Classification issues for Mineral and Energy Resources

Bram Edens / Ilaria DiMatteo

11th London Group Meeting, Pretoria South Africa
26-30 March 2007

Background

- No clear guidance in the SEEA-2003 on:
  - the extent of the resources to include in the physical asset accounts
  - the definitions of the different categories of resources (e.g. proven, probable, possible etc.)

  → nat. implementation and int. comparability
- 2004 - UN Classification Framework (UNFC) for Fossil Energy and Mineral Resources

Objective of the paper

- Continue the discussion on the issue of definition of physical reserves (in the issue list – Ch. 7)
- Follow up on the classification issue raised in Hass and Kolshus (2006)
- Identified additional issues related to the issues above

Outline

- Issues:
  - Reserves/resources terminology
  - Reserves/resources classification
  - Aggregation
  - Valuation
  - Additional issues
- Way forward
- Questions to the London Group

Terminology (1)

The SEEA-2003 seems to use the terms *resource* and *reserve* almost interchangeably

SEEA-2003 asset classification:

EA.11 *Mineral and energy resources*

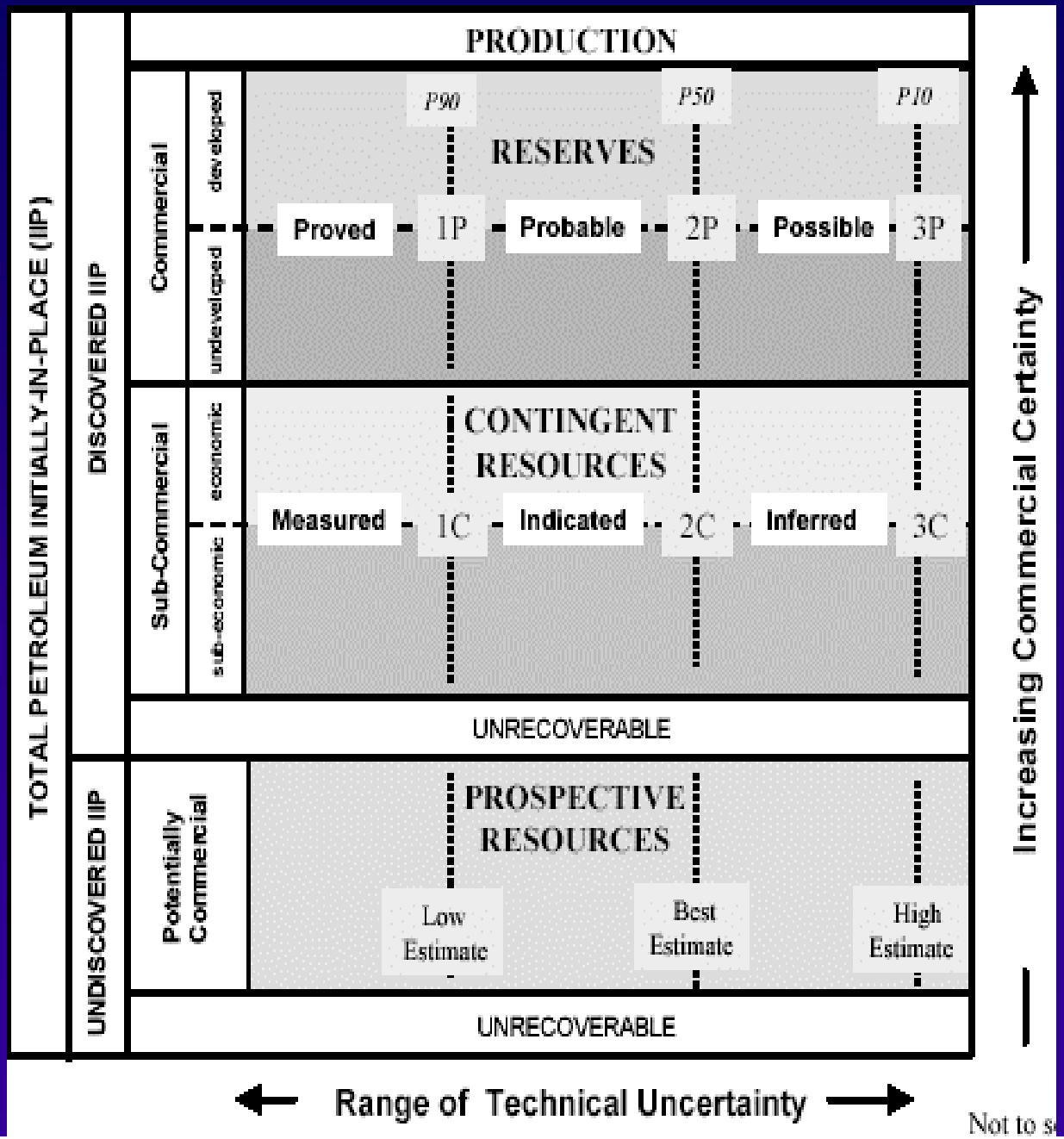
But it is not clear what it includes?

All the accumulations of fossil fuels and minerals based (only) on geological considerations?

OR

Proven, provable and possible reserves? OR what?

SPE/WPC/AAG/SPEE



Commercial: project feasibility + economic

Technical: geological + project recovery efficiency

Terminology (2)

In general, in existing classifications:

- *Reserves* seems to refer to a subset of *resources* based on some criteria (e.g. economic recoverability of the resource given current conditions)
- *Resources* seem to encompass a larger part of the *reserves* ranging from whatever is discovered (as in the UNFC) to whatever is in the ground (SPE/AAPG/WPC/SPEE) based on geological knowledge**

Classifications (1)

There exists several classification schemes/systems for mineral and energy resources:

- Government and industry reporting standards (NPD, JORC code)
- Security disclosures (SEC, UK-SORP)
- International classifications UNFC, SPE/WPC/AAPG/SPEE, CRIRSCO, OPEC
- Geological surveys (USGS)

McKelvey Boxes (1)

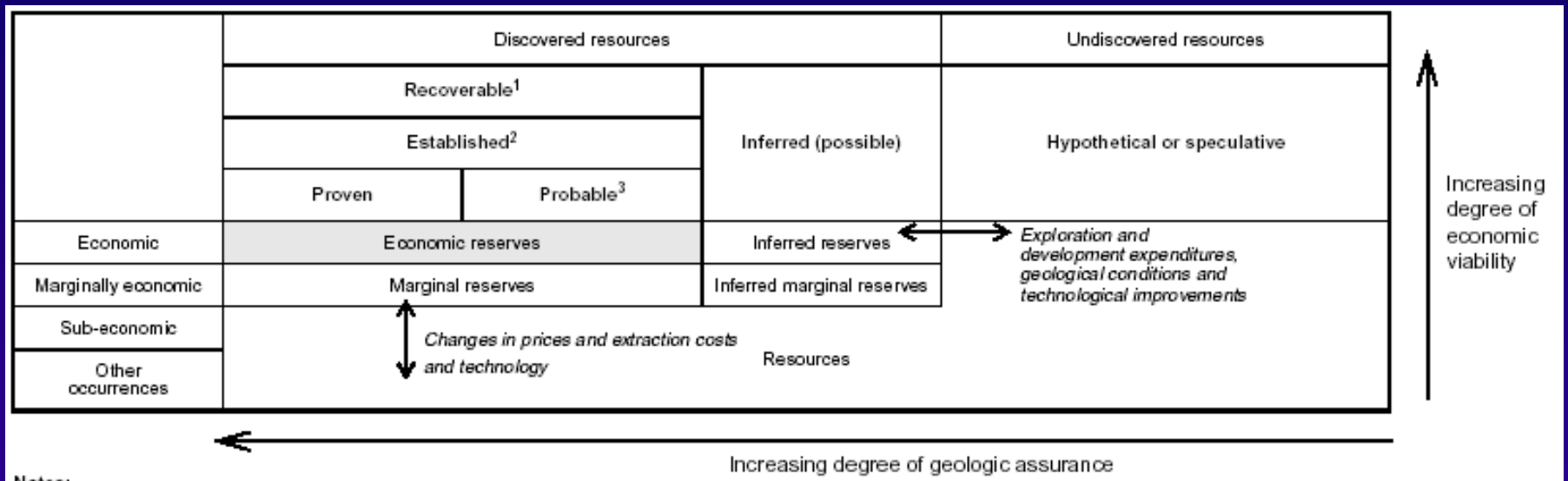
Table 8.1 McKelvey box for the UK continental shelf oil reserves, 31 December 1999

Million tonnes

	Discovered reserves				Undiscovered reserves
	Proven Over 90%	Probable 50-90%	Possible 10-50%	Potential additional Less than 10%	Hypothetical or speculative
Economic	665	455	545		250 – 2600
Marginally economic				85 - 370	
Sub-economic					

Source: United Kingdom Office for National Statistics, 2001.

McKelvey Boxes (2)



Notes:
1. Economic reserves of coal and uranium are termed "recoverable."
2. Economic reserves of crude oil, natural gas and crude bitumen are termed "established."
3. Economic reserves of metals and potash are termed "proven and probable."

The principal physical and monetary accounts of the SAA represent "economic reserves" only (the shaded area in the figure). These are discovered and economically defined resources. Supplementary physical accounts of the SAA include both discovered and undiscovered reserves and resources.

Source:
Adapted from McKelvey, 1972.

McKelvey Boxes (3)

The McKelvey box

		Physical resource base				
		Discovered			Undiscovered	
		Established		Possible	Hypothetical	Speculative
		Proven	Probable			
Economic	Developed	X	-	-	-	-
	Non-developed	X	X	X	X	X
Sub-economic		X	X	X	X	X
Non-economic		X	X	X	X	X

NPD

- Example: Norway

Project status category	
0	Sold and delivered petroleum
1	Reserves in production
2 F/A	Reserves with an approved plan for development and operation
3 F/A	Reserves which the licensees have decided to recover
4 F/A	Resources in the planning phase
5 F/A	Resources where recovery is likely but not clarified
6	Resources whose recovery is not very likely
7F/A	Resources that have not yet been evaluated
8	Resources in Prospects
9	Resources in leads, and unmapped resources.

Classifications (2)

- Most of the classification schemes use the feasibility of economic recovery, degree of geological certainty and project status
- Project status appears to have become increasingly important over the years
- The original McKelvey box has been modified to adapt to country's situation and classification

Aggregation (1)

How to aggregate over different categories of reserves (e.g. proven, probable and possible): simple or weighted sum?

- The SEEA-2003 describes the 2 options but recommends: proven + probable
- Eurostat taskforce suggests weighted sum of proven, probable and possible
- Type of weights are different in the SEEA-2003 and Eurostat TF
  - Probability of existence
  - Probability of being converted to proven
- Countries seem to use the sum of proven and probable (or similar terms)

$\sum_i P(E|C_i)P(C_i)$

Aggregation (2)

- In UNFC and SPE classifications reserve categories are based exclusively on Geological Dimension (111, 112, 113)

UNFC for petroleum

- Proven 111, probable 112, possible 113

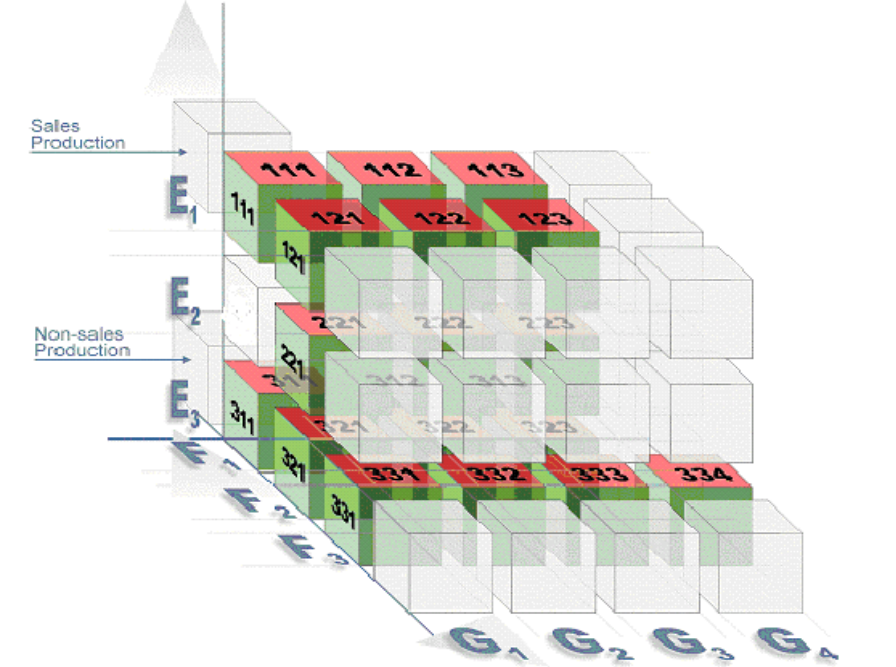


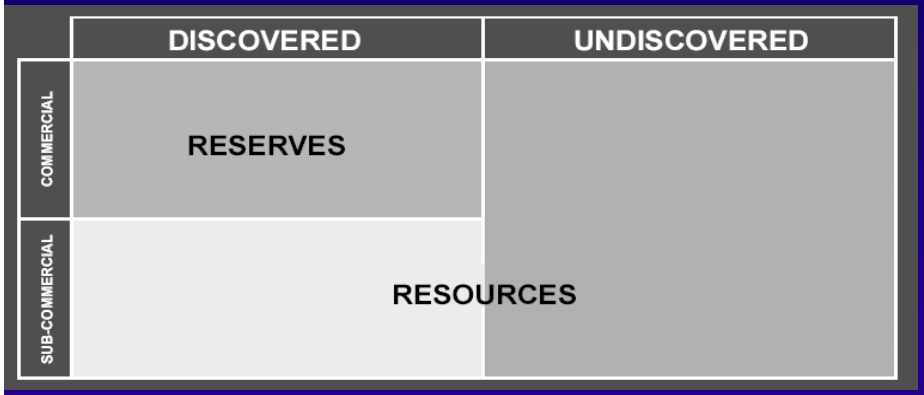
Figure 6. UNFC as applied to petroleum

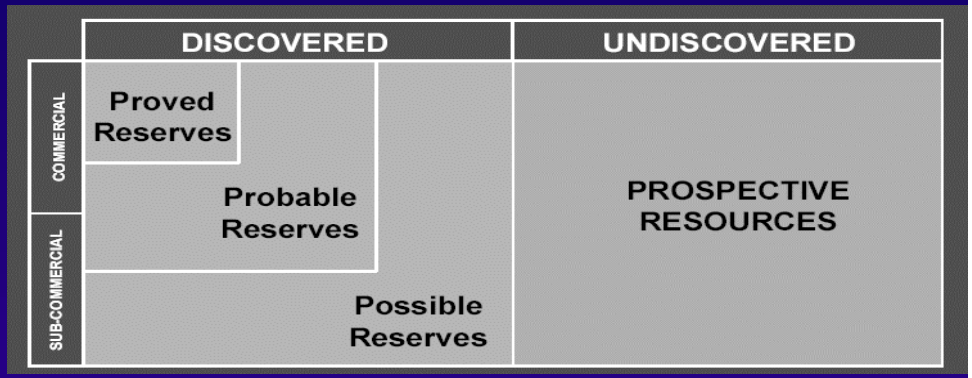
$\sum_i P(E|C_i)P(C_i)$

Aggregation (2)

- In UNFC and SPE classifications reserve categories are based exclusively on Geological Dimension (111, 112, 113)
- In McKelvey representation this is not always clear

Which uncertainties?





Geological (Left) OR geological and economic (Right)

SEEA-2003 definitions refer to both:

SEEA-2003: Probable covers reserves which are known to exist but where some doubt exists over whether they are technically or economically viable.

Aggregation (3)

Crucial question: How are proven, probable and possible reserves defined?

Do they correspond to different levels of uncertainty of the same distribution? OR

Do they correspond also to different probability distributions? (e.g. recoverability given current conditions, future conditions etc.)

- In the first case, it may not be necessary to use a weighted average

Example

0.9 = Pr(recover at least x_1) [x_1 proven]

0.5 = Pr(recover at least x_2) [x_2- x_1 probable]

0.1 = Pr(recover at least x_3) [x_3- x_2 possible]

with $x_1 < x_2 < x_3$

→

Median, x_2 (corresponding to proven + probable), is a reasonable estimate of recoverable quantities

Aggregation (4)

Aggregation issue goes beyond the aggregation across different categories of *reserves*: it extends to the aggregation across different categories of *resources*.

Conclusion: the aggregation issue can be addressed after a classification scheme is defined (or chosen) in the revised SEEA-2003

Valuation

Issue: what part of the physical stock of *mineral and energy resources* should be valued in the monetary asset accounts?

Examples:

- All *resources*?
- Only *reserves*?
- Only *proved reserves* (as in SNA 1993)? [proved reserves have remained constant….]

….different choices, different life-lengths of the asset

Way forward

All these issues are very much linked to the classification (and definition) issue of mineral and energy resources

Advisable that the revised SEEA-2003 include a clearly defined classification scheme taking into account existing classification schemes/standards and possibly mapping them to that of the revised SEEA-2003

Way forward (2)

The UNFC is a good starting point as

(a) it has been endorsed by ECOSOC and it is being implemented in an increasing number of countries

(b) it is flexible: countries can map their own classifications into the UNFC categories

UNSD is willing take the initiative to prepare a proposal for classification of mineral and energy resources with experts from UNFC and members of the subgroup on mineral and energy accounts

Some additional issues

- Extension to minerals
- Aggregating reserve estimates across fields (proven + proven)
  - deterministic vs probabilistic
- Heterogeneity of resources
  - the resource can be a mix of different types of energy or mineral resources, how to separate the resource rent?
  - mineral or energy resources may have different quality, how to reflect this in the accounts?
- Unconventional reserves often not recognized

Extension to minerals

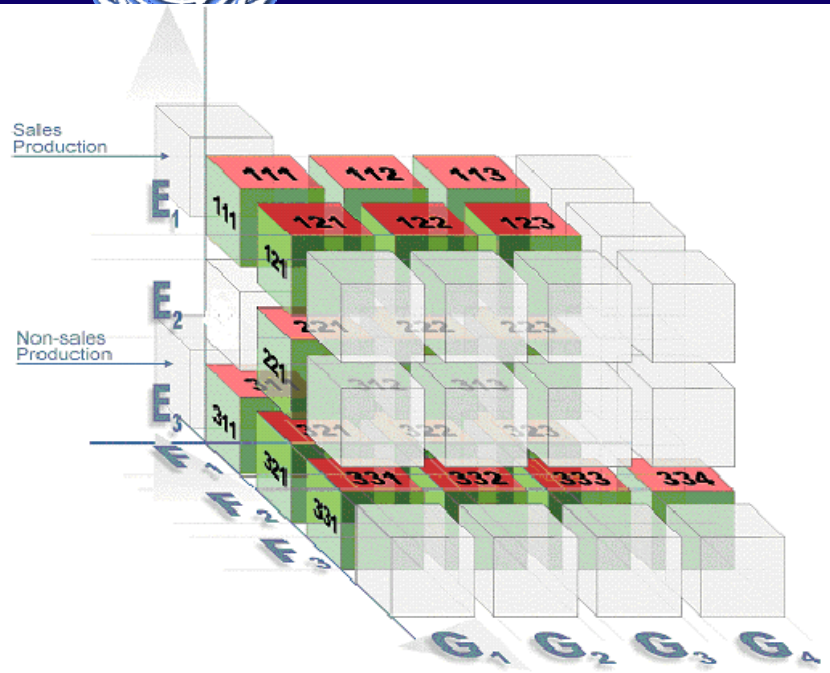


Figure 6. UNFC as applied to petroleum

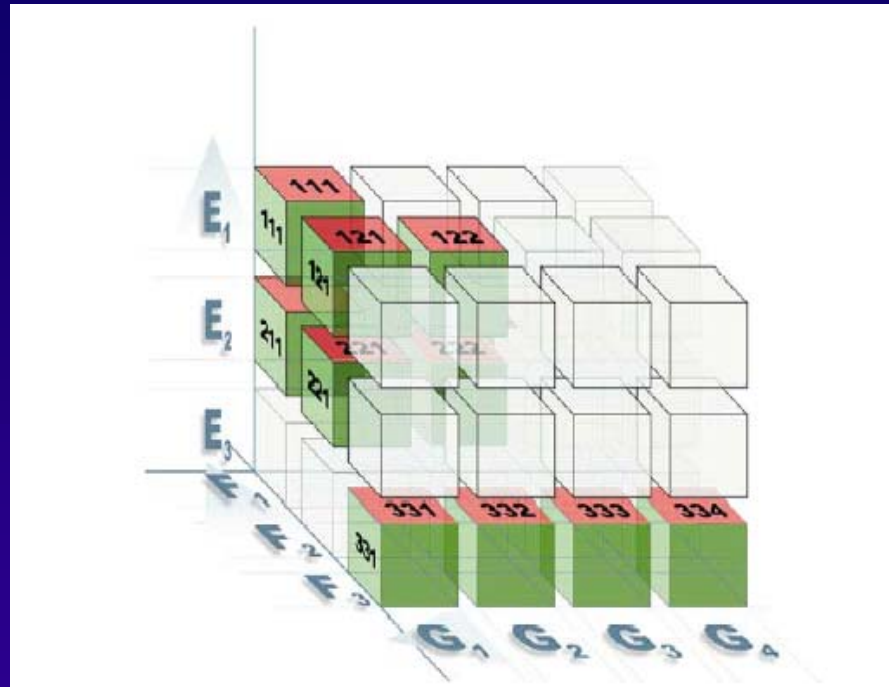
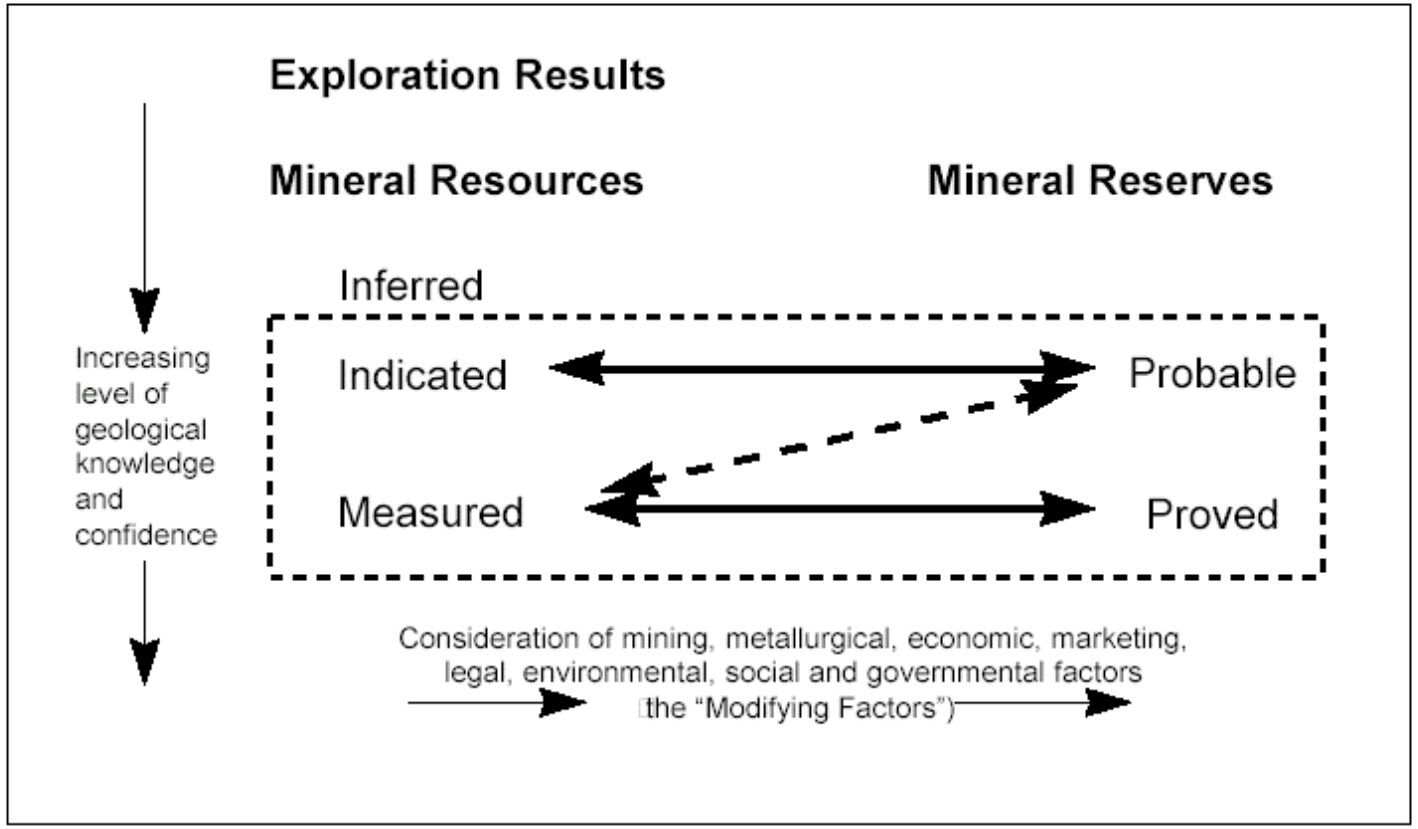


Figure 5. UNFC as applied to coal, uranium and other solid minerals

- UNFC maps: no integration!
- No unique coordinates for probable reserves
- SPE expressed doubts about reconciliation

Extension to minerals (2)

Figure 1 General relationship between Exploration Results, Mineral Resources and Mineral Reserves



CRIRSCO template: no possible category!

How to aggregate proven + proven?

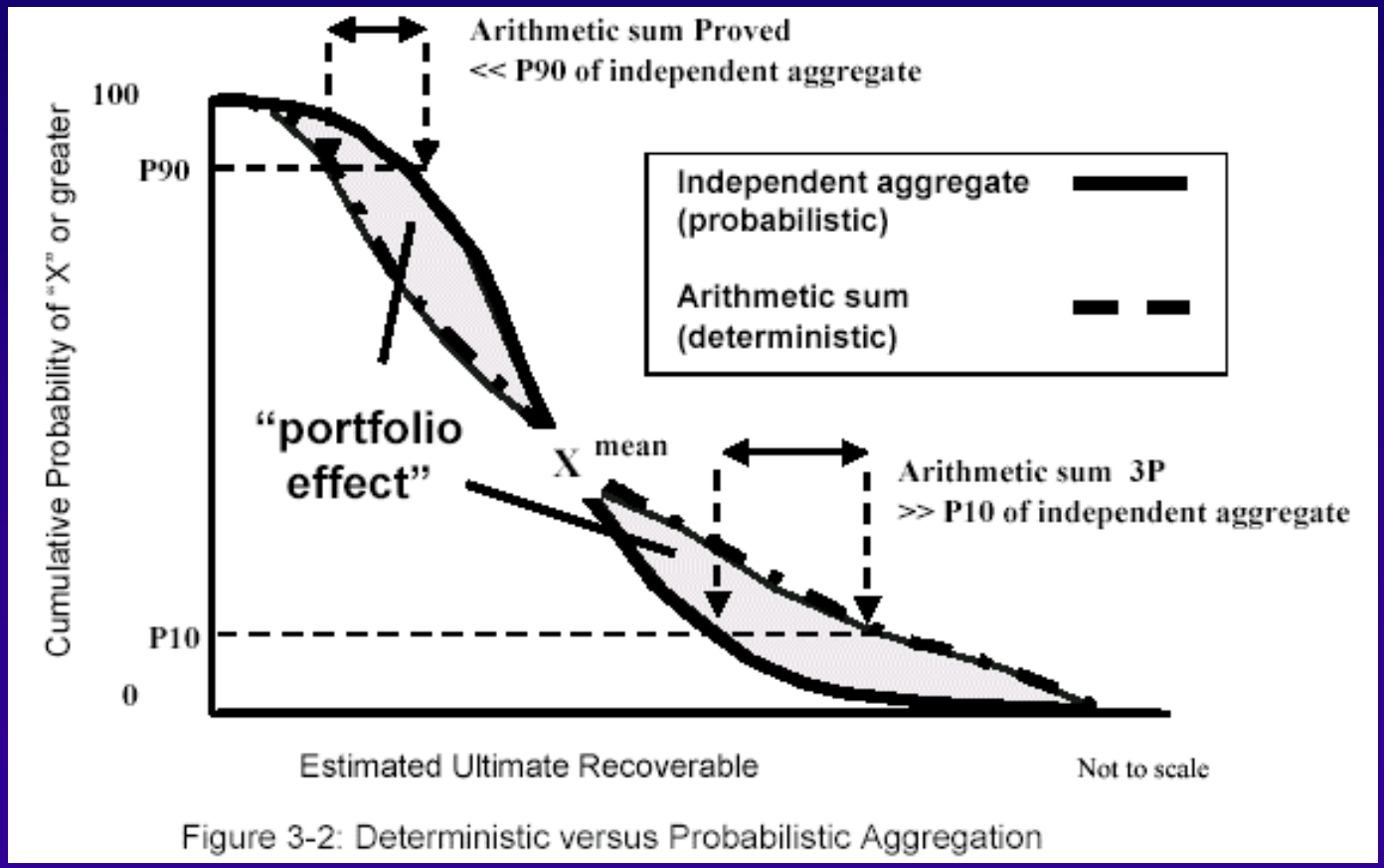


Figure 3-2: Deterministic versus Probabilistic Aggregation

- Arithmetic or probabilistic: same for P50

Questions to the LG

a) *Resources* vs *reserves*

Do you agree that the asset boundary of *mineral and energy resources* include the accumulation of fossil fuels and minerals based (only) on geological considerations (as introduced in paragraph 6)?

b) *Classification of Mineral and energy resources*

Do you agree that the revised SEEA-2003 should explicitly define a classification scheme/system of mineral and energy resources based on existing classifications?

Additional issues to resolve

c) Do you agree with the description of the aggregation issue in paras 21-25?

d) Valuation issue in paras 26- 27: IN or OUT?

e) 'Aggregation of estimates across different fields', 'Heterogeneity of resources' or others: IN or OUT?

f) Do you agree with the suggested way forward?