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**GUIDELINES TO THE UNITED NATIONS INTERNATIONAL FRAMEWORK
CLASSIFICATION FOR RESERVES/RESOURCES**

SOLID FUELS AND MINERAL COMMODITIES

(Submitted by the UN-Task Force on Reserves/Resources for
Solid Fuels and Mineral Commodities)^{*/}

1. Introduction

The United Nations International Framework Classification for Reserves/Resources - Solid Fuels and Mineral Commodities - (abbreviated: UN Framework Classification) has been designed and formulated during the last six years with the participation and assistance of more than fifty countries and organisations. Furthermore, the content of the major conventional classification systems has been taken into consideration, thus ensuring that the UN Framework Classification reflects the conventional systems in one way or another. This will facilitate their harmonisation with the UN Framework Classification and their incorporation into it.

The UN Framework Classification, being the latest effort to introduce a universally acceptable and internationally applicable scheme for classifying and reporting

^{*/} In accordance with the decision of the Committee on Sustainable Energy at its last session in November 2000 (ECE/ENERGY/43, para., para12.(iv).

reserve/resource data, represents an advance on conventional systems in three significant ways.

Firstly, the numerous different terms describing classes of reserve/resources of increasing geological assurance are replaced by activity-related terminology. This is based on the fact that the geological assessment activities used worldwide as standard professional practice, i.e. Reconnaissance, Prospecting, General Exploration, and Detailed Exploration, in order of increasing detail, each produce resource data with a clearly defined degree of geological assurance. Secondly, the same principle of using generally accepted consecutive stages of investigation is applied to obtain the classes of increasing degree of Feasibility Assessment, i.e. Geological Study, Prefeasibility Study, and Feasibility Study and/or Mining Report. Thus, we have classes reflecting conventional professional practice which define an increasing degree of assurance of economic viability. Thirdly, the above classes based on stages of assessment are superimposed on the conventional classes based on descriptive terms and definitions. Thus, the different terms and definitions currently used for classifying mineral reserves/resources can be readily correlated with those of the new UN Framework Classification.

Designed as an umbrella system, the UN Framework Classification provides an efficient link between market economy countries and countries in transition in terms of reporting and communication of reserve/resource data. Resulting improvements in the international comparability of mineral statistics will benefit all users of resource information. In addition, the use of Feasibility Assessment studies based on the format typical in market economies will contribute towards encouraging private foreign investment and facilitate loan financing in the countries in transition.

The Final Version of the UN Framework Classification was published by UN/ECE in February 1997 as ENERGY/WP. 1/R.70 document. This original English-language version has been translated and published by UN/ECE in the following languages: Chinese, French, German, Portuguese, Russian and Spanish. Furthermore, various nations have translated the UN Framework Classification in their language like for example Hungary and Bulgaria. The UN Framework Classification was endorsed by the 50th session of UN/ECE in March 1997 and its world-wide application recommended by ECOSOC session in July 1997. The Classification is now undergoing a trial application period which is being monitored by UN/ECE.

When preparing these Guidelines extensive use of the literature listed under References has been made, without individually citing in the text of the Guidelines.

2. Objective

These Guidelines are aimed at both technical and non-technical persons and are designed to assist in the use and application of the UN Framework Classification. The

definitions of terms relevant to the UN Framework Classification are given in Appendix I making the Guideline a comprehensive document. The main objective of the Guidelines is to assist in incorporating the numerous conventional classifications into the UN Framework Classification in order to make them comparable. This harmonisation will finally allow mineral statistics to be communicated internationally using a uniform system based on market economy criteria. These Guidelines can be adopted on a national basis, taking into account country specific features.

For those who do not deal daily with the classification of reserves/resources, a Key for the Classification of Reserves/Resources has been prepared (ECE-UN document: ENERGY/2001/10). This Classification Key provides the user with an easy to use tool for classifying reserves/resources according to the UN Framework Classification.

It should be emphasised that the UN Framework Classification is not intended as a means of regulating the methods by which Mineral Resources and Mineral Reserves are estimated or of controlling national and in-house procedures for estimating and accounting. Its purpose is to provide a standard international framework within which important information on Mineral Reserves and Mineral Resources is reported to all interested parties.

The UN Framework Classification has been designed in such a way as to be flexible in application in order to accommodate different interests and requirements. For example an individual mining company is initially interested in estimating and classifying its reserves for the purpose of internal production planning. Mining houses, in particular the major ones, are more interested in establishing their overall reserve/resource situation, since it is of importance for strategic planning and investment decisions. In addition, mining houses monitor the reserve/resource situation of competing companies, even on a global scale, in order to analyse the market situation of a given mineral commodity. Investors and banks involved in financing mining projects are interested in the estimates and classification of reserves/resources for a given project and its global status, in order to evaluate the potential of their investment and the associated risks. Governments, in particular in market economy countries, require reliable, internationally comparable reserve/resource information in order to secure an adequate supply of mineral commodities in the future. International institutions are interested in the world mineral market and require a global classification system.

This wide range of interest in reserve/resource estimates and their classification underlines the importance of having a uniform system that is flexible enough to meet all these demands.

3. Application of the UN Framework Classification

Since the introduction of the UN Framework Classification in 1997, a number of countries have started to apply it on a national level and to adopt it to their specific needs. Other countries are considering applying it, and several countries without their own national

classification system are now commencing to formulate a national system on the basis of the UN Framework Classification.

The UN Framework Classification consists of a three-dimensional grid with the following three axes: Feasibility Assessment, Geological Assessment and Economic Viability. Each of these will be dealt with separately below.

3.1 Geological Assessment

The numerous different terms used in conventional classifications for describing classes of resources of increasing geological assurance are replaced by activity-related terminology. Thus, instead of using a more or less arbitrarily chosen qualitative attribute to describe the degree of geological assurance of a given class, the system uses terminology related to the process of Geological Assessment, which is conducted in stages of increasing detail. The basic idea is, therefore, that the typical consecutive stages of geological investigation, i.e. Reconnaissance, Prospecting, General Exploration, and Detailed Exploration, each produce resource data with a clearly defined degree of geological assurance. These four stages are therefore used as Geological Assessment classes in the classification.

In defining the four major consecutive stages of Geological Assessment: Reconnaissance, Prospecting, General Exploration and Detailed Exploration, qualitative descriptions as used in the conventional systems were taken into consideration. Thus, correlation is feasible between the different systems without major adjustment.

Geological Assessment of a deposit or part of it depends on the interpretation of limited information on location, shape and continuity of the mineralisation and on the results of sampling. Appendix II provides a detailed description of the requirements of a Geological Study. The choice of the appropriate class depends on the quantity and quality of data available and the level of confidence attached to the data. The choice of the appropriate class is of prime importance as the consecutive Feasibility Assessment and mining decision is based on the choice made.

Geostatistics has been proposed as the best, objective means of choosing the appropriate class. It has become increasingly important for estimating reserves/resources of individual deposits and is used on a regular basis by those companies and institutions having suitably qualified personnel. It is furthermore used in the stage of Feasibility Study and to a less degree in the stage of Prefeasibility Study. For the purpose of reserve/resource classification, however, it has not yet been accepted in practice for a number of reasons.

One reason is that a meaningful geostatistical study requires a sufficient amount of data, which is probably only available in the Detailed Exploration and General Exploration classes. Another reason is that geostatistics normally requires an expert, who is often not available. (The number of geologists trained in geostatistics is, however, increasing and thus

geostatistics may eventually be accepted for classification purposes in the future.) Further, not all geological uncertainties can be dealt with by geostatistics, notably those due to tectonic deformation.

Other conventional systems such as that proposed by the CMMI stipulate that the choice of the appropriate class must be determined by a Competent Person. Such a person is defined as an individual who is a Corporate Member of a relevant institute and has a minimum of five years experiences in the estimation, assessment and evaluation of mineral reserve/resources similar to the type of mineralisation under consideration.

The approach used by the former communist countries for classifying classes of Geological Assessment is based on practical experience. A similar method is used in other countries like USA and Canada for coal resource classification, for example. In principal the tectonic setting and type of mineralisation are categorised into groups of differing complexity. Within each group a minimum distance of observation points is recommended for the different stages of geological assessment. The obvious advantage of these recommendations lies in the input provided by practical experience. In addition, it gives a valuable guide at an early stage of geological assessment for planning the layout of the required investigation. Experience shows, however, that if the recommendations are followed too rigidly, this procedure may result in over-exploration. Furthermore such grouping tends to become too complicated if it has to take into account too many different types of mineralisation. It is recommended gathering experience on the optimal exploration patterns for chief different tectonic settings and types of mineralisation at a national level and to apply this as a guide for assigning the appropriate class.

3.2 Feasibility Assessment

Feasibility Assessment studies form an essential part of the process of assessing a mining project. Feasibility Assessment used as a principal dimension in the classification, and reporting, of mineral reserves/resources has the benefit of clearly documenting the validity and reliability of the statements made. This is because the typical consecutive stages of Feasibility Assessment, i.e. Geological Study as initial stage followed by Prefeasibility Study and Feasibility Study/Mining Report, are well defined in terms of content and margin of error.

The fact that most classification systems - with the exception of the former Russian system - do not provide accurate guidelines on assessing mining projects naturally leaves ample room for the judgment of the individual estimator. Thus, as long as the ways and means of the assessment process are not accurately defined and documented, the validity and reliability of the statements cannot be controlled effectively. The inevitable effects are lack of comparability of reserve/resource data and unreliable information on investment risks associated with mining projects.

The explicit use of Feasibility Assessment studies for assessment and reporting purposes, reduces the danger of different people have a different understanding of what is

economic and what is not. Planners know exactly that mineable quantities backed by a bankable feasibility study can be brought into production in a reasonable time and investors are better able to assess the risks associated with a mining project and are, thus, in a position to provide finance at more favourable terms.

The Feasibility Assessment dimension enables the UN Framework Classification to improve the accuracy of international reporting and enhances the comparability of mineral statistics. This should benefit all nations. As such it can provide an efficient link between market economy countries and countries in transition in terms of reporting and communication of reserve/resource data. The use of Feasibility Assessment studies based on the format typical in market economies would, furthermore, encourage private foreign investment and facilitate loan financing in the countries in transition. The typical requirements of a Feasibility Study are listed in Appendix III.

Finally, on a national level this system, in particular the Feasibility Assessment classes, can also provide an indication regarding the state of maturity of a country's exploration and mining sector. While in many developing countries, large quantities of resources will still be reported under the Geological Study class, countries with a long mining tradition would have most of their reserves/resources in the Feasibility Study/Mining Report class.

3.3 Economic Viability

All contemporary classifications rank reserves/resources according to their degree of Economic Viability into Economic and Subeconomic classes. The term Economic invariably means that the quantities of reserves in this class are considered to be exploitable at a profit under existing socio-economic conditions and with current mining and processing technology. Consequently, quantities which do not meet this requirement at the time of assessment are, by definition, Subeconomic provided they may become Economic in future.

The degree of Economic Viability (Economic or Subeconomic) is assessed in the course of Prefeasibility and Feasibility Study/Mining Report. A Prefeasibility Study provides a preliminary assessment with a lower level of accuracy than that of a Feasibility Study, by which Economic Viability is assessed in detail. In this way the UN Framework Classification provides, in addition to the degree of Economic Viability, a measure of its accuracy. For example in the English language version, the Proved Mineral Reserve class refers to economically mineable amounts assessed with high accuracy by means of a Feasibility Study/Mining Report, while a Probable Mineral Reserve assessed by means of a Prefeasibility Study has a lower degree of accuracy. In direct relation to the accuracy requested for a Feasibility Study and a Prefeasibility is the accuracy in which the Geological Assessment has to be undertaken. For this reason a Feasibility Study is based on Detailed Exploration while a Prefeasibility Study includes resource data obtained by General Exploration as well. As a rule geological data obtained during the Prospecting and Reconnaissance stages is insufficient to undertake a meaningful Feasibility Assessment.

The resource estimate undertaken in the course of Geological Assessment contains a preliminary evaluation of Economic Viability, which is normally done by application of meaningful cut-off values from comparable mining operations. Thus, Geological Study represents the initial stage of Feasibility Assessment; in general the accuracy is so low that only the "Economic to Potentially Economic" range is quotable, which is referred to as being of Intrinsic Economic Interest. It is recommended that the cut-off values most commonly used on national level be compiled and used as a guide.

4. Systems integration and reporting of mineral reserves/resources figures

The principal objective of the continuing international discussion on reserve/resource classification systems is to establish a universally acceptable and generally applicable system.

As an umbrella system, the UN Framework Classification has been designed in a manner that will enable the integration of the various national systems. Fig. 1 illustrates how the UN Framework Classification, as an embracing matrix, permits existing national systems to retain their classification units.

Fig. 1: Integration of National Systems into the UN Framework Classification

United Nations International Framework Classification for Reserves/Resources - Solid Fuels and Mineral Commodities -					
UN International Framework ↓	National System ↓	Detailed Exploration	General Exploration	Prospecting	Reconnaissance
Feasibility Study and/or Mining Report		(111) 1	usually		
		(211) 2	not		
Pre-feasibility Study		(121) + (122) 1	relevant		
		(221) + (222) 2			
Geological Study		(331) 1 - 2	(332) 1 - 2	(333) 1 - 2	(334) ?

Economic Viability 1 = economic 1 - 2 = economic to potentially economic (intrinsically economic)
Categories: 2 = potentially economic ? = undetermined

Code: (111) Date :

All countries assisting in finalising the UN Framework Classification indicated that their national systems could be integrated, in some cases with minor adjustments. For example, in one nation the Prefeasibility Study stage is carried out in practice in several

different steps of increasing detail prior to the Feasibility Study. Such individual sub-classes can be inserted into the UN Framework Classification on national level, and international comparability is maintained.

In other countries the Detailed Exploration stage is subdivided and an additional pre-mining exploration sub-stage is added on national level, which again is not incompatible with the UN Framework Classification. In a number of countries no Feasibility Assessment is undertaken in the case of low-investment mineral commodities like sand and gravel. The economic viability is simply assumed by experience, and mining/quarry operations are then started on this basis. In such cases it is possible to quote in the UN Framework Classification under the Geological Study stage that such deposits are economically mineable. A detailed description is provided in the Key for the Classification of Reserves/Resources on how to classify low-investment mineral commodities.

Another country requires simple cost-benefit estimates prior to granting a mining licence for low-investment commodities. Consequently this country has modified the definition of Prefeasibility Study to cater for this specific requirement. These few examples show the flexibility of the UN Framework Classification in its adoption to national requirements as well as those of specific mineral resources.

A detail of substantial practical relevance, finally, is the format of the reporting forms to be used under the UN Framework Classification. A proposal for an integrated reporting form based on the classification principles of the UN Framework Classification is presented in Fig. 2.

Fig. 2: Integrated Reporting Form

**United Nations International Framework Classification for Reserves/Resources
- Solid Fuels and Mineral Commodities -**

Deposit / Mine	Feasibility Study and/or Mining Report		Prefeasibility Study		Geological Study			
	Economic	Potentially economic	Economic	Potentially economic	Detailed Exploration	General Exploration	Prospecting	Reconnais- sance
	(111)	(211)	(121) (122)	(221) (222)	(331)	(332)	(333)	(334)
Total								

 = National System

Date :

Code: (111)

In order to enable data documentation on a sheet of paper or using a computer spreadsheet program, the classification matrix has been simplified into the above form. This

is accomplished by an integrated structure in which reporting dimensions are both superimposed and arranged side by side. The resulting reporting form encompasses three main compartments in accordance with the assessment stages used in the UN Framework Classification for categorisation purposes. The main compartments of the Feasibility Study/Mining Report and of the Prefeasibility Study are further subdivided an Economic and Potentially Economic columns. At the level of the Geological Study, at which Economic and Potentially Economic quantities cannot be separated, the subdivision is according to the stage of Geological Assessment reached.

The reporting form is simple in structure and is well suited for the compilation of reserve/resource data from national systems. The same format can be used for regional and international compilations and for company reporting purposes. Data from individual mines or mineral deposits are entered as single lines, in the box corresponding to the assessment stage reached and the degree of Economic Viability established. The sum of the columns provides company or country totals for each class.

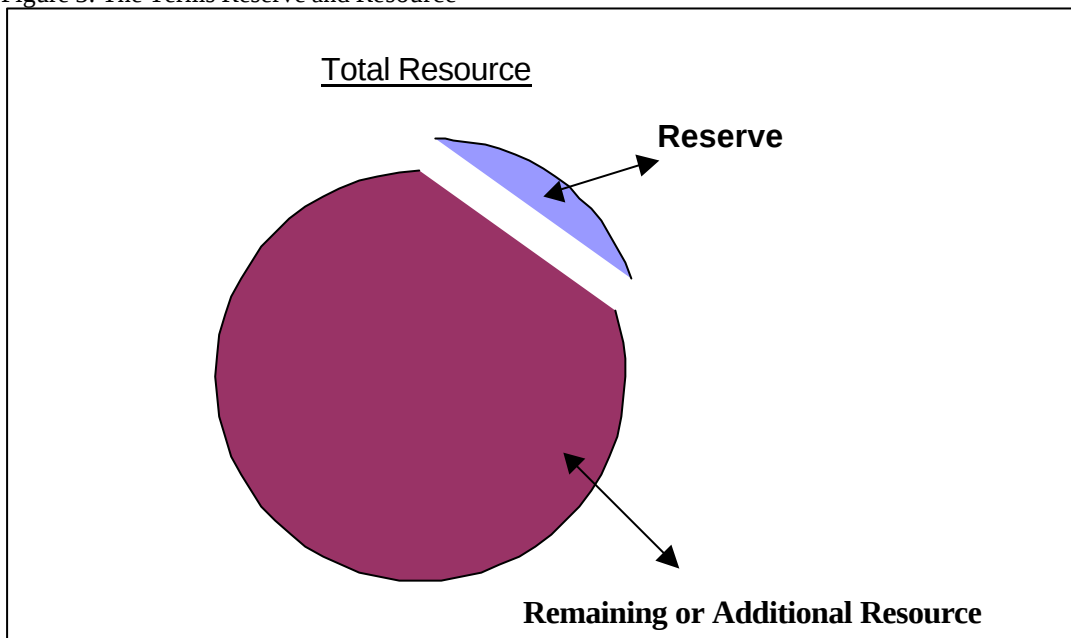
5. The Terms Reserve and Resource

A considerable semantic problem exists worldwide concerning the meanings of the terms reserve and resource. The issue is further complicated by the fact that in some languages one of the terms reserve or resource does not exist and in other languages one or both of the terms have a completely different meaning from that usually attached to them.

However, in the English speaking community dealing with geomatters, a growing trend is to apply the term reserve to economically extractable, appropriately assessed quantities and the term resource to quantities that are currently not economic but may possibly be so in future. Furthermore, there is a growing understanding that reserve is a part of resource, which to some extent contradicts the above meaning of resource as being currently not economic.

For this reason the term Total Resource has been introduced. Thus, Reserve plus Additional Resource comprise the Total Resource, or Total Resource minus Reserve gives the Remaining Resource (Fig. 3), depending on the viewpoint: The investor, banker, and industry tend to see an "additional resource" since the reserve is their prime interest; in contrast, the planners tend to see a "remaining resource" since their prime interest is the Total Resource.

Figure 3: The Terms Reserve and Resource



The statement of Total Resources only becomes meaningful when the amount or percentage of Reserves is provided at the same time.

6. Definition of Reserve and Resource Classes

The terms of the individual Reserve and Resource classes as used in the original English language version of the UN Framework Classification are based on those of the Council of Mining and Metallurgy Institutions (CMMI). The reason for giving preference to the terms of CMMI in the English language was that considerable progress has been made by CMMI during the few last years in establishing a set of uniform Reserve and Resource terms to be used by its members.

The definitions of the UN Framework Reserve and Resource terms are short, abbreviating and reflecting the detailed definitions of the individual assessment stages of the Framework Classification. The CMMI International Reserves Committee and the UN Task Force met in October 1998 and November 1999 and agreed to adopt the CMMI standard reporting

definitions for the Reserve and Resource classes common to both systems and on there specific joint wordings.

The below given Figure 4 provides for the English language Reserve and Resource terms and definitions of the UN Framework Classification and the joint CMMI/UN ones. Table 1 represents an update of Appendix II of pages 15 to 17 of the UN/ECE document: ENERGY/WP.1R.70 (17 February 1997): United Nations International Framework Classification for Reserves/Resources - Solid Fuels and Mineral Commodities - Final Version.

It should be noted that the content of both sets of Reserve and Resource definitions is identical. Furthermore, the UN Framework Classification provides for three additional Resource classes which are of particular interest for government planning purposes.

Figure 4: Proposed English Language Reserve/Resource Terminology

**United Nations International Framework Classification for Reserves/Resources
- Solid Fuels and Mineral Commodities -**

UN International Frame- work ↓	National System ↓	Detailed Exploration	General Exploration	Prospecting	Reconnaissance
Feasibility Study and / or Mining Report		1 Proved mineral reserve (111) 2 Feasibility mineral resource (211)	usually not relevant		
Prefeasibility Study		1 Probable mineral reserve (121) 2 Prefeasibility mineral resource (221)			
Geological Study		1 - 2 Measured mineral resource (331)	1 - 2 Indicated mineral resource (332)	1 - 2 Inferred mineral resource (333)	? Reconnaissance (334) mineral resource

Economic Viability Categories:

1 = economic
2 = potentially economic

1 - 2 = economic to potentially economic (intrinsically economic)
? = undetermined

Code: (111)

Date :

Table 1: **Definition of Mineral Reserve and Resource Classes***

Terms and code	UN Framework Classification (UNFC)	English Language Reserve/Resource Terminology (Joint CMMI/UNFC Definitions)
Mineral Reserve	A "Mineral Reserve" is the economically mineable part of Total Mineral Resource as demonstrated by Feasibility Assessment.	¹ A 'Mineral Reserve' is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, and include consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is justified. ²The mineability (Economic Viability) is demonstrated in consecutive Feasibility Assessment stages which may be, in order of increasing detail, Prefeasibility Study and Feasibility Study/Mining Report. A Probable Mineral Reserve may derive from a Prefeasibility Study and a Proved Mineral Reserve from a Feasibility Study or mining activity documentation. Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proved Mineral Reserves.
Proved Mineral Reserve (111)	Demonstrated to be economically mineable by a Feasibility Study or actual mining activity usually undertaken in areas of Detailed Exploration.	¹ A 'Proved Mineral Reserve' is the economically mineable part of a Measured Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, and include consideration of, and modification by, realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate, with a high level of confidence at the time of reporting, that extraction is justified. ²Proved Mineral Reserve may be demonstrated to be economically mineable by a Feasibility Study or actual mining activity usually undertaken at the Detailed Exploration stage. UNFC Code: 111.
Probable Mineral Reserve (121+122)	Demonstrated to be economically mineable by a Prefeasibility Study usually carried out in areas of Detailed Exploration and General Exploration.	¹ A 'Probable Mineral Reserve' is the economically mineable part of an Indicated and, in some circumstances, a Measured Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, and include consideration of, and modification by, realistically assumed mining, metallurgical,

* Revised version of Appendix II,
Document ENERGY/WP.1/R.70
page 15 - page 17

¹ Definition identical for CMMI and UNFC

² Additional UNFC definition

Mineral Resource	A Mineral Resource (Remaining or Additional Resource) is the balance of the total Mineral Resource that has not been identified as a Mineral Reserve.	economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is justified. ² A Probable Mineral Reserve may be demonstrated to be economically mineable by a Prefeasibility Study usually carried out at the Detailed Exploration and General Exploration stages. UNFC Code : 121 +122. A Probable Mineral Reserve has a lower level of confidence than a Proved Mineral Reserve. ¹ A 'Mineral Resource' is a concentration [or occurrence] of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge. ² The resource figures are quoted as being of intrinsic economic interest, depending on the results of a Prefeasibility Study and Feasibility Study. Generally, only in-situ resource figures are reported at this stage of geological assessment. Mineral Resources are subdivided, in order of increasing geological confidence, into Inferred, Indicated and Measured classes. Portions of a deposit that do not have reasonable prospects for eventual economic extraction must not be included in a Mineral Resource.
Measured Mineral Resource (331)	Estimated to be of intrinsic economic interest based on Detailed Exploration establishing all relevant characteristics of a deposit with a high degree of accuracy.	¹ A 'Measured Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm geological and/or grade continuity. ² A decision to conduct a Feasibility Study can be made from the information provided by Detailed Exploration. UNFC Code: 331.
Indicated Mineral Resource (332)	Estimated to be of intrinsic economic interest based on General Exploration establishing the main geological features of a deposit providing an initial estimate of size, shape, structure and grade.	¹ An 'Indicated Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed. ² The level of confidence should be sufficient for deciding whether a Prefeasibility Study and Detailed Exploration are warranted. UNFC Code: 332. An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource, but has a

Inferred Mineral Resource (333)	Estimated to be of intrinsic economic interest based on Prospecting having the objective to identify a deposit. Estimates of quantities are inferred, based on outcrop identification, geological mapping, indirect methods and limited sampling.	higher level of confidence than that applying to an Inferred Mineral Resource. ¹ An ‘Inferred Mineral Resource’ is that part of a Mineral Resource for which tonnage, grade and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which is limited, or of uncertain quality and reliability. ²This level of confidence is usually not sufficient to allow a Prefeasibility Study to be carried out. UNFC Code: 333. An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource.
Reconnaissance Mineral Resource (334)	Based on Reconnaissance, having the objective to identify areas of enhanced mineral potential. Estimates of quantities should only be made if sufficient data are available and when an analogy with known deposits of similar geological character is possible and then only within an order of magnitude.	² A ‘Reconnaissance Mineral Resource’ is based on regional geological studies and mapping, airborne and indirect methods, preliminary field inspection, as well as geological inference and extrapolation. The aim is to identify areas of enhanced mineral potential worthy of further investigation towards deposit identification. The level of confidence is lower than that applying to an Inferred Mineral Resource and is usually not sufficient to quote tonnage and grade figures. UNFC Code 334. Estimates of quantity based on limited information and analogies with known deposits of similar geological character may be possible but are inadequate for classification as Inferred Mineral Resources.
Prefeasibility Mineral Resource (221 + 222)	Demonstrated to be potentially economic by a Prefeasibility Study usually carried out in areas of Detailed Exploration and General Exploration.	² A ‘Prefeasibility Mineral Resource’ is that part of an Indicated, and in some circumstances Measured, Mineral Resource, that has been shown, after a Prefeasibility Study has been carried out, to be not economically mineable. The Prefeasibility Study will have included consideration of realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors, but will have demonstrated at the time of reporting that extraction is presently not justified. This material is identified as being possibly economically viable subject to changes in technological, economic, environmental and/or other relevant conditions. UNFC Code: 221 + 222. A Prefeasibility Mineral Resource has a lower level of confidence than a Feasibility Mineral Resource.
Feasibility Mineral Resource (211)	Demonstrated to be potentially economic by a Feasibility Study or prior mining activity usually carried out in areas of Detailed Exploration.	² A ‘Feasibility Mineral Resource’ is that part of a Measured Mineral Resource, that has been shown, after a Feasibility Study has been carried out, to be not economically mineable. The Feasibility Study will have included consideration of realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors, but will have demonstrated at the time of reporting that extraction is presently not justified. This material is identified as being possibly economically viable subject to changes in technological, economic, environmental and/or other relevant conditions. UNFC Code: 211.

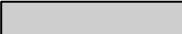
7. World Energy Resource Survey

For a global survey it is of particular importance to use a uniform classification in order to obtain the sums of identical reserve and resource classes. The numerical codification system of the UN Framework Classification would provide a bridge for directly comparing the different reserve/resource classification of oil & gas, coal and uranium. At a global level reserve and resource figures have to be summarised as an overall picture is requested.

The UN Framework Classification is capable of catering for global surveys using the summarizing table shown in Figure 5 and the Reserve and Resource Classes as shown in Figure 6.

Fig. 5: Table for World-wide Survey

Fi	Countries	Prefeasibility Study, Feasibility Study and / or Mining Report		Geological Study	
		Economic	Potentially Economic	Detailed & General Exploration	Prospecting & Reconnaissance
		(111) (121) (122)	(211) (221) (222)	(331) (332)	(333) (334)
		Reserve	Remaining or Additional Resource		
	Total World				

 = International System

Date :

Code: (111)

Fig.6: Reserve and Resource Classes for World Energy Resource Survey

Terms		General Content	Code
Total Resource	Reserve	Economically extractable quantity, appropriately assessed	1 Σ Σ^*
	Remaining/ Additional Resource	Potentially economically extractable quantity appropriately assessed, which is currently not economic but may possibly be so in future	2 Σ Σ
		Intrinsically economic in-situ quantity with future economic prospect pending appropriate assessment	3 Σ Σ

* Σ sum of the individual
classes in question

The Remaining/Additional Resources are made up of two quantities, which might be worth stating separately, as they have considerably different economic significance.

UN/ECE is recommending a modus for directly comparing the different energy reserve/resource classification in the document: ENERGY/2000/8 [August 2000]: FRAMEWORK CLASSIFICATION FOR WORLD ENERGY RESOURCES SURVEY - OIL & GAS, COAL, URANIUM -

8 Codification

The numerical codification system of the UN Framework Classification has been found to be extremely useful in directly comparing the different national and international reserve/resource classes in use worldwide. A full description of the principle behind the codification is given in Appendix IV.

Appendix I *

Definitions of Terms to be used in the English Language Version of the
United Nations International Framework Classification for Reserves/Resources
- Solid Fuels and Mineral Commodities -

Definitions of Stages of Feasibility Assessment

Mining Report	A Mining Report is understood as the current documentation of the state of development and exploitation of a deposit during its economic life including current mining plans. It is generally made by the operator of the mine. The study takes into consideration the quantity and quality of the minerals extracted during the reporting time, changes in Economic Viability categories due to changes in prices and costs, development of relevant technology, newly imposed environmental or other regulations, and data on exploration conducted concurrently with mining. It presents the current status of the deposit, providing a detailed and accurate, up-to-date statement on the reserves and the remaining resources.
Feasibility Study	A Feasibility Study assesses in detail the technical soundness and Economic Viability of a mining project, and serves as the basis for the investment decision and as a bankable document for project financing. The study constitutes an audit of all geological, engineering, environmental, legal and economic information accumulated on the project. Generally, a separate environmental impact study is required. Cost data must be reasonably accurate (usually within $\pm 10\%$), and no further investigations should be necessary to make the investment decision. The information basis associated with this level of accuracy comprises the reserve figures based on the results of Detailed Exploration, technological pilot tests and capital and operating cost calculations such as quotations of equipment suppliers. A detailed list of the items addressed in a Feasibility Study is given in Appendix III.

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- Source: ECE Document, ENERGY/WP.1/R.70

Definitions of Stages of Feasibility Assessment (Cont.)

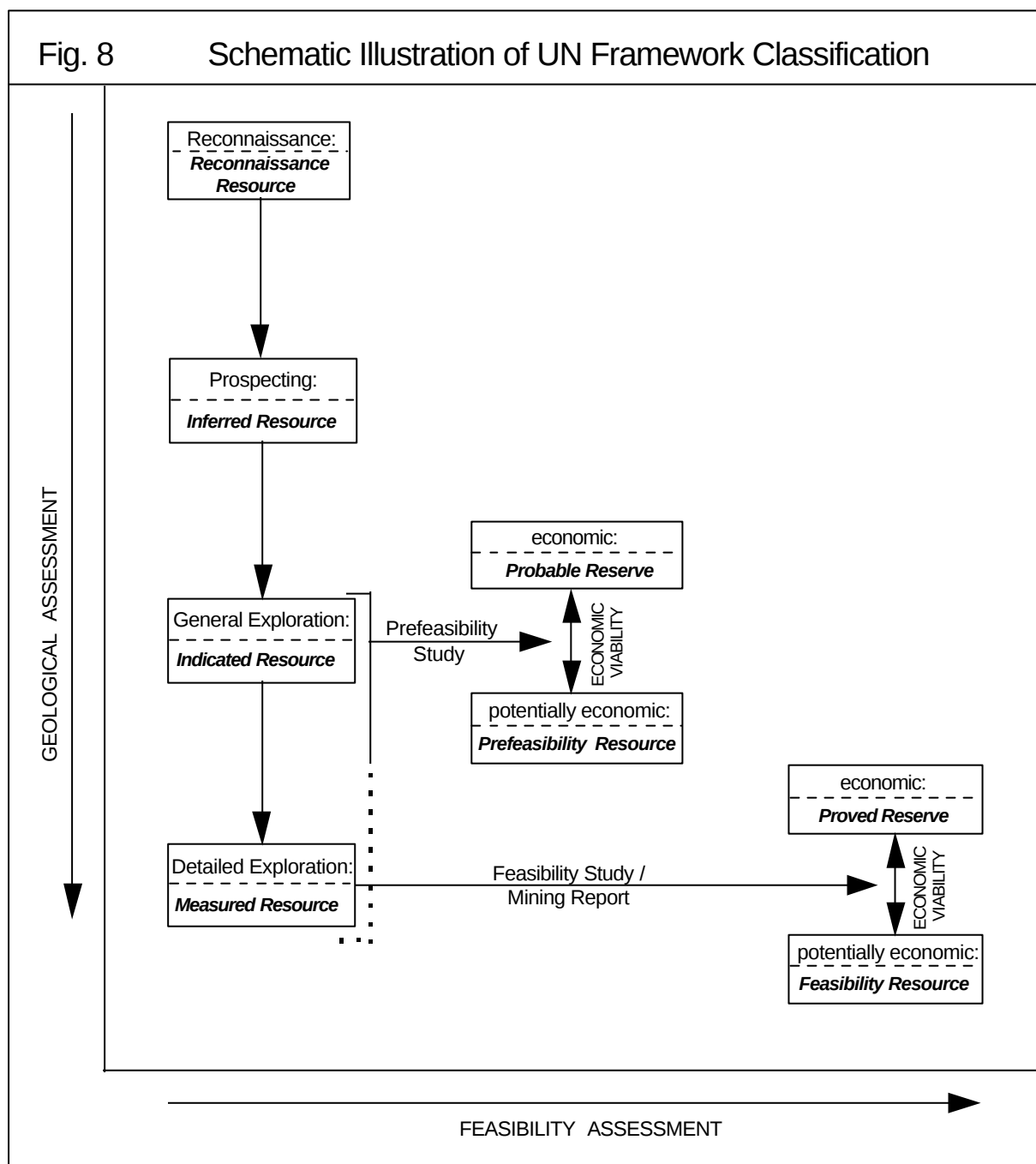
Prefeasibility Study	A Prefeasibility Study provides a preliminary assessment of the Economic Viability of a deposit and forms the basis for justifying further investigations (Detailed Exploration and Feasibility Study). It usually follows a successful exploration campaign, and summarizes all geological, engineering, environmental, legal and economic information accumulated to date on the project. In projects that have reached a relatively advanced stage, the Prefeasibility Study should have error limits of $\pm 25\%$. In less advanced projects higher errors are to be expected. Various terms are in use internationally for Prefeasibility Studies reflecting the actual accuracy level. The data required to achieve this level of accuracy are reserves/resources figures based on Detailed and General Exploration, technological tests at laboratory scale and cost estimates e.g. from catalogues or based on comparable mining operations. The Prefeasibility Study addresses the items listed under the Feasibility Study, although not in as much detail.
Geological Study	A Geological Study is an initial evaluation of Economic Viability. This is obtained by applying meaningful cut-off values for grade, thickness, depth, and costs estimated from comparable mining operations. Economic Viability categories, however, cannot in general be defined from the Geological Study because of the lack of detail necessary for an Economic Viability evaluation. The resource quantities estimated may indicate that the deposit is of intrinsic economic interest, i.e. in the range of economic to potentially economic. A Geological Study is generally carried out in the following four main stages: Reconnaissance, Prospecting, General Exploration and Detailed Exploration (for definition of each stage see below). The purpose of the Geological Study is to identify mineralization, to establish continuity, quantity, and quality of a mineral deposit, and thereby define an investment opportunity.

Definitions of Stages of Geological Study

Reconnais-sance	A Reconnaissance study identifies areas of enhanced mineral potential on a regional scale based primarily on results of regional geological studies, regional geological mapping, airborne and indirect methods, preliminary field inspection, as well as geological inference and extrapolation. The objective is to identify mineralized areas worthy of further investigation towards deposit identification. Estimates of quantities should only be made if sufficient data are available and when an analogy with known deposits of similar geological character is possible, and then only within an order of magnitude.
Prospecting	Prospecting is the systematic process of searching for a mineral deposit by narrowing down areas of promising enhanced mineral potential. The methods utilized are outcrop identification, geological mapping, and indirect methods such as geophysical and geochemical studies. Limited trenching, drilling, and sampling may be carried out. The objective is to identify a deposit which will be the target for further exploration. Estimates of quantities are inferred, based on interpretation of geological, geophysical and geochemical results.
General Exploration	General Exploration involves the initial delineation of an identified deposit. Methods used include surface mapping, widely spaced sampling, trenching and drilling for preliminary evaluation of mineral quantity and quality (including mineralogical tests on laboratory scale if required), and limited interpolation based on indirect methods of investigation. The objective is to establish the main geological features of a deposit, giving a reasonable indication of continuity and providing an initial estimate of size, shape, structure and grade. The degree of accuracy should be sufficient for deciding whether a Prefeasibility Study and Detailed Exploration are warranted.
Detailed Exploration	Detailed Exploration involves the detailed three-dimensional delineation of a known deposit achieved through sampling, such as from outcrops, trenches, boreholes, shafts and tunnels. Sampling grids are closely spaced such that size, shape, structure, grade, and other relevant characteristics of the deposit are established with a high degree of accuracy. Processing tests involving bulk sampling may be required. A decision whether to conduct a Feasibility Study can be made from the information provided by Detailed Exploration.

Economic	Quantities, reported in tonnes/volume with grade/quality, demonstrated by means of a Prefeasibility Study, Feasibility Study or Mining Report, in order of increasing accuracy, that justify extraction under the technological, economic, environmental and other relevant conditions, realistically assumed at the time of the determination.
	The term economic comprises both normal economic and exceptional economic as defined below. These two subcategories are for optional use on a national level.
	Normal Economic Normal economic reserves are reserves that justify extraction under competitive market conditions. Thus, the average value of the commodity mined per year must be such as to satisfy the required return on investment. Exceptional Economic (conditional economic) Exceptional (conditional) economic reserves are reserves which at present are not economic under competitive market conditions. Their exploitation is made possible through government subsidies and/or other supportive measures.
Potentially Economic	Quantities, reported in tonnes/volume with grade/quality, demonstrated by means of a Prefeasibility Study, Feasibility Study or Mining Report, in order of increasing accuracy, not justifying extraction under the technological, economic, environmental and other relevant conditions, realistically assumed at the time of the determination, but possibly so in the future.
	The term potentially economic comprises both marginal and submarginal as defined below. These two subcategories are for optional use on a national level.
	Marginal Economic Marginal economic resources are resources which at the time of determination are not economic, but border on being so. They may become economic in the near future as a result of changes in technological, economic, environmental and/or other relevant conditions. Submarginal Economic Submarginal economic resources are resources that would require a substantially higher commodity price or a major cost-reducing advance in technology to render them economic.
Economic to Potentially Economic (intrinsically economic)	Quantities, reported in tonnes/volume with grade/quality, estimated by means of a Geological Study to be of intrinsic economic interest. Since the Geological Study includes only a preliminary evaluation of Economic Viability, no distinction can be made between economic and potentially economic ¹ . These Resources are therefore said to lie in the range of economic to potentially economic. Generally only in-situ quantity figures are reported.

¹ Except in the case of low investment mineral commodities like sand, gravel and common clay, where a distinction between economic and potentially economic can be made. A detailed explanation is provided in the document: Key for the Classification of Reserves/Resources.



Definition of a Competent Person

The studies involved in the UN Framework Classification must be undertaken by a **Competent Person**. A Competent Person is defined as one who is qualified for the position by training and who has relevant experience in assessing resources and reserves of the type of deposit in question. The qualifications and experience required will vary between countries, for example in some countries licensing may be required.

Appendix II

List of the More Important Items to be Addressed in a Geological Study

The purpose of the Geological Assessment is to identify mineralization, to establish continuity, quantity and quality of a mineral deposit as basis for Feasibility Assessment in order to define an investment opportunity. The Economic Viability is general evaluated initially by assumptions indicating that the deposit is of intrinsic interest.

The main consecutive stages of Geological Assessment are: Reconnaissance, Prospecting, General Exploration and Detailed Exploration. These provide four Resource categories reflecting increasing degree of geological assurance, which is documented in the respective reports. They are termed:

Stage of Geological Assessment	Resource Category
Reconnaissance	Reconnaissance Mineral Resource
Prospecting	Inferred Mineral Resource
General Exploration	Indicated Mineral Resource
Detailed Exploration	Measured Mineral Resource

The UN Framework Classification provides a description of the activities undertaken at each stage and its objective. From this description, the definition of each Resource category is derived, as given in Appendix II of the UN Framework Classification.

The Geological Assessment addresses the items as listed below. The amount of work done increases from stage to stage of Geological Assessment as defined in the UN Framework Classification.

<u>Summary</u>	All the essential factual data in the report should be summarized. If it is concluded that the work should be carried out, then the recommended work, the objectives, and a summary of the cost estimates, should be included. If the report is only descriptive, then the fact that no conclusions or recommendations are given would be discussed in the "introduction".
<u>Introduction</u>	The section should outline the scope and purpose of the report and state under the authority under which it is written. The manner in which the investigation was conducted, the dates of any current and past property examination, the principal sources of information and acknowledgements should be included in this section.
Property Description, Location and Access	A description of the size, continuity, shape and surface rights should be provided. A listing of including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, title interests, staked claims, leases, patents, and surface rights with the hectares and expiry dates should be given.

	If the property titles and rights have been ascertained, then the author should state by whom and in which Recording Office or Land Titles Office. If these were not checked then this fact should be clearly stated. The property location should be clearly identified and should include the following information as required: latitude, longitude, township, district, mining division, etc. as well as the transportation routes and distances from major towns and utilities. The availability of other utilities and resources such as water, timber, electrical power, natural gas, agriculture, manpower, etc., should also be acknowledged. Special environmental situations and development restrictions such as planning acts, parks, nature preservation areas, etc., should be noted as well. Other factors, such as climate, topography, site conditions or factors effecting exploration and development should also be summarized in this section and, if necessary, under separate subheadings. A map(s) showing property, individual land titles, utilities, roads, towns, nearby parks, etc., should accompany this section of the reports.
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History	This section should describe all previous pertinent geological, feasibility and running programs. If this information is from previous reports, suitable acknowledgements must be given. If there is extensive work over long periods, a summary map(s) illustrating the location and significant features of these earlier programs should be included. When data are available in sufficient detail the results of previous program(s) should be tabulated and appropriate plans, sections and profiles also should be provided in this section or in subsequent sections. If mining has previously taken place on the property, a brief description of the workings should be given and the most reliable past production data should be summarized. Comments regarding the reason(s) for closure should also be given; any other unusual positive or negative features of past production should be noted as well as significant production data and other pertinent features from nearby properties.
Geoscientific Investigations	
Geology	A general description of the regional and property geology including the stratigraphy, lithology and structure should be provided, together with appropriate maps and profiles. Description of the thoroughness with which all significant lithologic, structural, mineralogical, alteration, or other geological or geotechnical characteristics were recorded. Significant data are data that could materially influence the estimated quantity and quality of the resource. Description of geological model and inferences made from this model. Discussion of adequacy of data density and reliability, and whether the quality and quantity of information are sufficient to support statements made or inferred concerning potential for significant economic discovery.
Investigation Methods	A general description of the instrumentation and techniques employed and the results of the geological, geophysical and/or geochemical surveys completed should be included together with maps at an appropriate scale. All techniques used to assist in the interpretation of the stratigraphy and structure and to located mineralization also should be included and adequately described.

	Data density: the data density must be stated and a comment should be made on the reliability of such data density in the context of the style and size of the mineralization being reported. Diagrams: where possible, maps, sections and tabulations of intercepts should be included for any material discovery being reported if such diagrams significantly clarify the Report. Historical or current workings in the immediate or general area. Other substantive exploration data, if meaningful and material: – Geological observations; – Indicator minerals: presence, type and quantity; – Geophysical survey results; – Geochemical survey results; – Bulk samples: size and method of treatment; – Metallurgical test results; – Bulk density and rock characterization; and – Potential deleterious or contaminating substances.
The Mineral Deposit	
Features of Deposit	The type of mineralization, the mode of occurrence, the size as indicated by measured or estimated length, width and depth, quantity of mineral(s) of economic interest and relationship of the mineralization to the geology (i.e. gangue, alteration, structure, etc.), geophysics and geochemistry should be clearly stated. Explanation should be given whether the features of the deposit are based on sufficient data or on postulated assumptions; whether constrained by one model or consideration given to possible alternative interpretation. Appropriate maps of any deposits outlined on the property should be included in the report.
Sampling Details	The quantity and quality of sample information is critical to the reliability of resource estimates. Particular attention should be given to this information. Description of accuracy of location of sampling points of sample type and sample collection method (hand, grab, trench, channel, or chip sample; core hole, rotary hole, or reverse circulation; bulk sample). Discussion of sample quality and representativeness (sample recovery, high grading, selective losses or contamination, and any other factors that may have resulted in sample biases). Discussion of whether duplicate samples or alternative methods of sampling were used to verify sample quality. If indirect methods of measurement were used (geophysical methods), these should be described with attention given to errors in interpretation. Description of method used for sample preparation, subsampling and size reduction, and likelihood of inadequate or nonrepresentative sample (improper size reduction, contamination, etc.). Discussion of whether tests were performed to verify the suitability of sample preparation. Particular attention should be given to drill hole logging and other sample information used in resource evaluation.

Analysis Details	Identification of laboratory and analytical method (fire assay, AA assay, emission spectroscopy, etc.). Discussion of precision and accuracy, including the use of check assays, quality control program, and submission of samples to other laboratories for verification. Confirmation of exceptional results, difficult analyses or subjective valuation techniques (e.g. mineral quality valuation). Where doubt exists about material results, those doubts and plans to verify the results must be clearly stated and the verified results reported in a timely fashion.
Quality / Grade	Data aggregation methods: weighted averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades applied and assumption made must be stated. Where aggregate intercepts incorporate short lengths of high grade results with longer lengths of low grade results, the procedure used for such aggregation must be stated and some typical examples of such aggregations should be shown in detail. The assumptions used for any reporting of metal equivalent values must be clearly stated.
Resource Estimation	Mineral Resource estimates are not precise calculations, being dependent on a geological interpretation and on samples which represent only a minute fraction of the mineralized body. Statements of tonnage (or volume) and grade should be rounded so as to reflect this uncertainty. In most situations, rounding to the second significant figure should be sufficient. There will be occasions, however, where rounding to the first significant figure may be necessary in order to convey properly the uncertainties in estimation. This would often be the case with Inferred Resources and will be the case when reporting Reconnaissance Resource figures. In order to reinforce the qualitative nature of a Mineral Resources estimate, it is recommended that the final result always be referred to as an estimation not a calculation. Relationships between widths and intercept lengths of mineralisation should be reported where the geometry is known. Where the geometry of the mineralization with respect to the drill hole angle is not known and only the down-hole lengths are reported, there should be a clear statement to this effect (e.g. "downhole length, true width not known"). Detailed description of the method used and the assumptions made to estimate tonnages and grades (section, polygon, inverse distance, geostatistical or other method). Description of how the geological interpretation was used to control the resource estimates. If a computer method was chosen, description of programs and parameters used. Geostatistical methods are extremely varied and should be described in detail. The method chosen should be justified. The geostatistical parameters, including the variogram, and their compatibility with the geological interpretation should be discussed. Experience gained in applying geostatistics to similar deposits should be taken into account. Discussion of how the tonnage factor (specific gravity) was determined (inferred or measured). If inferred, which assumptions were made and on which basis. If measured, by what method and how frequently. Discussion of whether different tonnage factors were used in different parts of the deposit and why. Discussion of sufficiency of data density to assure continuity of mineralisation and provide an adequate data base for the estimation procedure used. Discussion of the extent to which the interpretation is based on data or on assumptions and whether consideration was given to alternative interpretations or models.

Economic Viability Estimation	In a Geological Study the Economic Viability is not assessed but roughly estimated. This estimation is done by adopting meaningful cut-off values for thickness, grade, depth, and costs by comparison with mining activities carried out in similar deposits. The use of these limiting cut-off values is mandatory for the computation of tonnage/volume and grade/quality resource figures. This implies a judgement by the geologist of order of maximum and minimum limiting cut-off values to be required to enable economic exploitation. However, the degree of assurance of the resource figures with respect to Economic Viability is such that in general no distinction can be made between Economic and Potentially Economic. The resource quantities estimated may indicate that the deposit is of intrinsic economic interest and that there are reasonable prospects for eventual economic exploitation.
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Appendix III**List of the More Important Items to be Addressed by Feasibility Assessment**

The technical soundness and economic viability of a deposit or part of it is investigated by means of Feasibility Assessment. The first stage comprises a Prefeasibility Study which is followed by a Feasibility study.

Feasibility Assessment is the heart of the mine evaluation process. A Feasibility Assessment represents an engineering/economic appraisal of the commercial viability of that project. As such, it is the result of a relatively formal procedure for assessing the various relationships that exist among the myriad of factors that directly or indirectly affect the project in question. In essence, the objective of a Feasibility Assessment is to clarify the basic factors that govern the chances for project success. Once all the factors relative to the project have been defined and studied, an attempt is made to quantify as many variables as possible in order to arrive at a potential value or worth of the property.

Prefeasibility Study	A Prefeasibility Study provides a preliminary assessment of the technical soundness and economic viability of Mineral Resources based on Detailed and General Exploration i.e. Measured Mineral Resource and Indicated Mineral Resource. Both the Measured Mineral Resource and the Indicated Mineral Resource are transformed by virtue of a Prefeasibility Study into a Probable Mineral Reserve if the Economic Viability has been demonstrated to justify extraction under competitive market conditions. On the other hand, if the mineability has been demonstrated to be Potentially Economic, not justifying extraction at the time of determination but possibly so in future, they are transformed into a Prefeasibility Mineral Resource. The Prefeasibility Study addresses the items listed under Feasibility Study, although not in as much detail. It is based on preliminary engineering designs and plans for mining and processing facilities, and initial estimates of project revenues and costs which are obtained in comparison with existing mining ventures. It is constructed to support a continuum of decisions relating to the next major spending requirement of a Feasibility Study.
Feasibility Study	A Feasibility Study represents a detailed analysis of all the parameters contained in the Prefeasibility Study, along with other pertinent factors relating to political and legal aspects affecting project viability. A Feasibility Study is prepared by groups of specialists in the numerous and

varied aspects of mine development. All aspects are planned and costed in detail. They are accompanied by engineering plans, diagrams and maps for the mine, plant, equipment and infra-structure. The capital and operating costs should be estimated with reasonably accuracy (usually within $\pm 10\%$). After-tax cash flow forecasts, including descriptions of the financial assumptions, must also be included as a basis for estimating the economic potential of the deposit.

Specific data requirements for incorporation into Feasibility Studies are

given below. In general, the study contains analyses of the project's geology and deposit characteristics, mineralogy, mineral processing characteristics, designs and plans for mining and processing equipment requirements, construction schedules, investment requirements and timing, estimates of revenues and costs, marketing plans, cash-flow calculations, sources and methods of financing, and risk and sensitivity analyses of important project variables. The purpose of the Feasibility Study is to assess the technical and economic viability of the project and to assist in making the "go/no-go" decision regarding project development.

Although there is no prescribed format for reporting the results of a Feasibility Study, the final report must fulfill the following essential functions:

- Provide a comprehensive framework of established and detailed facts concerning the mineral project.
- Present an appropriate scheme of exploitation complete with plans, designs, equipment lists, etc., in sufficient detail for accurate cost estimation and associated economic results.
- Indicate the most likely profitability on investment in the project, assuming the project is equipped and operated as specified in the report.
- Provide an assessment of pertinent legal factors, financing alternatives, fiscal regimes, environmental regulations, and risk and sensitivity analyses on important technical, economic, political, and financial variables affecting the project.
- Present all information in a manner intelligible to the owner and suitable for presentation to prospective partners or to sources of finance. The document must be "bankable".

A Feasibility Study is based on Probable Mineral Reserves obtained by means of a Prefeasibility Study. It transforms a Probable Mineral Reserve or part of it into a Proved Mineral Reserve if economic mineability has been demonstrated justifying extraction under competitive market conditions. If the mineability has been demonstrated to be Potentially Economic, not justifying extraction at the time of determination but possibly so in future, it is transformed into a Feasibility Mineral Resource. The Geological Assessment should be in the stage of Detailed Exploration providing the degree of accuracy required in a Feasibility Study. This is usually achieved by additional geological investigation pursuing a successful Prefeasibility Study.

The typical Feasibility Study requirements are outlined below. It is convenient to classify a Feasibility Study in the following inter-related categories: Technical, Costing, Marketing, Economic Viability, Other Factors.

Feasibility Study – Technical -	
Geology	An adequate description of the geological setting of the deposit, its local geology, mineralogy and the identification of the ore types.
Reserves	Reserve Estimates - methods and factors used in estimating specific gravity and tonnages, grades, cut-off grades, in-situ, mineable and recoverable reserves. Drilling - size, type, core recovery, spacing, assays, analyses, continuity of mineralisation. Bulk Sampling - amounts, results, where tested, comparisons with core assays.
Mining	Method - reasons for selection, geotechnical testwork, main access, ventilation and pumping. Pre-production Development - amount and timing, main underground facilities and mine design. Mine Plan - forecasts of ore tonnes, grade, waste tonnes, production schedule. Mining recoveries and efficiencies. Equipment Selection - major items, rating and numbers, spares, life and replacement schedules, utilisation and productivity. Manning Requirements - working schedules, manning levels, mine management. Environmental and Safety requirements. Waste disposal arrangements.
Processing	A basic process description together with a summary of studies justifying the choice of the intended processing route should be included. Details of testwork, scale-up and extrapolation factors used. If the treatment is based on a proven and tested process, this should be noted. Typically the following data should be provided: Testwork and derivation of major design parameters; Design criteria and assumptions; Process flow diagrams, plant layout and descriptions; Major equipment list, including ratings, capacities; Product and by-product specifications and tolerances; Working schedule, manning levels; Fuel, power, consumables usage factors; Environmental considerations.
Infrastructure and Services	Infrastructure and services, especially transportation and townships, are major cost items in some projects and often determine the overall economic viability of the proposed operation. The lender needs to be satisfied that adequate provision has been made, especially for projects in remote locations, for items such as: Water/power supplies and services

	Maintenance workshops Transport facilities Housing.
Construction	The sponsor should include a presentation on how he intends to carry out the engineering, procurements, construction and management (EPCM) functions required to convert a project concept into reality. Details should be submitted on matters such as: Responsibility for EPCM functions - in-house or by ontractors/ consultants, and their respective qualifications/capabilities. Construction schedule indicating major activities, allowances for lost time on account of weather/industrial disputes, commissioning and start-up. Manpower requirements. Construction camp and facilities. Labour agreements.
Feasibility Study – Costing -	
Capital Costs	Sufficient background information and detail should be provided to allow a lender to establish a confidence rating in the estimates, and allow him to make comparisons with similar elements of other projects or other available data. Here it is assumed that the estimate is presented in the format of a base cost as of a certain date to which are added allowances for contingencies and escalation. A typical framework of a base cost estimate can consist of the following major components: Direct Costs made up of major equipment, bulk materials, direct labour for installing these materials and subcontracted work. Distributable Costs which cover the services at the job site provided to support the direct labour involved in installing the direct materials. Home Office Costs for off-site services which can include engineering procurement, estimating, personnel, labour relations etc., Gross Margin which includes an allowance for the overhead costs associated with the provision of the home/off-site services plus a profit margin/fee. The estimate description should include: Definitions Date of estimate Summary of costs into identifiable categories and by major equipment/facilities consistent with the "Technical" section. Nature and quantity of quotations. Sources of major equipment, local or overseas. Allocation of freight, duties and landing costs, sales tax.

	Timewise cost expenditure schedule. Contingency allowances. Accuracy range of cost estimates. Escalation rates and money-of-the-day cost estimates. Over-run allowances.
Operating Costs	The presentation should be consistent with the "Technical" descriptions and include: Methods of cost derivation whether from past or comparative experiences, testwork, field trials, "first principles" or design estimates. Specification of costs into fixed and variable components. Labour cost rates by craft and comparisons with industry/local rates. Manning levels. Allowances for training, absenteeism, turnover. Equipment running cost assumptions. Materials, power, fuels, consumables usage factors and unit costs. Freight, royalty, selling expenses to point of sale. Overhead cost estimates. Inflation rate trend studies for major components of operating cost. Effects on future costs due to planned/expected changes in operational factors such as deeper mining, longer hauling distances, variations in ore body characteristics, etc.
Capitalised Costs	A sponsor may prefer to "capitalise" certain of the costs that are of an operating nature for taxation/depreciation purposes. This occurs frequently for pre-production and start-up expenses (also interest on borrowings during construction) and thus presented as part of the capital cost estimate. Another item of an operating nature is capital replacement. The basis for these cost items as well as the working capital requirements should be submitted.
Feasibility Study – Marketing -	
Marketing Overview	It is important to view the project's specific prospects in the context of the total market scene. For this purpose, the following information should be submitted: Industry structure Supply-demand relationships (both historical and projected) Determinants of demand Pricing trends Basis of competition - price, quality, reliability.

Specific Market Aspects	The following type of information should be provided in support of the project's revenue forecasts: - Selling arrangements - spot or term contracts - Price forecasts and justifications, for various products and co-products - Price basis, cif/fob negotiated or tied to a market price - Currency exchange risk - Volume forecast and justifications - Number and size of buyers. If term contracts: type of contract, details of buyers, currency, length of term, volume and minimum-maximum options, stockpile requirements and penalty provisions, protective clauses for costs and currency changes, maintenance of competitive pricing, renegotiation options - Government requirements including export approval tariff protection, price levels Specific marketing advantages/disadvantages of project.
Feasibility Study – Economic Viability -	
Cashflow Forecasts	The main test for overall economic viability, from a lender's point of view, is through cashflow analysis. The Feasibility Study should therefore contain cashflow projections, as well as the corresponding forecasts of the profit and loss and balance sheet statements. A base case cashflow forecast, extending at least through twice the life of the proposed loan(s), should be prepared. It should reflect the project's financial performance under the most probable set of conditions consistent with the costing and marketing assumptions justified elsewhere in the report. All forecasting periods should be at least on a half yearly basis during construction (but preferably quarterly) and for the first year or so thereafter, whilst production is built up to design levels and when major increases in working capital usually occur. Thereafter, forecasting is normally shown on an annual basis. A typical cashflow format would show: - Construction and development work cash expenditures - Equity funds contribution - Loans funds drawdowns - Receipts from sales - Operating cost segregated into identifiable categories - Reclamation cost - Capital additions/replacements - Movement in working capital - Taxation and royalty payments - Scheduled debt service (interest and principal) payments

	Dividend payments Overall cash surplus and deficit position
Inflation Effects	Ideally two sets of cashflow forecasts should be prepared. In the above cashflow forecasts inflation rates assumed over life for revenues, capital costs and operating costs should be stated and applied so that the cashflow forecasts are in money-of-the-day terms and will show the ability to cover debt servicing requirements. Since the bank will wish to apply its own estimates of inflation rates, it is useful to have cashflow forecasts. Uninflated, in constant current money terms to which the bank can apply its estimates. These forecasts should be on an all-equity basis with no financing assumptions so that various financing arrangements can be tested.
Sensitivity Studies	The effect of variations in the base case assumptions should be shown covering: - Sales price - Grade - Operating Costs - Delays in achieving full production - Lower than designed output - Lower than targeted sales.
Feasibility Study – Other Factors -	
Independent Verification	The Feasibility Study should identify those aspects investigated and prepared 'in-house' by the sponsor's own organisation and those by external independent consultants. Where independent consultant organisations have been employed, specific statements by them concerning their scope of assignments, validation conclusions and qualifications should be highlighted in the submission, together with their experience/expertise in the areas within their brief.
Statutory Requirements	The terms and conditions of the mining lease(s) shall be stated. Advices of the appropriate approvals from the respective levels of government, local through to federal, which have been sought and granted as well as any special conditions should be submitted. These would include the outcome of matters such as the projects Environmental Impact Statement, export approval, federal and provincial approvals. Any environmental constraints with regard to operation and rehabilitation should be detailed. Although, ideally, these should be settled before the sponsor looks for loan funds, this sometimes is not practicable, and any future approvals that are pending or still under consideration should also be detailed.
Labour Relations	Labour/industrial relations can have considerable consequences, at both the construction phase and also the operational stage. A presentation on the labour relations scene pertinent to the project, the steps taken by the sponsor to minimise industrial disputes and the allowances provided for such disputes in the planning and cost areas should be included.

Appendix IV

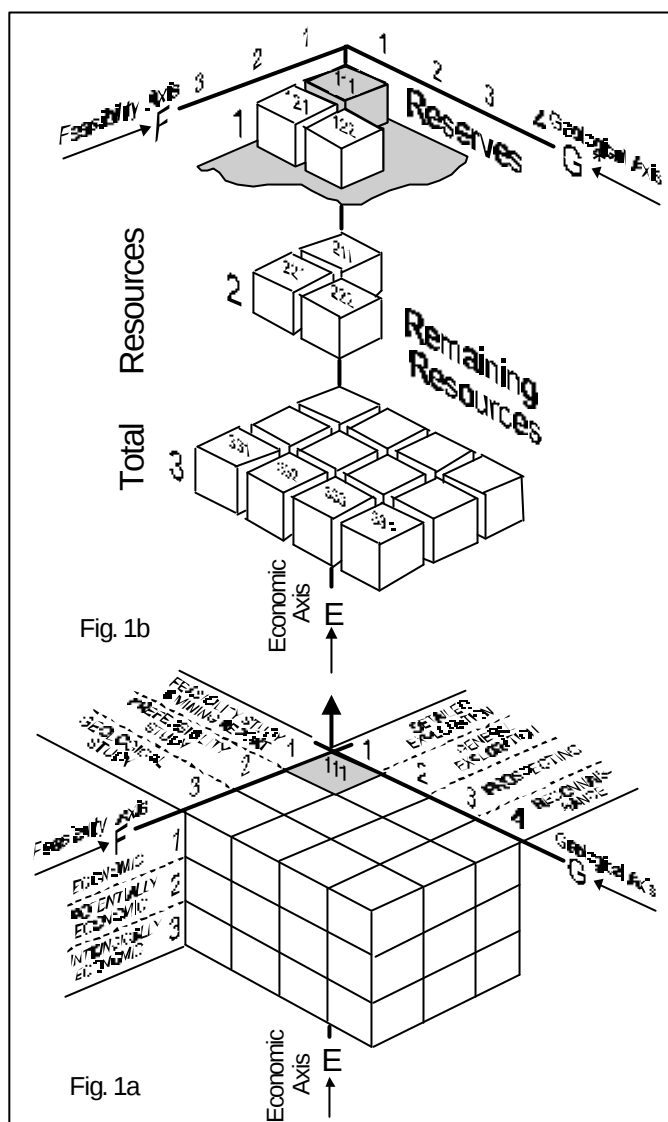
Codification*

Codification has the further advantage of providing a short, unambiguous identification of the reserve/resource classes which facilitates computer processing of data and exchange of information. The codification makes the UNFC a comprehensive, truly transparent international classification system.

Figure 1a shows the principle behind the proposed codification of the UN Framework Classification, the three dimensions of categorization represented by the edges of a cube, the E (Economic) axis for Economic Viability, the F (Feasibility) axis for Feasibility Assessment, and the G (Geology) axis for Geological Study. The digits are quoted in the order EFG firstly because alphabetical order is easy to memorise, and secondly because the first digit refers to the Economic Viability, which is of decisive interest to both mining company and investor.

Numbers are used to designate the different classes; the lowest number, in accordance with the usual perception that the 1st is the best, referring to the highest degree of Economic Viability on the E axis, and the highest degree of assurance on the F axis and G axis. Figure 1b represents an "exploded" three dimensional layout of Figure 1a showing the codified classes which are applicable in practice.

The class coded 111, which is shaded in Figure 1a and 1b, is of prime interest to an investor: it refers to quantities that are economically mineable (number 1 as the first digit), have been proved by means of a Feasibility study or actual mining (number 1 as the second digit), and are based on Detailed Exploration (number 1 as the third digit).



* Source: ENERGY/WP.1/R.70

** Up-dated to: Remaining or Additional Resources

References

- A Guide for Reporting Exploration Information, Resources, and Reserves. Report of Working Party #79 Society for Mining, Metallurgy, and Exploration, Inc. 1991 (updated 1994).
- A Guideline for Reporting of Diamond Exploration Results, Identified Mineral Resources and Ore Reserves. The Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories. Published by NAPEGG, May 1995.
- A Standardized Coal Resource/Reserve Reporting System for Canada. Geological Survey of Canada, Paper 88-21, Energy, Mines and Resource Canada, 1989.
- Australasian Code for Reporting of Mineral Resources and Ore Reserves. Prepared by the Joint Ore Resource Committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia (JORC), Effective September 1999.
- Coal Resource Classification System of the U.S. Geological Survey. Geological Survey Circular 891, 1983.
- DIATCHKOV, S.A. (1994): Principles of Classification of Reserves and Resources in the CIS Countries. Mining Engineering, March 1994.
- ENERGY/WP.1/R.70 ECE-UN document [17 February 1997]: United Nations International Framework Classification for Reserves/Resources - Solid Fuels and Mineral Commodities - : Geneva
- ENERGY/2000/8 ECE-UN document [August 2000]: Framework Classification for World Energy Resources Survey - Oil & Gas, Coal, Uranium: Geneva
- ENERGY/2001/10 ECE-UN document [22 August 2001]: Key for the Classification of Reserves/Resources: Geneva.
- Instructions for Geological Investigations according to stages (Solid Mineral Commodities). Translation of Document No 690 dated 15.12.1975, Ministry of Geology, CSSR (unpublished).
- Klassifikationen, Instruktionen und Richtlinien der Zentralen Vorratskommission für mineralische Rohstoffe der Deutschen Demokratischen Republik. Wissenschaftlich-Technischer Informationsdienst des Zentralen Geologischen Institutes. Berlin, 1964.
- NÖTSTALLER, R. & FETTWEIS, G.B.L. (1996): Comparison of the „United Nations International Framework Classification for Reserves/Resources“ with Conventional Classification System. Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover 1996. (in print).

SME Mining Engineering Handbook. 2nd Edition, Volume 1. Published by Society for Mining, Metallurgy, and Exploration, Inc., Littleton, Colorado, 1992.

WELLMER, F.-W. (1992): Rechnen für Lagerstättenkundler und Rohstoffwirtschaftler Teil 1. Clausthaler Tektonische Hefte 22, Verlag Sven von Loga, 1992.