United Nations ECE/ENERGY/GE.3/2020/3

Economic and Social Council

Distr.: General
10 February 2020
Original: English

Economic Commission for Europe

Committee on Sustainable Energy

Expert Group on Resource Management

Eleventh session
Geneva, 20-24 April 2020
Item 10 of the provisional agenda
Accommodating social and environmental considerations in the United Nations Framework Classification for Resources and the United Nations Resource Management System

Principles of Resource Classification

Prepared by the Social and Environmental Considerations Working Group of the Expert Group on Resource Management

Summary

Resource classification provides a key part of the information required for resource management. This report prepared by the Social and Environmental Considerations Working Group of the Expert Group on Resource Management describes the principles of classification that apply to all types of resources and, although the focus is on the United Nations Framework Classification for Resources (UNFC), they should also apply to other classification systems, including those that are aligned with UNFC.

Different users of resource evaluations and classifications are described in the report. They have different objectives and a resource evaluation and classification should meet a user's needs, that is, it should be "fit for purpose". The conditions and assumptions of evaluation and classification that meet different user's objectives may differ even for the same project, for instance on product prices or timing of operations.

This report summarizes the basic principles of resource classification as they apply to any type of resource and sets out the classification principles according to which UNFC may be applied to a range of resource types.

GE.20-01910(E)

* 2 0 0 1 9 1 0 *

Contents

I. Introduction

1. Resource classification is a key part of the information required to manage resource development. A classification framework is provided by the United Nations Framework Classification (UNFC) but, even for the same project, different users often require evaluations under different sets of conditions. This can be summed up by requiring that the evaluation and classification of a project and the resulting report should be “fit for purpose”.

2. This report summarizes the basic principles of resource classification as they apply to any type of resource. It sets out the classification principles according to which UNFC [1] may be applied to a range of source types as shown in Table 1. The term “resource” is used here in a general sense to describe a material or energy that can be accessed for use and applies to all UNFC sub-classes, classes, and categories.

Table 1
The resource types to which UNFC may currently be applied

Resource Type	*Classified quantity*	
	Material	*Energy*
Solid minerals	✓	
Coal	✓	
Uranium, Thorium	✓	
Oil	✓	
Gas	✓	
Geothermal		✓
Solar		✓
Wind		✓
Bioenergy	✓	✓
Hydropower and Marine		✓
Anthropogenic	✓	
Groundwater	✓	
Injection[2]	✓	?

3. Many of the topics in this document warrant greater detail and would benefit from further discussion than given here.

4. This report addresses general issues that apply to all resource types. Resource-specific classification systems such as the Petroleum Resourced Management System (PRMS)[3] for oil and gas and the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) International Reporting Template for Exploration Results, Mineral Resources and Mineral Reserves[4] for solid minerals, describe well developed resource-specific procedures and practices and contain extensive resource-specific guidance. The report makes frequent reference to these procedures and practices. It is believed that this is useful input into defining appropriate specifications and guidelines for the broad set of resources covered by UNFC.

[1] United Nations Framework Classification for Resources Update 2019 (ECE/ENERGY/125 and ECE Energy Series 61), which replaces the United Nations Framework Classification for Fossil Energy and Mineral Resources 2009 incorporating Specifications for its Application (ECE/ENERGY/94 and ECE Energy Series 42).

[2] Injection is permanent or temporary storage of previously produced material.

[3] https://www.spe.org/en/industry/reserves/

[4] http://www.crirsco.com/template.Asp

5. The motivation for this report arose from the findings of the Social and Environmental Considerations Working Group of the Expert Group on Resource Management, set out in two documents that were submitted to, and approved by, the Expert Group at its ninth session in 2018.[5]

II. Classification

A. Introduction

6. The basic principles of classification have been studied for many years.[6] [7] Resource classification is a systematic process that assigns a recoverable or potentially recoverable resource to an appropriate UNFC category and is part of the process of resource management:

- Collecting information
- Cleaning and verifying, quality control
- Analysing and describing
- Classifying
- Reporting
- Using.

7. Perfect classification would make an assignment without error but limitations in the quantity and quality of information and the inherent variability of resources makes this unlikely. Resource classification is typically, and unavoidably, imperfect and includes the likelihood of error (see Section V, Information and the Nature of Estimates) and hence is more realistic.

B. Purpose of Classification

8. The purpose of resource <u>evaluation</u> is to provide an estimate of the quantity of a potentially recoverable resource and, often to derive a value. These may be presented as deterministic, single, values but are time-dependent points on a probabilistic continuum at an assigned probability.[8] If there is interest in tracking changes over time, such as for resource management, an evaluation needs to be carried out periodically under the same, or at least well understood, conditions.

9. The primary purpose of resource <u>classification</u> is to provide information on the current status of a resource for decisions, in a progression from initial identification to becoming available for use. However, unlike evaluation, classification is not a continuum, but is discrete. Only enough information is required to assign a quantity to the appropriate Class or Category ("bucket", or UNFC "box"), not to decide where it falls within that Class or Category. For instance, oil or gas that has an estimated probability of recovery that falls anywhere in the range less than 90% or greater than 10% would be classified as a

---

[5] Draft guidance for accommodating environmental and social considerations in UNFC (ECE/ENERGY/GE.3/2018/3). (Draft guidance 2018).
Accommodating Social and Environmental Considerations in UNFC: Concepts and Terminology (ECE/ENERGY/GE.3/2018/4). (Concepts 2018).

[6] See https://en.wikipedia.org/wiki/Classification_rule for an accessible general review of classification.

[7] See Fukunaga, K., 1990, Introduction to Statistical Pattern Recognition, Academic Press (particularly chapters 3 and 4) for a more detailed account. Although not immediately applicable to resource classification it describes the concepts that underlie all classification processes in greater depth than the Wikipedia article. It is beyond the scope of this report to develop them for resource classification.

[8] It is not always clear what this probability is but could be a Mean or High probability of occurrence that may be referred to as a Proved Reserve.

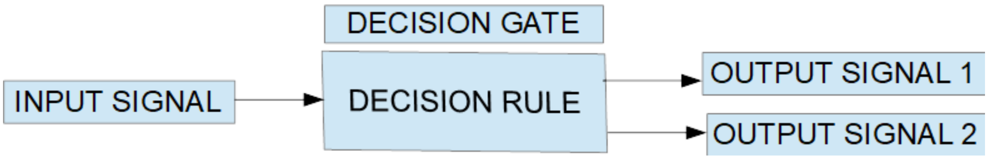
E1F1(G1+G2), whether the estimate is 70% or 25%. Classification is carried out for a purpose that depends on the needs of the users and the same basic information on a resource could lead to different classifications for different users, as described in Section IV.

C. The Process of Classification

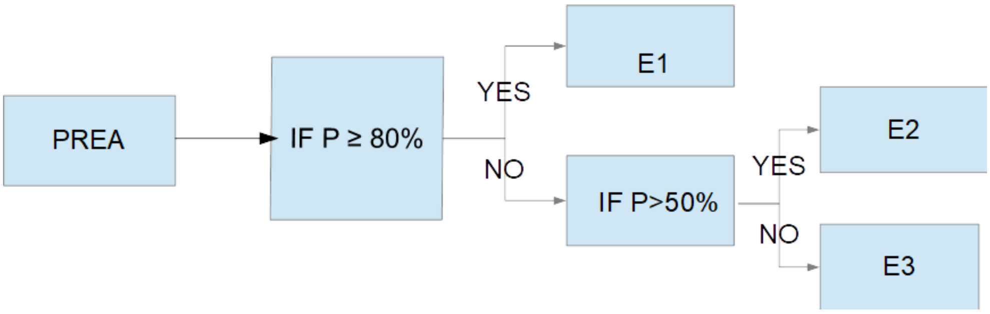
10. Classification can be considered as a process of feeding input signals (information) through a series of filters or Decision Gates containing Decision rules[9] that create output signals indicating a step towards a UNFC Category as illustrated in Figure I. The Input Signal contains the information that is required for the Decision.

Figure I
The Classification Process

(a) General signal processes



(b) Example of Probability of Environmental Approval (PREA). UNFC does not currently specify probabilities to determine E axis categories. This is a proposed approach.



11. A full evaluation and classification process is a series of connected Signals and Decision Rules that can be pictured as a decision tree or flow diagram.[10]

12. Decision rules are discussed in more detail in Section VII.

13. All resource types go through several sets of decision rules as they progress through the UNFC Categories to the final step of supply to a user (111, 112).

14. **Identification.** Every resource type has its own characteristics and terminology, but an example of the steps is the classic oil and gas exploration model,[11] Play, developing to Lead, developing to Prospect.

- Play: A family of geologically similar fields, discoveries, prospect and leads.
- Lead: A potential accumulation within a play that requires more data acquisition and/or evaluation to be classified as a prospect.

[9] Also called Classifiers or Classification Rules.

[10] A UNFC example of this can be found on pages 22 to 25 in the report: "Specifications for the application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) to Geothermal Energy Resources", which shows decision tree diagrams for the E, F, and G axes for geothermal resources. (http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_GEOTH/UNFC.Geothermal.Specs.pdf)

[11] Cited in the Canadian Oil and Gas Evaluation Handbook (COGEH) Resources Other than Reserves (ROTR), 2014, after Rose and modified from PRMS.

- Prospect is a lead within a play that is sufficiently well defined to represent a viable drilling target.

15. **Assessment.** Much variation between resource types, but generally resulting in a spectrum of quantities and values representing the current status.

16. **Development** of a technical process to utilise a resource, initially experimental, then scaling to a technically viable process, and then to a commercially viable process.

17. **Commercialisation,** when all conditions required to deliver a resource to a commercial user have been satisfied.

18. Each of these requires decisions on investment of money, materials, man hours, etc.

III. Uses of Resource Information

A. Introduction

19. Resource classification is carried out for a specific purpose and for different users who have different purposes and often a need for different information. UNFC identifies four areas of application (UNFC, Update 2019 (ECE/ENERGY/125), page 1, I. Application):

- Policy formulation based on resource studies. A study may be carried out for many purposes, including for UNFC, but is an intermediary provider of resource information to users and a basis for other purposes, not an end.
- Resource management functions. This may be by national and sub-national governments, indigenous groups, operating organizations, resource users (e.g., buyers of oil, gas, metals), etc.
- Corporate business processes. This is the physical activity of producing a resource and providing it to a user and may be carried out by companies, governmental, or other entities (in this report, referred to as Operators).
- Financial Capital Allocation. This relates to acquiring and allocating capital, accounting, and the reporting requirements of the securities market and other sources of financing directed towards providing relevant information to investors to assist in investment decisions. It may also refer to the internal accounting and reporting processes of organizations involved in resource activities.

20. For the purposes of this document, the interests of the users will be discussed further under the headings:

- Operators
- Resource management[12]
- End users of resources
- Finance
    - Capital access and allocation
    - Financial reporting
- Miscellaneous.

[12] The Expert Group on Resource Management's concept of resource management is much broader but is not addressed here.

21. Table 2 shows, in a simplified form, examples of the roles and interest (which could be in the product quantities and/or financial) of three types of user. Although not shown in the table, the interests could be in quantities or values.

Table 2
Illustrating the interests of some of the different users of resource information

	Government	*Operator*	*End user*	*Financing*
ACTIVITY	Administration, Supply and Planning	Recovery	Material and Energy supply	Access to capital
ENTITLEMENT	Mineral Rights ownership (national, sub-national, etc.)	Lease/Purchase and Sales Agreement (PSA)	Purchase contract	Financial Reporting
COST	General and Administrative (G&A) Abandonment, Decommissioning & Reclamation (AD&R)	G&A Lease payment Capex Opex Taxes Royalty AD&R	Market/contract price	
REVENUE	Bonus payments Lease payment Taxes Royalties	Sale of produced product	Sale of processed product	

B. Operators

22. An operator is an organization that carries out the physical activities required to access a resource, carry out a recovery process (e.g., oil, gas, minerals), transform it to an energy supply (e.g. hydropower, solar energy, bioenergy) or material, and deliver it to users. This requires:

- Relevant competence and capability.
- Access to a resource by exploration for minerals, wind and sun for power generation, raw material for bioenergy, etc. This is generally obtained through an agreement with the original resource owner.
- Production and processing.
- Energy storage.
- Transport.
- A market.

23. An operating entity, typically a company, seldom owns a resource directly and the right to explore for, develop, and sell a product, is granted by an owner, such as a government, through a contractual agreement that is limited in geographic area, geological unit, time, and possibly other factors, and can be in various forms (lease, production sharing agreement, or

similar arrangement). The ensuing revenue to an operator is through ownership of such mineral rights. To attract financing, they need to carry out their activities to achieve a positive payout within a limited number of years.

24. Public reporting of resources by operators on securities markets is the most prominent form of resource reporting and has driven the development of standards such as CRIRSCO, PRMS, Canadian Oil and Gas Evaluation Handbook (COGEH), United States Securities and Exchange Commission (U.S. SEC), and others.

C. Resource Management

25. National, sub-national, or indigenous organizations, own non-renewable resources and would collect royalties, taxes, lease payments, or similar payments, but may grant freehold mineral rights to an individual or company in which case it then no longer has a direct interest.

26. Whatever the ownership status, resources are managed under a regulatory jurisdictional system[13] that carries out day to day administration and plans for current and future supply. As an example of the responsibilities of a government resource manager, based on the Canadian Alberta Energy Regulator:[14]

- Administration of resource activities within a jurisdiction, includes:
  - Safe, efficient, orderly, and environmentally responsible development
  - Granting rights to operating organizations to carry out resource recovery activities
  - Providing regulatory approvals, including consideration of social and environmental impacts.
- Estimating oil and gas supply and demand as part of a national materials and energy strategy.
- Estimating the potential revenue from taxes and royalties that accrue from oil and gas extraction activity.

27. Governments are interested in estimates of the resource quantity, forecast production and revenue, and may have interests in broader social, environmental and economic impacts, that differ from the approach taken by an operator to the information that is required (see Figure II).

- Revenue. A government may take a share of production ("in kind") but the revenue accruing to a government or freeholder does not usually come directly from the sale of products, but from taxes, royalties, or other arrangements such as Production Sharing Agreements (PSAs), which may be complex and have different provisions for government take. Government revenue may be obtained from a typical evaluation by extracting government take items, such as lease sales, taxes, and royalties, and presenting that as the government revenue cash flow
- Projects evaluated by governments may differ in the geographic area, geological unit of interest, and timing, and conditions from those of an operating organization, and can have a broader scope. They may also differ from operating entities in the contingencies they consider. For example, since a government grants regulatory approval this may not be a factor in its categorization, but it will depend on operators for information on activities, such as timing and number of wells. Payout time for a corporate project is not likely to be as limiting a classification factor for a government.

28. An example of this is the Athabasca Oil Sands, which contains numerous operating company level projects, that may be combined by the government agency (the Alberta Energy

[13] This may not be the case for situations such as artisanal mining or a failed state.

[14] Canadian sub-national provinces hold mineral rights and the Alberta Energy Regulator administers these on behalf of the Province of Alberta.

Regulator) into a smaller number of larger projects, or even as one very large project. A lack of detailed operational information of the type possessed by an operator, and the large scale of government exercises, will often dictate the use of a simplified approach.

D. End Users

29. An end user accepts a product for direct use or distribution to other end users. The many end users of resource information may be split into two groups:

- Material resource users (e.g., oil, gas, metals) such as refineries, smelters, chemical and power plants, etc., which convert the resource into another material form or to energy
- Energy (e.g., wind, solar, hydropower) sold to an end user without further treatment or conversion to another form.

30. Resources may also be stored for later use (e.g., oil in salt cavities, hot water for energy, surface reservoirs for water for material and/or energy generation), or for indefinite disposal (e.g., CO_2, salt water or radioactive waste).

31. Whatever the form of a resource or ultimate use, supply to a user is usually governed by a legal agreement between the provider and the user that stipulates prices, quality, amount per year, etc. This typically requires resource quantities and qualities estimated by defined procedures and conditions, and any overriding conditions that may be specified in the contract,[15] and it is not unusual for a user to require periodic audits to confirm the ability of an operator to deliver contracted quantities.

32. Changes in market conditions may lead to an operator being unable to economically produce and deliver the contracted quantities (leading to a downgrade in the UNFC class), in which case an operator may be required to purchase make-up quantities on the open market. The converse may be the case, when a purchaser has contracted to take a certain quantity that it is unable to accept, which has occurred with some take-or-pay gas purchase contracts.

33. Facilities construction, such as by mid-stream companies, pipelines, refineries and smelters, require an estimate of the quantities and their properties that will flow through them, to design the facility. This information is also required for ongoing operation, optimisation, and maintenance.

E. Finance

1. Capital Access and Allocation

34. There are various sources of capital for financing resource activity including internal generation, governments (state-owned enterprises (SOEs)), private and public debt and equity, all of which require information on the revenue and cash flow that is anticipated to be generated by recovery and sale of a resource. The scope of this information ranges, for example:

- The debt market (e.g., banks) often considers only lower risk quantities (such as E1F1.1G1, Viable Project On Production) over a limited time period
- The equity market:
    - Small and mid-sized companies may expand the risk profile to include undiscovered resources, with a somewhat longer time frame

[15] These may be very specific, for instance there is a difference in the Standard Temperature and Pressure conditions for gas that are specified by the neighbouring provinces of Alberta and British Columbia, in Canada. The difference would be insignificant for small quantities but can be significant for the large volumes of typical gas purchase contracts.

- Larger companies and governments can have a longer view (as much as twenty years) that considers not only current production but includes investment decisions on technology development for new types of resource.

35. The primary interest of the finance industry is not the resource quantities per se but the potential return on investment, to support current and future funding needs. However, resource quantities are an important input to determining revenue and cash flow and revisions can have a significant impact on the willingness of providers of finance to continue this financing. This is most noticeable in the stock market, through an impact on share prices.

2. Financial Reporting

36. Resource information is used for accounting applications, such as ceiling tests, depreciation, and depletion. It may also be used to calculate metrics such as finding and development costs, barrels of oil equivalent, asset valuation, etc. These may be carried out under specified conditions, but standards may vary between and even within jurisdictions and for some measures (such as finding and development costs), there are no generally recognised standards.

F. Miscellaneous

37. Other uses of resource information include:

- Legal issues, such as disputes over ownership
- Unitisation negotiation.

IV. Realm of Discourse, Projects, Scenarios

A. Introduction

38. The previous section briefly described different users, often with different requirements for information that may lead to different quantities and classifications.

39. An understanding of the result of a classification will be limited unless the factors that underlie it are known. In practical terms, this means that the purpose, conditions, contingencies, and any other factors should be clearly stated when reporting resource classification. Without this information, evaluations and classifications are likely to be of limited use and should be treated with caution, and in some cases with scepticism.

B. Realm of Discourse (ROD)

40. No project takes place in isolation and, as discussed in the previous section, users have different information needs. The same project may be assessed under different conditions by various organizations and for different purposes and, consequently, resources may be categorised in different ways.[16] These conditions constitute a Realm of Discourse (ROD) that describes the specific context and the conditions for evaluating and classifying a resource project.

41. An organization such as an operating company is likely to assess all its projects under the same ROD; a government agency would have its own, often different, ROD for the same projects. For example, a gas development project is likely to be assessed under different conditions and assumptions (i.e., RODs) by government organizations, operating companies, and potential purchasers of the resulting gas supply. Other examples of different RODs for the same project and resource are:

[16] For example, the Alberta Energy Regulator classifies oil and gas resources using COGEH except for oil sands for which it uses the Inter-Provincial Advisory Committee on Energy (IPACE) system.

- Oil and gas evaluations prepared under PRMS and COGEH guidance. Although similar, there are some differences in the RODs that could result in differences in classification.
- Oil and gas reports prepared for the U.S. SEC and Canadian Securities Administrators (CSA) regulatory filings can differ significantly because of different mandated and/or permitted content, such as price.
- A UNFC resource categorisation that is prepared strictly in accord with the Sustainable Development Goals (SDGs) is likely to differ from one that is prepared for the same project that does not consider the SDGs.
- The internal requirements of an operating company compared to those of a government agency.
- An annual audit to confirm the ability of a supplier to meet the contractual delivery requirements of a gas purchase contract to one prepared for the same property for a financial filing by an operator.
- A bank assessment may look only at Viable Project On Production using its own price forecast, compared to an assessment by an operator for the same property that can look at the whole spectrum of resource classes including Prospective Projects and for a different price forecast.

42. Knowledge of the ROD of a project is essential to fully understand the reported results of an evaluation.

43. Two special RODs are relevant to UNFC:

(i) The SDGs. Item N of the work plan of the Expert Group on Resource Management for 2020-2021 "…requires the production of specifications, guidelines, and other documents such as case studies and white papers that will assist in the use of UNFC and UNRMS as a useful tool to aid the attainment of the relevant Sustainable Development Goals, as well as the reduction of greenhouse gas (GHG) emissions arising from the development and production of energy and raw materials."

Some of the SDGs imply or suggest a set of policies or practices that could affect the economic, social, and environmental implications of resource projects. Those policies or practices would define a ROD for an evaluation and may result in resource classifications that differ from traditional practice. Classifying a resource in conformance with the SDGs will require developing appropriate decision rules that are likely to differ from those in current use but should conform to the principles described here. Social and environmental issues are central to this.

UNFC could be used in studies carried out to assess and provide information on specific SDGs that have a direct implication for resource development, such as #7, Affordable and clean energy, perhaps #9 Industry, Innovation and Infrastructure, #12, Responsible Consumption and Production, and #13 Climate Action.

Development of the use of UNFC for the SDGs and the Paris Agreement on Climate Change would benefit from further discussion but is beyond the scope of this exercise.

(ii) Resource Management. This report does not address the broader issue of resource management. The principles described here would be relevant.

C. Projects

44. Existing guidelines tend to treat a Project as if it existed in isolation, but it is part of a wider picture that consists of an Objective, Projects, and Scenarios.

- Objective. Every project is carried out with the intent to achieve an objective. This can be varied and not necessarily confined geographically, by scope, time, or in any other way. It should be described concisely, in one or two sentences.

  Examples:

  - Appraise the XYZ oil discovery to decide whether it will be viable to develop
  - Carry out a geophysical survey to assess the petroleum potential of the ABC region as the basis for exploration drilling
  - Assess the merits of installing compression at the DEF gas field.

- Project. Definitions of a Project are given in UNFC, COGEH Resources Other Than Reserves (ROTR) 2016 and PRMS 2018[17] and although the CRIRSCO Template uses the term "project", it is not defined. A general definition of a project that can apply to any type of resource and any type of use covered by UNFC is:

  "a defined activity, or set of activities, directed towards resource recovery."

45. For UNFC, it provides the basis for the assessment and classification of a resource project.

46. What constitutes a project for a user depends on the objectives and the conditions under which evaluation and classification are carried out. This will be dictated by technical factors such as the nature of the resource and non-technical factors including those internal to an operator, a jurisdiction, conditions mandated in contracts, by banks, or the securities markets, etc. Some examples are:

  - Identification of a potential oil, gas, or mineral deposit by activities such as a geological or a geophysical survey.
  - To raise funds to develop oil, gas, or minerals.
  - Assessing the installation of compression facilities for gas production.
  - Forecast of a potential supply of a product from a mining, geothermal, or other project.
  - Forecast of the potential revenue to a government from resource activity in parts, or all, of its jurisdiction.

- Scenario. A scenario describes the specific details, activities, and conditions under which a project is evaluated, such as timing of activities, forecasting production rates, and costs. The same project may be assessed under several scenarios, for example:

  - The timing of drilling wells for a five well development project:
    - Scenario 1: 5 wells in year 1, or,
    - Scenario 2: 3 wells in year 1 and 2 wells in year 2.
  - Regulatory reporting in Canada and the United States:
    - Scenario 1, Constant prices for the U.S. SEC
    - Scenario 2, Forecast prices for the CSA.

[17] Current definitions often tend to describe what a Project does (more along the lines of an example) than what it is.

V. Information and the Nature of Estimates

A. Introduction

47. The type of information used in resource evaluation and classification varies considerably, for example:

- Whether a well has been drilled that confirms the presence of a resource
- The existence of a technical process that has been confirmed to be technically successful
- Whether a technically viable process in one reservoir will be economically viable in a different reservoir
- The status of regulatory approvals for a project
- Characteristics of the source (e.g., porosity and other properties of a potential oil reservoir).

48. Although methods of dealing with this type of information vary, they are all underlain by fundamental concepts that are touched on briefly below, but a full account is beyond the scope of this paper.[18]

B. Populations, Samples, and Representative Samples

49. The total information on a subject of interest is that of the population but it is usually characterised by a subset obtained by sampling. The degree to which a sample adequately represents a population depends on many factors, including the characteristics of the population and the size of the sample.

50. A representative sample is a subset of a population that reflects the characteristics of the population within limits that are considered acceptable for the intended purpose, but the extent of sampling is typically constrained by the cost of sampling.

51. As an example, a core may be taken as a sample to characterise the properties of an oil or mineral accumulation. A core taken in an oil or gas well is typically 4 inches in diameter and if cores are taken in four wells in a section (square mile), a relatively high sampling density, the sample is only 1.59 x 10^{-6} % of the rock volume within that section! In practice, this would be supplemented by other information that limits the uncertainty.[19]

C. Certainty and Uncertainty

52. The standard statistical definitions are probabilities of occurrence of Certain = 1.0 (100%), Uncertain = 0 (0%), but common usage is not so rigorous, and the term "Certain" may be used in the sense of a low degree of uncertainty ("almost certain") and Uncertain to mean that the true value of a parameter is less than 100%. This can be captured by a measure such as a standard deviation (e.g., porosity is expressed as 10±2%) or a cut-off. In a few cases, there is certainty in the information; you either have a well or you do not, but most information on resources is uncertain.

53. Certainty is illustrated in Figure II left and shows a parameter with the value of 0.6 (60%) of occurring (and 0.4 (40%) that it does not occur).[20] For example, a Final Investment Decision has been formally approved or it has not. Uncertainty is illustrated in Figure II right by a Uniform Distribution. In the absence of information on a parameter, it is possible to assign a minimum value of zero and a maximum of one (rescaling as appropriate for the

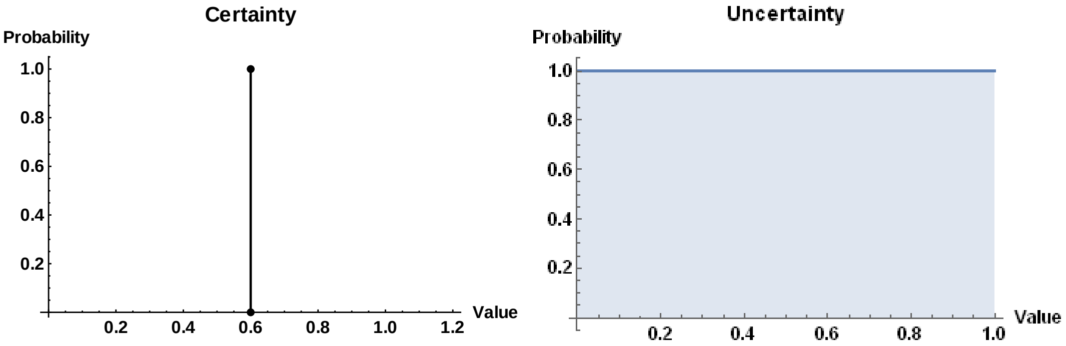
18 Greater detail is available in numerous statistics texts and on-line sources.

19 These include geological concepts such as depositional models, pressure build up tests, etc.

20 It is possible to have a discontinuous situation with outcomes such as Case A 60%, Case B 25% and a Case B 15%.

parameter of interest, e.g., porosity from zero to 30%) which can be presented as a Uniform Distribution in which every value has the same probability of occurrence.

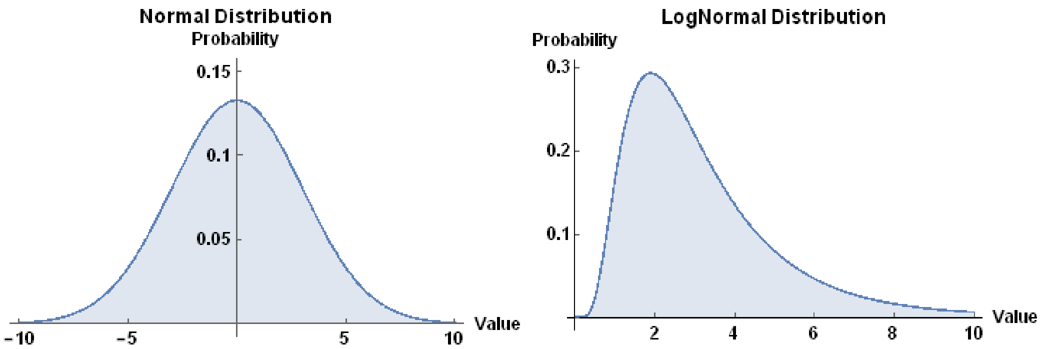
Figure II
Certainty (left), (Total) Uncertainty (right)



54. The information used for evaluation and classification is usually between the extremes of (total) uncertainty and certainty, with many variations.

55. Real data is often fitted with a model distribution and care should be taken to choose one that adequately represents the data. The simple triangular distribution may be used when information is limited to upper and lower bounds and a guess may be made at the mode but has its drawbacks and can be regarded as an intermediate step between a Uniform and a more complete distribution. Normal (Figure III, left) or LogNormal (Figure III, right) distributions may be used, but this should not be automatic, as there are others, such as a Poisson or binomial distribution, that may better represent a data set. The distributions in Figure III are illustrations of a great variety.

Figure III
Distributions: Normal, left, LogNormal, right



D. Uncertainty: Error and Bias

56. Both evaluation and classification require an assessment of probability but not necessarily formal quantitative analysis. The information used for evaluation and classification is typically based on a sample of limited size that is assumed to be representative of a parameter of interest and is usually uncertain to a greater or lesser degree. The uncertainty can be captured by a simple relationship:

Observed Value = Actual Value ± Error ± Bias

- The Actual Value is not known until resource activity finally ceases, for instance when an oil well or a mine, is abandoned.
- Error is inherent in any measurement or estimation process. This is the realm of good practice and statistics.
- Bias has several forms and may or may not be intentional.

E. Quantitative Information

57. Methods of dealing with uncertainty in quantitative data can be found in many statistical textbooks and online.

F. Quantitative Expression of Qualitative Information

58. Most of the information used for evaluation is quantitative but classification decision rules are often qualitative and require subjective judgment. Common objections to quantifying such criteria are:

- "I can't calculate that", for instance a definition for G1 that there is a 90% probability of a greater volume. Such a criterion may be more helpfully rephrased as, "Is there a 1 in 10 chance that the actual quantity will be less than your estimated quantity?"
- Regarding a criterion for a definition such as for G1 that there is "90% probability of a greater volume", as an absolute, with a fear that the actual quantity will be less than the estimate. However, it means that 9 times out of 10 your estimate is likely to be equal to or greater than that target, but also that 1 time out of ten, you can expect it to be less. This can be tested if the information is available.

59. Methods of dealing with qualitative information range from making informal "best guesses" to a formal Delphi process[21] and can be found in many textbooks and papers.

60. Qualitative information may be quantified based on the common usage of the words that are used to describe it. Tables 3 to 6 illustrate a quantification of qualitative estimates from surveys of the quantitative meaning of common qualitative expressions reported by Mosteller and Youtz[22] (e.g., "Likely to rain" is commonly thought to mean that there is at least a 71% probability of rain).

Table 3
Probabilities of occurrence, of certain qualitative expressions and their interquartile range (from Table 2 of Mosteller and Youtz)

Expression	*Median Probability %*	*IQR %*
Certain	98.7	1.1
Almost certain	90.2	7.5
High probability	82.3	10.1
Likely	71.1	15.0
Probable	70.2	13.0
Possible	38.5	42.7
Usually	75.1	16.7
Not unreasonable	37.6	29.1

61. An Interquartile Range (IQR)is the difference between the twenty-fifth and seventy-fifth percentiles and captures the central 50% of the survey responses.

62. A term such as "Almost certain" has a Median of 90%, and 50% of the responses fall within a narrow range of about 83 to 98%. This may be considered acceptable for resource classification and could be equated to the intent of the probabilistic interpretation of the

[21] A formal process for consulting a group of experts that can be carried out at different levels of sophistication. See https://en.wikipedia.org/wiki/Delphi_method (contains links to more detailed references).

[22] Mosteller, F., and Youtz, C., 1990. Quantifying Probabilistic Expressions". Statistical Science, Vol. 5, No. 1, pp.1-34. This paper contains a much more comprehensive account than is given here and should be consulted by anyone who wants to understand the nuances.

expression "reasonable certainty" in oil and gas reserves definitions as 90%, but which Harrison and Falcone[23] report as being typically 70 - 75% in practice.

63. A term such as "Possible" with a Median of 38.5% and an IQR of 42.7% (due to an asymmetry in the responses) has such a wide range of interpretation that it is of little use to the point of being misleading.

64. Many terms can be used with modifiers, such as "high", "low", "very" that alter the assigned probability as shown in the table below.

Table 4
The effect of modifiers on the term probability

Modifier	*Term*	*Median %*	*IQR*
Very high	probability	91	5.4
Very	probable	85	8.9
High	probability	81	10.1
	Probable	69	13.0
Moderate	probability	52	18.5
Low	probability	16	14.5
Very low	probability	6	5.7

65. The qualifying term, reasonable, of "reasonable certainty" as a qualitative definition for proved oil and gas reserves, is not in Mosteller and Youtz, but "Not unreasonable" with a Median of 37.6% may be considered the converse of "Reasonable", suggesting that "reasonable" should be interpreted as 62.4%.

66. The Guidelines for Accommodating Environmental and Social Considerations in UNFC uses a simple version of this approach with few levels of modifier.

Table 5
Terms used in Guidance for Social and Environmental Considerations to quantify verbal descriptions. Based on Mosteller, F., and Youtz, C.

Verbal Description	*Range of Probability*
High	≥ 80
Medium	≥ 50 to 80
Low	< 50

67. A similar approach is used by the Intergovernmental Panel on Climate Change (IPCC), with a different number of levels and verbal descriptions.

68. A more complete tabulation of recommended qualitative to quantitative assignments, from Kadane in Mosteller and Youtz, is provided in Table 6.

[23] Harrison, B., Falcone, G., 2017. Are We Reasonably Certain That Reasonable Certainty Adequately Defines Uncertainty in Our Reserves? SPE-185497.

Table 6
Quantitative Expression of Qualitative Expressions (Kadane, in a comment on the paper, Mosteller, F., and Youtz, C., "Quantifying Probabilistic Expressions"). Statistical Science, Vol. 5, No. 1, pp.1-34)

Verbal Description	*Range of Probability*	*E axis*
Almost never	0 to 5	Low[a] ≤ 50%
Seldom	5 to 15	
Infrequent	15 to 25	
Sometimes	25 to 35	
Less than even chance	35 to 45	
Even chance	45 to 55	
More often than not	55 to 65	Medium 50 to 80%
Often	65 to 75	
High probability	75 to 85	High[b] ≥ 80%
Very high probability	85 to 95	
(Virtually) certain	95 to 100	

[a] < in the original table has been replaced by ≤ here.
[b] > in the original table has been replaced by ≥ here.

69. When developing definitions, decision rules, etc., care should be taken to use words that are least likely to be subject to great variation in understanding (i.e. have a limited interquartile range (IQR)). This is particularly important in resource definitions and it is recommended that a qualitative term should be explicitly linked to a quantitative measure.

70. In some cases, an estimated Range of Probability will overlap the range of a classification criterion, for example, 30 to 70% for the E axis of UNFC. It will be a matter of judgement as to which category (verbal description) should be chosen but it is recommended that:

- The Class that contains the greater portion (or at least 60%?) of an overlap should be chosen.
- When the overlap is equal, the lower class should be chosen.
- In case of doubt, the lower class should be chosen.

71. For example, for the E axis:

- Most of an estimated range of 60 to 85% would be classed as Medium since that is the where the greatest overlap occurs.
- A range of 60 to 40% overlaps the Low and Medium Classes equally and would be classed as Low.

VI. Contingencies

A. Introduction

72. Contingencies are criteria or conditions that must be satisfied before a project can proceed to the final stage of a supply to a user, and each Sub-class of UNFC has a set of contingencies that must be satisfied. General contingencies apply to all resources, with individual resource types having their own specific contingencies. Whether or not a contingency has been satisfied will be determined by applying a Decision Rule.

73. PRMS refers to contingencies and the CRIRSCO Template uses the term "modifying factors" in the same sense.

B. Types of Contingency

74. The list below describes the major types of general contingencies. Not all will be relevant in every case, they vary in detail for every project, and there may be additional contingencies.[24]

1. Technical contingencies (G and F axes)

- **Identification** (G axis). The first step for a subsurface resource such as oil, gas, and minerals may include geological studies and exploration wells. Other sources, such as renewable or anthropogenic, will have their own initial identification contingencies.
- **Measurement** (G and F axes). Once identified, the quantity and quality of a resource will be assessed by further technical investigation.
- **Application of a technical process** to utilise a resource (F axis). The stages listed below are based on COGEH Volume 2, Section 2 (ROTR Guidelines) but are probably generally applicable:
    - Established Technologies (not a contingency but included for completeness and equivalent to the U.S. SEC “Reliable Technologies”). Reserves may be assigned.
    - Technology Under Development. Field tests to establish the economic viability of an extraction process. Contingent Resources, but not Reserves, may be assigned.
    - Experimental Technology. Field tests to establish the technical viability of a recovery process. No recoverable products may be assigned (although production would be recorded and reconciled at the end of a reporting period).

2. Environmental, Social, and Economic Contingencies (E axis)

a. Economic Contingencies

- Economic viability is measured by processes such as a Discounted Net Present Value (DNPV).
- Fiscal regime (prices, royalty rates, production sharing terms, income taxes in the case of after-tax evaluations, etc.). An example may be a contingency for a gas price to increase from US$ 2/Mcf (1,000 cubic feet of natural gas) to US$ 4/Mcf to move from being uneconomic to being economic.
- Costs (capital costs, operating costs, pipeline tariffs or tolls, etc.).

b. Social and Environmental Contingencies

75. The term “Social licence” is often used to describe the collection of social and environment issues related to a project. It is colloquially useful for this purpose, but there may not be agreement on what the issues are for a project and they are likely to be different for every project. For this reason, it is not recommended as a classification criterion and the relevant individual contingencies that constitute the social licence for, and are specific to, a project should be used.

- Environmental contingencies (refer to Glossary for a definition).
- Social contingencies (refer to Glossary for a definition).

c. Related Contingencies

- Legal: the right to explore for, produce and sell, or receive in kind, or payment for risk services.

[24] Based on COGEH Volume 2, Section 2 (ROTR Guidelines) which uses the PRMS classification that is aligned with UNFC.

- Contractual contingencies that may need to be satisfied (e.g., for market access) to move to the next Class or Sub-class.
- Regulatory contingencies: regulatory approval to proceed with exploration, development and production.
- Market access.
- Political factors: these may be international, national, or local, and could include political or social unrest, war, or government action of any kind that may impede proceeding with a project. See separate comment below.
- Internal and external approvals and commitment to project development.
- Development timing (see below).

3. Timing of Development

76. Some classification guidelines (e.g., PRMS and COGEH), and regulatory requirements (e.g., U.S. SEC) prescribe a classification criterion that a contingency must be resolved within a defined period (e.g., that proved reserves must usually be developed with six months or downgraded to a contingent resource). There is typically some allowance for projects that have a long lead time and a year may be appropriate for a shallow well in a mature area with a ready market but an offshore, deep oil project, could take many years.

4. External and Internal Contingencies

77. Resource classification has traditionally focused on the immediate extraction process as carried out by an operating entity with little or no consideration of externalities, which are described as: "An externality is a cost or benefit resulting from an action that is borne or received by parties not directly participating in the action." (the United States Environmental Protection Agency (U.S. EPA), 2010).[25]

In the current context:

- An internality is a cost or benefit that affects an equity participant in a project.
- An externality is a cost or benefit that affects a party who did not choose to incur that cost or benefit.

78. These may have adverse (negative) or beneficial (positive) effects, but projects proceed by progressively satisfying negative internalities or externalities. Positive internalities and externalities may motivate a project, but once resolved a contingency plays no further role in classification.

79. Concerns about social and environmental issues often involve externalities that have not traditionally been previously considered in resource assessment but are becoming of increasing importance. They may be dealt with by processes such as an Environmental and Social Impact Assessment (ESIA).[26]

[25] U.S. EPA, 2014, Guidelines for Preparing Economic Analyses, EPA 240-R-10-001, December 2010 (updated 2014); Front Matter, p. 15. Available at: https://www.epa.gov/environmentaleconomics/guidelines-preparing-economic-analyses. Additional information and references can be found at https://en.wikipedia.org/wiki/Externality

[26] http://www.ifc.org/wps/wcm/connect/296ae980488551f5aa0cfa6a6515bb18/ESIA.pdf?MOD=AJPERES 9

80. The contingencies of the SDGs and the Paris Agreement on Climate Change have historically been considered as externalities, but many projects are now unlikely proceed if they are ignored. Examples of alternative approaches are:

- Climate change may not be a consideration for the evaluation of a resource, but there is an increasing necessity for the CO_2 emissions of a project to be addressed. This may be done in several ways, (depending on the ROD) and could include:
- That there is currently no CO_2 price that blocks the project and the issue is ignored; there is no contingency.
    - Applying a shadow price for future CO_2 costs that would block the project; a contingency until resolved.
    - Government imposed costs for CO_2 emissions (by various means) that could affect the economic viability of a project; a contingency that must be addressed.
- The design of a national legal/fiscal framework about factors such as climate change or social issues that promotes, hinders, or prevents, the development of a resource.

81. Most existing resource classification systems (PRMS, CRIRSCO Template, etc.) make mention of externalities, but provide little guidance, and have historically only considered internalities. However, externalities are becoming of increasing importance and cannot be ignored. Unless they are addressed it may not be possible to gain approval (social licence) for a project.

Table 7
Internalities and Externalities of a Project

	Costs		*Benefits*	
	Operator	*Society*	*Operator*	*Society*
INTERNALITY	Capex, Opex, Gross taxes & other fees	X	Profits from sales	X
EXTERNALITY	X	Social and environmental	X	Raw material, Revenue from Taxes, Royalties, Jobs

82. The cost to society of the social and environmental considerations may be assessed by a process such as the System of Environmental-Economic Accounting (SEEA)[27] which also addresses the issue of "residuals" which are increasingly likely to be generated the longer a project goes on. This may also include changing views on legacy wastes which cause materials not previously regulated as residuals to be classed as a potential resource during a project rather than from the beginning. This is an example of how and why a contingency provision should be made in any full cost accounting approach to a whole project life cycle.

5. Formal and Informal Contingencies

83. Contingencies can be considered as having two components:

- **Formal**. The legal and regulatory processes such as the granting of environmental approval, approval to drill, explore, develop, construct, etc.
- **Informal.** Those outside a formal legal or regulatory process such as:
    - Externalities, unwanted costs that may be imposed on local communities by a mineral recovery project.

[27] https://unstats.un.org/unsd/envaccounting/seea.asp

- Objections by organizations or individuals that would not be directly affected, but who have concerns of a more general nature (e.g., object to the recovery of uranium in principle).

  This may trigger further activity within a formal legal or regulatory setting, or informal civil activity ranging from protests to violent action. In the extreme, civil unrest and war may also fall under this heading.

84. These factors could also be further divided into those issues that can or cannot be affected by an organization (operating entity, equity participant or government) but this may not be straightforward when activities such as lobbying are considered.

6. Political Contingencies

85. A political contingency is action by a controlling organization that may influence, impede, prevent, or facilitate the ability to proceed with a project. It is identified as a contingency in classification systems that are aligned with UNFC and could include political or social unrest, war, or government action of any kind that that may impede development. However, there is no current guidance and it is not clear where the boundary between political and social contingencies lies.

7. The Foreseeable Future

86. UNFC uses the term “foreseeable future” and, in one form or another, it is a contingency for resource classification. It may be dealt with by imposing an arbitrary time limit (e.g., the U.S. SEC five-year limit for Proved Undeveloped Reserves, or a COGEH fifty-year limit to assigning reserves to bitumen recovery projects). However, not only do resource projects differ greatly, but there are many components to a resource evaluation, each with its degree of predictability over time, and it would not be realistic to impose a definite time for all projects. This needs clarification.

VII. Decision Rules

A. Introduction

87. A Decision Rule or classifier[28] is a procedure by which elements of a data set are predicted to belong to one or more classes.[29] Misclassification can occur for a variety of reasons and result in false positives and negatives as shown in Table 8, for belonging or not belonging to a Class A (e.g., to E1).

Table 8
True and false classification assignments

Decision	*Class A (E1)*	*Not Class A (Not E1)*
Positive for A (E1)	True positive	False positive
Negative for A (E1)	False negative	True negative

88. An example of a false positive would be classification as E1 when the correct classification is E2 (in oil and gas terms, e.g. used in PRMS, as a reserve when it should be a contingent resource). A false negative is the converse, for example, classification as E2 when it should be E1.

[28] This section is based in part on the Classification rule as described in Wikipedia, which gives a clear and more extensive account of the topic https://en.wikipedia.org/wiki/Classification_rule. This provides links to more comprehensive literature.

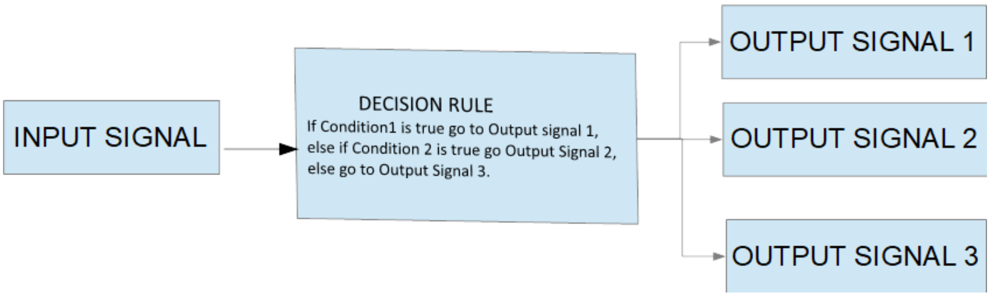
[29] More formally. Given a data set consisting of pairs x and y, where x denotes an element of the population or sample and y the class it belongs to, a classification rule $h(x)$ is a function that assigns each element x to a predicted class $\hat{y} = h(x)$. Where $\hat{y}$ represents an approximation.

89. The probability of the correct assignment to Class A or Not Class A depends on the quality of the data, the power of the decision rule, and a lack of bias.

- Generally, the less representative the data is of the population (see Section V.F) the greater will be the likelihood of a false positive or negative.
- The power of a decision rule is its ability to distinguish between different classes. The wording of a decision rule is important and the more open it is to interpretation, the less is its power. For example, the interpretation of the term “reasonable certainty” as a classifier for proved oil and gas reserves is open to varied interpretation and has been a subject of debate for many years.[30] Section V.F discusses the meaning of certain words as expressed by the Median and the Interquartile range of associated probabilities from a metadata analysis of surveys of word usage reported by Mosteller and Youtz.[31]

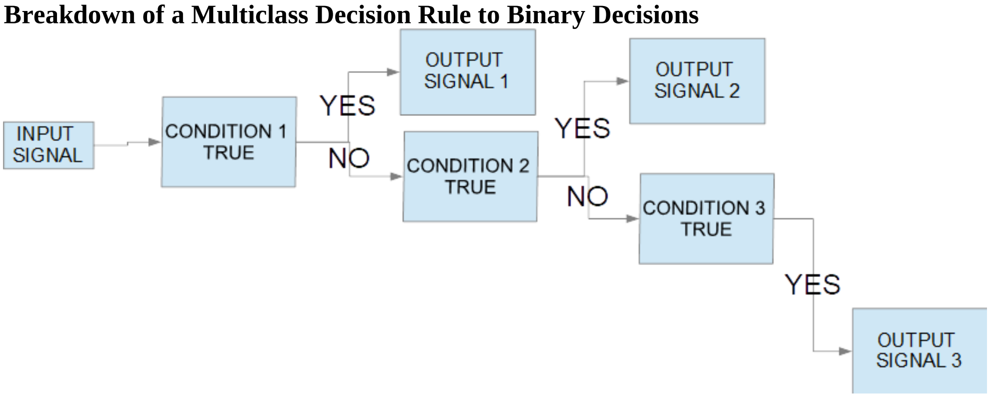
90. Multiclass decision rules assign an object to more than one class, as in Figure IV below and a composite decision rule should be constructed, such as in Figure V:

Figure IV
A Multiclass Decision Rule



91. This will get more complex as the number of decisions increase and it is better to break it up into a series of binary decision rules as in Figure V.

Figure V
Breakdown of a Multiclass Decision Rule to Binary Decisions



B. Decision Criteria

92. The discussion above describes the basics of decision rules but UNFC Classes are not structured for simple binary decision rules and may need to be broken down to a series of binary decision rules. This may not be a trivial exercise, and some simplification and rules of thumb may be appropriate. However, the principles should be kept in mind, especially for the most important decision rules.

93. UNFC resource classes are of the form E <u>and</u> F <u>and</u> G for which all the relevant categories must be satisfied.

[30] Harrison, B., Falcone, G., 2017. Op cit.
[31] Mosteller, F., and Youtz, C., Op cit.

94. Resource classification systems that have been aligned with UNFC, and others, contain definitions and guidelines on which decision rules can be based but require careful review to minimise uncertainty in their interpretation. An example of this is a question that appears to be clear and simple, but is not, is the criterion for a discovery of hydrocarbons by a well:

- Has a well that has been drilled identified the presence of a significant quantity of hydrocarbons?

95. The answer would seem to be a simple, binary "Yes" or "No" but may not be straightforward as, since it hides a multitude of detailed questions, such as:

- Has a well actually been drilled? This is usually easy to answer, but a well may not have been drilled, is not in the claimed location, or has not penetrated the interval of interest.
- What is the evidence for the presence of hydrocarbons: oil cutting of mud while drilling, cuttings, logs, cores, tests, and what type of tests? These all carry their own degree of uncertainty that should be considered in developing a decision rule.
- What constitutes a "significant" quantity? PRMS states, "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".[32]
- A question that is occasionally raised when developing a decision rule for a discovery, is whether a "significant" quantity requires that a flow test has demonstrated the presence of moveable hydrocarbons (not necessarily economically viable).[33] What would "demonstrated" mean here?

96. If the question is modified to:

- Has a well been drilled and identified the existence of a significant quantity of potentially recoverable hydrocarbons?[34]

97. The term "potentially recoverable" adds a further level of complexity that cannot be pursued in detail here, but suggests further questions, such as:

- What level of certainty does the word "potentially" signify: 90%, 50% … probability?
- What rates and forecast quantities are needed to answer this question in the affirmative?
- Does "potentially" mean that there is already a developed recovery technology or that it provides an incentive to develop a recovery technology (experimental technology or technology under development).
- Does it imply economically recoverable?

98. This example may be similar to one for mining but although not directly relevant for other resource types, it shows that building a decision rule requires careful consideration of the definition as it applies to a specific project. In mature areas there is often enough precedent for simple empirical rules to be adequate; in less developed areas, a deeper analysis may be required.

99. Examination of resource guidance and definitions for any type of resource would reveal similar layers of complexity that cannot be pursued here.

[32] PRMS 2.1.1 Determination of Discovery Status.

[33] This has been a topic of vigorous debate between engineers and geologists, the former often contending that a flow test is required to claim a discovery and the geologists that it is not. The advent of unconventional hydrocarbons seems to have rendered the question moot, in favour of the geologists.

[34] This is part of the discovery criterion in PRMS.

C. United Nations Framework Classification for Resources

100. UNFC can be described as a ternary system in which each resource class must satisfy the levels of the criteria of the three categories, E, F, and G. As currently constituted the UNFC contains 48 classes (colloquially, "boxes") in the main body of the "cube" plus two outliers (Sold or used production and Production which is unused or consumed in operations).

101. Progression through the E-F-G system is essentially a probability dependent process that the relevant quantity will progress, from box to box, to eventually being provided to a user (111). Uncertainty (high, moderate, low) is a specific criterion for the G axis, but it is not clear how this translates into uncertainty in the E and F categories.

102. Starting from the least known and most uncertain class (E3F4G4) to a final point of most certainty (E1F1G1) with no classification reversals, and that moves from one class to another are orthogonal (i.e., only up, or sideways), there are several possible routes. Depending on its location, each UNFC box allows a specific number of moves to an adjacent box. For instance, there are three possible moves for E3F4G4 (to E2F4G4, E3F3G4, E3F4G3), but a corner box such as E3F4G1 has only two permissible changes and there are no possible changes once E1F1G1 has been reached. The 48 basic E-F-G class definitions generate 103 sets of definitions to move through the UNFC cube, plus two more for the Sales and Non-sales quantities.

103. It is beyond the scope of this report to examine all the 48 definitions, but for example:

104. E1 states, "Development and operation are environmentally-socially-economically viable on the basis of current conditions and realistic assumptions of future conditions. All necessary conditions have been met (including relevant permitting and contracts) or there are reasonable expectations that all necessary conditions will be met within a reasonable timeframe". This requires decision rules for an identified resource for which there is an applicable economically viable recovery process that includes:

- The creation of a "project" for which the economic viability can be assessed.
- Whether the relevant social, and environmental factors have all been considered and have either been satisfied or there is a high probability that they will be satisfied.

105. F2 states, "Technical feasibility of a development project is subject to further evaluation". This requires a decision rule for a resource that has or may be discovered and is in the process of assessing factors such as:

- A potentially applicable recovery process that is still being assessed.
- The creation of a "project" to assess the likelihood of a successful recovery project.
- An estimate of the quantities that may be technically recovered.

106. The G-axis definitions use the term "known source" but without clear guidance as to what this means although there is a reference to resource specific guidance in the glossary. PRMS and COGEH contain further guidance for petroleum. The latter is more extensive and devotes two pages to describing the criteria for the superficially simple term "known accumulation".

VIII. Recommendations

107. Every project is different and may be evaluated and categorized under different Realms of Discourse, but some recommendations are given here.

- Evaluation and classification should be "fit for purpose".
- Be clear about the objective.
- The Realm of Discourse should match the purpose of an evaluation.
- Construct a project and scenarios to satisfy the objective and the ROD.

- Understand the quantity and quality of your data; to what extent it represents the resource being evaluated, any biases it may introduce, and the associated uncertainty.
- Identify your contingencies and the actions that are needed to satisfy them.
- Quantitative probabilities are rarely available for categorization and qualitative probabilities are most frequently used. These should be assigned with care and, when important, may warrant a disciplined approach such as the Delphi method.
- Decision Rules should be as clear as possible and it should be clear about what the criteria and terms they contain mean.
- There should always be a report that is in enough detail to be the basis for an audit. However, in many cases, a shorter report will be more useful. This will depend on the needs of a user and may be from half a page to many pages.
- This report is intended to lay out some initial ideas on resource classification and further thought on this topic is warranted.
- Many of the examples, etc., are from the oil and gas industry. The content of the report would benefit from input from other resource types.

Glossary of Terms

108. This glossary is provided to clarify terms used in this document and may differ from the glossaries in UNFC and associated guidelines such as PRMS and the CRIRSCO Template. An attempt to bring them into conformity would be useful.

Classification A procedure by which a resource quantity is assigned to a UNFC Sub-class, Class, or Category.

Given a population whose members each belong to one of a number of different sets or classes, a classification rule or classifier is a procedure by which the elements of the population set are each predicted to belong to one of the classes. A perfect classification is one for which every element in the population is assigned to the class it really belongs to. An imperfect classification is one in which some errors appear, and then statistical analysis must be applied to analyse the classification. (Wikipedia)

Contingency A specific criterion or condition that must be satisfied before a project can proceed. A contingency is unique to one of the E, F or G categories.

Decision Gate A decision gate is an approval event with established entry and exit criteria that are embodied in a decision rule.

Decision Rule A decision rule expresses the criteria for a satisfying classification as a UNFC class by means of a decision gate.

Environmental The physical, chemical, and biological impact on, or changes to, the surrounding pre-existing environment, due to a project (e.g. heavy metal contamination in soils or water, disruption of wildlife habits and migration characters, etc.).

Externality A cost or benefit that affects a party who did not choose to incur that cost or benefit.

Internality A cost or benefit that affects an equity participant in a project.

Political Action by a controlling organization that may influence, impede, prevent, or facilitate the ability to proceed with a project.

Project A defined development or operation which provides the basis for environmental, social, economic and technical evaluation and decision-making. This is not necessarily the definition used in the various regulatory codes.

Realm of Discourse (ROD) Describes the conditions, the context, and the reason for evaluating and classifying a resource.

Scenario Describes the specific details, activities, and conditions under which a project is evaluated, such as timing of activities, forecasting production rates, and costs. The same project may be assessed under several scenarios,

Social The impact on humans and society, of environmental changes, such as:

- Effects stemming from environmental changes (e.g. health issues due to heavy metal contamination).
- Changes in social systems and structures, (e.g. ownership claims, traditional land usage, land and other value changes, changes in local population community structures, the creation of jobs and economic activity, etc.).

Source Sources, such as bioenergy, geothermal, hydro-marine, solar, wind, injection for storage, hydrocarbons, minerals, nuclear fuels and water, are the feedstock for resource projects from which products can be developed. The sources may be in their natural or secondary (anthropogenic sources, tailings, etc.) state.

Annex

Members of the Social and Environmental Considerations Working Group

111. Members of the Social and Environmental Considerations Working Group (and its predecessor, the Social and Environmental Considerations Task Force) are:

David Elliott (Chair)

John Atherton

Kathryn A. Campbell

Rodrigo Chanes-Vicente

Dr. H.G. Chong

Julio Claudeville

Sigurd Heiberg

Julian Hilton

Karen Jenni

Luis López

Michael Lynch-Bell

Sarah Magnus

Luis Martins

Carrie McClelland

Dennis Amos Mwalongo

Michael Neumann

Thomas Schneider

Slavko Solar

Claudio Virues

Yang Hua.