. Results reporting beyond this level should use arithmetic summation by category but should caution that the aggregate Proved may be a very conservative estimate and aggregate 3P may be very optimistic depending on the number of items in the aggregate. Aggregates of 2P results typically have less portfolio effect that may not be significant in mature properties where the statistical median approaches the mean of the resulting distribution.	4.2.5.4 The aggregation method used depends on the purpose. It is recommended that for reporting purposes, assessment results should not incorporate statistical aggregation beyond the field, property, or project level. Results reported beyond this level should use arithmetic summation by category but should caution that the aggregate Proved may be a very conservative estimate and aggregate 3P may be very optimistic, depending on the number of items in the aggregate. Aggregates of 2P results typically have less portfolio effect, which may not be significant in mature properties where the median approaches the mean of the resulting distribution.
Various techniques are available to aggregate deterministic and/or probabilistic field, property, or project assessment results for detailed business unit or corporate portfolio analyses where the results incorporate the benefits of portfolio size and diversification. Again, aggregation should incorporate degree of dependency. Where the underlying analyses are available, comparison of arithmetic and statistical aggregation results may be valuable in assessing impact of the portfolio effect. Whether deterministic or probabilistic methods are used, care should be taken to avoid systematic bias in the estimation process.	4.2.5.5 Various techniques are available to aggregate deterministic and/or probabilistic field, property, or project assessment results for the purposes of detailed business unit or corporate portfolio analyses where the results incorporate the benefits of portfolio size and diversification. Again, aggregation should incorporate the degree of dependency. Where the underlying analyses are available, comparison of arithmetic and statistical aggregation results may be valuable in assessing the impact of the portfolio effect. Whether deterministic, geostatistical, or probabilistic methods are used, care should be taken to avoid systematic bias in the estimation process.
It is recognized that the monetary value associated with these recoveries is dependent on the production and cash flow schedules for each project; thus, aggregate distributions of recoverable quantities may not be a direct indication of corresponding uncertainty distributions of aggregate value.	4.2.5.6 It is recognized that the monetary value associated with petroleum recovery is dependent on the production and cash flow schedules for each Project; thus, aggregate distributions of recoverable quantities may not be a direct indication of corresponding uncertainty distributions of aggregate value.
4.2.1.1 Aggregating Resources Classes Petroleum quantities classified as Reserves, Contingent Resources, or Prospective Resources should not be aggregated with each other without due consideration of the significant differences in the criteria associated with their classification. In particular, there may be a significant risk that accumulations containing Contingent Resources and/ or Prospective Resources will not achieve commercial production.	**4.2.6 Aggregating Resources Classes** 4.2.6.1 Petroleum quantities classified as Reserves, Contingent Resources, or Prospective Resources should not be aggregated with each other without a clear understanding and explanation of the technical and commercial risk involved with their classification. In particular, there may be a chance that accumulations containing Contingent Resources and/or Prospective Resources will not achieve commercial maturity.
Where the associated discovery and commerciality risks have been quantitatively defined, statistical techniques may be applied to incorporate individual project risk estimates in portfolio analysis of volume and value.	4.2.6.2 Where the associated discovery and commerciality chances have been quantitatively defined, statistical techniques may be applied to incorporate individual project estimates in portfolio analysis of quantity and value.