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A suggestion for SEEA classifications of energy resources

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1. Introduction

In this paper a suggestion for classifications related to SEEA energy accounts is presented. The classifications are developed for the purpose of being used in relation to the SEEA¹ and SEEA-E² standard tables on energy. The classifications are presented to the London Group in order to get comments with respect to how they can be improved and whether the classifications are suitable for inclusion in the SEEA-E and/or SEEA.

This paper should be seen in relation to the paper “A suggestion for SEEA Standard Tables on Energy” (Gravgård Pedersen, 2008), which also presents the background for the work on the energy tables in relation to SEEA and SEEA-E the background

It should be underlined that the classification presented in this paper reflects work in progress. The further development of the classifications has to be carried out in coordination with the work undergoing in relation to energy statistics and energy balances within the UNSD and the Oslo Group on energy statistics, and with the development of the United Nations Framework Classification (UNFC) for Fossil Energy and Mineral Resources managed by the Ad Hoc Group of Experts on Harmonization of Fossil Energy and Mineral Resources Terminology.

The discussion of the classification within the London Group is an important input into the further work. At the same time any conclusions reached at the London Group meeting in Bruxelles might need to be adjusted as the work on energy statistics and balances proceeds.

2. Question to the London Group

What is your view on the classifications presented, and would you at this point recommend them to be included in SEEA and SEEA-E ?

3. Classification of natural energy resources

3.1. Classification by type of energy resource

Energy resources are included in the general classification of natural resources in SEEA 2003. The general SEEA classification includes the aggregate category EA.11 Mineral and Energy Resources as part of EA.1 Natural Resources.

For the purpose of describing the energy resources in more detail it is suggested that EA.11 is further disaggregated, cf. Table 1. At the first level, a distinction between petroleum resources, non-metallic minerals and metallic minerals is suggested. Petroleum resources are further broken down by natural gas, oil and natural bitumen, extra heavy oil and others (tar sands/oil sands) n.e.c. Within the non-metallic minerals coal and other solid energy resources (oil shale, others, n.e.c.) are identified. Uranium ores are shown as a sub-category of metallic minerals.

¹ System of Environmental-Economic Accounting, cf. UN (2003)

² System of Environmental-Economic Accounting for Energy, cf. <http://unstats.un.org/unsd/envaccounting/seeae/>

Table 1. Suggested SEEA classification of energy resources within the general SEEA classification of natural resources

EA.1	Natural resources		
	EA.11	Mineral and energy resources	
		<i>EA.111</i>	<i>Petroleum resources</i>
			<i>EA.111.1</i> <i>Natural gas</i>
			<i>EA.111.2</i> <i>Oil</i>
			<i>EA.111.3</i> <i>Natural bitumen, extra heavy oil, and others n.e.c.</i>
		EA.112	Non-metallic minerals
			<i>EA.112.1</i> <i>Solid energy resources</i>
			<i>EA.112.1.1</i> <i>Coal</i>
			<i>EA.112.1.2</i> <i>Other solid energy resources (oil shale, others n.e.c.)</i>
			EA.112.2 Other non-metallic minerals
		EA.113	Metallic minerals
			<i>EA.113.1</i> <i>Uranium ores</i>
			EA.113.2 Other metallic minerals
	EA.12	Soil resources	
	EA.13	Water resources	
	EA.14	Biological resources	

Renewable energy resources, such as wind, solar and wave energy are not at this point included as energy assets in the SEEA.

3.2. Classification by asset characteristics

In addition to the classification of energy resources by type another dimension is introduced to further characterize the resources. This second dimension relates to a “quality and knowledge” component of the energy resources and expresses the economic, geological and project feasibility status in relation to the resources.

The suggested SEEA standard classification by resource characteristics includes three broad classes:

- A. Best estimate of reserves
- B. Other reserves
- C. Other resources

Together A and B make up what is often called *reserves*. In broad terms, it is the part of the resources, which based on technical and economic and other relevant (e.g. environmental) considerations could be recovered and for which extraction to some extent is justified. The exact definition of reserves depends on the kind of resources in focus.

Even if the reserves are recoverable and extraction could be justified, this does not mean that all of the reserves will necessarily be extracted. Project feasibility and geological conditions may in the end mean that part of the reserves will in fact not be extracted. Since the extraction takes place in the future it is not possible to predict with certainty how much of the reserves that will in fact be extracted. However, for the accounting it is necessary to give a *best estimate* of how much of the resources, which are expected to be extracted in the future. This best estimate constitutes class A in the characterization of the resource. The next class, B, includes the rest of the re-

serve. Class C includes energy resources, which are not part of the reserves, but are nevertheless regarded as having some (non-economic) value for society.

The distinction between class A. Best estimate of reserves and class B. Other reserves is introduced first of all for the sake of the monetary asset accounts. The best estimate of reserves is the part which should be assigned a monetary value; while class B. Other reserves and class C. Other resources are of interest only in relation to the physical asset accounts.

Reference is made to the United Nations Framework Classification for Fossil Energy and Mineral Resources, UNFC (cf. <http://www.unece.org/ie/se/reserves.html>) in order to more specifically determine the parts of the resources which fall into these three classes.

UNFC is a flexible scheme for classifying and evaluating energy and mineral reserves and resources. It is designed to allow the incorporation of currently existing terms and definitions into the framework and thus make them comparable and compatible. UNFC is intended to meet the basic needs for an international standard. In February 2004, the UN Economic Commission for Europe endorsed the UNFC and proposed to the United Nations Economic and Social Council (ECOSOC) that it recommended its application worldwide.

The UNFC is based on a breakdown and numbering of the resources according to three criteria affecting their recoverability:

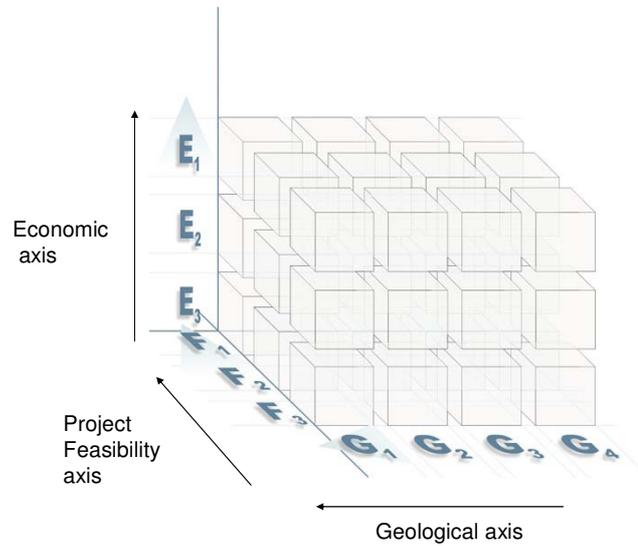
- Economic and commercial viability (E)
- Field project status and feasibility (F)
- Geological knowledge (G)

The E, F and G axis are divided into three, three and four categories, respectively. Each of the categories is then further divided into sub-categories, as indicated in the tables below.

The economic criteria reflect whether extraction seems to be justified or not. The field project status refers to the status of a project to extract the resource. It ranges from early exploration and research projects, to development, production and abandonment projects. The geological criterion refers to the studies and data related to the geological features and production performance of the natural resource.

It should be noted, that some of the categories are mutually exclusive. If, for example, no project feasibility study has been carried out, the deposit cannot at the same time be identified as being economic. On the other hand it is possible that a deposit is categorized as economic based on pre-feasibility studies. At a later stage when further feasibility studies have been carried out the deposit might then be re-categorized from economic to potential economic. The validity and exact definition of the cubes depend, as shown below, on whether the categorization is applied to solid energy resources or petroleum resources.

Figure 1. UNFC Classification principle



Source: UNFC, <http://www.unece.org/ie/se/pdfs/UNFC/UNFCemr.pdf>, figure

Textbox: Explanation of the numbering of categories in the UNFC

The three dimensions of categorization are represented by the edges of a cube. The digits are quoted in the order EFG firstly because the alphabetical order is easy to memorize, and secondly because the first digit refers to the economic viability, which is of decisive interest to producers, investors and host countries.

Numbers are used to designate the different classes. Number 1, in accordance with the usual perception that the first is the best, refers to the highest degree of economic viability on the E axis, the most advanced project status on the F axis and the highest quality assessment on the G axis.

The use of categories is different for fluids and for solids. This is primarily due to the fact that fluids may flow in a reservoir, irrespective of the level of geological knowledge. In the case of solids, recovery will normally be restricted to rock bodies that have been reliably assessed.

Source: UNFC <http://www.unece.org/ie/se/pdfs/UNFC/UNFCemr.pdf>

3.2.1. Solid energy resources

UNFC applies the categories shown in Table 2 to solid minerals (coal, uranium and other solid minerals):

Table 2. UNFC categories for coal, uranium and other solid materials

Categories and subcategories	
E1	Economic
E1.1	Normal Economic
E1.2	Exceptional Economic
E2	Potentially Economic
E2.1	Marginal Economic
E2.2	Sub-Marginal Economic
E3	Intrinsically Economic
F1	Mining Report and/or Feasibility Study
F1.1	Mining Report
F1.3	Feasibility Study
F2	Pre-feasibility Study
F3	Geological Study
G1	Detailed Exploration
G2	General Exploration
G3	Prospecting
G4	Reconnaissance Study

Source: United Nations Framework Classification for Fossil Energy and Mineral Resources
<http://www.unece.org/ie/se/pdfs/UNFC/UNFCemr.pdf> table

Valid combinations of categories for solid energy resources are according to UNFC: 111, 121, 122, 211, 221, 222, 331,332,333, and 334. In the number combinations the first digit refers to the economic axis, the second to the project feasibility-axis, and the third one to the geological axis. Thus 111 means resources that are normal economic (E=1) and for which mining report and/or feasibility study (F=1) and detailed exploration activities (G=1) have been carried out.

To obtain the three SEEA-E classes, A, B, and C, the UNFC categories are aggregated as shown in Table 3 below. For ease of reference, the UNFC three digits coding is shown and UNFC sub-classes are shown in italics. The sum of class A and class B. i.e. *Reserves* is a corresponding class included in the UNFC as well. For solid energy resources, the total estimate of reserves is taken as being the best estimate of reserves and future extraction. It means that for solid energy resources the class of other reserves (B) is always empty.

C. *Other resources* include the remaining part of the resources that are able to bring current or future benefits, although the benefits can not be immediately monetized (cf. option value, bequest value, and existence value).

Table 3. Bridge between SEEA classification and UNFC categories for coal, uranium ores and other solid resources

	SEEA	UNFC codes
A	Best estimate of reserves	
	<i>Proved Mineral reserves</i>	111
	<i>Probable Mineral reserves</i>	121, 122
B	Other reserves	Empty
C	Other resources	
	<i>Feasibility mineral resources</i>	211
	<i>Pre-feasibility mineral resources</i>	221, 222
	<i>Measured mineral resources</i>	331
	<i>Indicated mineral resources</i>	332
	<i>Inferred mineral resources</i>	333

Note: Categories in italics refer to UNFC classes

If resources fall into the UNFC category G4 (i.e. UNFC category 334) the resources are located or estimated from reconnaissance studies (e.g. regional geological mapping, airborne and indirect methods, geological inference and extrapolation). It is suggested that they are not included within the SEEA asset boundary. The reason is that these resources are speculative, and are assumed not be associated with any economic or other benefits. However, the knowledge obtained by the reconnaissance studies might have a monetary value. This value is attributed to the exploration and evaluation activity, and recorded as gross fixed capital formation of the knowledge asset.

3.2.2. Petroleum resources

UNFC applies the categories shown in Table 4 to classify petroleum resources

Table 4. UNFC categories for petroleum

Categories and sub-categories	
E1	Economic
E1.1	Normal Economic
E1.2	Exceptional Economic
E2	Potentially economic
E2.1	Marginal Economic
E2.2	Sub-Marginal Economic
E3	Intrinsically Economic
E3.1	Non-sales
E3.2	Undetermined
E3.3	Unrecoverable
F1	Justified Development and/or Production Project
F1.1	Project in Production
F1.2	Committed Development Project
F1.3	Uncommitted Development Project
F2	Contingent development project
F2.1	Under Justification
F2.2	Unclassified or On hold
F2.3	Not Viable
F3	Project Undefined
G1	Reasonably Assured Geological Conditions
G2	Estimated Geological Conditions
G3	Inferred Geological Conditions
G4	Potential Geological Conditions

Valid combinations for petroleum are: 111, 112, 113, 121, 122, 123, 221, 222, 223, 311, 312, 313, 321, 322, 323, 331, 332, 333, and 334.

To obtain the three SEEA-E classes, A, B, and C the UNFC categories for petroleum are aggregated, as shown in Table 5.

Class A. *Best estimate of reserves* includes UNFC categories 111 and 112, while class B. *Other reserves* includes UNFC category 113. Category 113 includes those resources covered by a so-called justified development and/or production project (F=1), which are considered economic (E=1), but where the geological conditions are inferred (G=3). Due to the uncertainty related to the geological conditions this part of the reserves is not included in the best estimate of reserves and future extraction, but on the other hand regarded as part of the reserves. Together class A and class B make up the reserves.

As is the case for solid energy resources class C. *Other resources* includes the rest of the resource, which on one hand are not considered reserves and on the other hand are considered as being associated with some benefit, although the benefits does not have a market value.

Table 5. Bridge between SEEA classification and UNFC categories for petroleum

	SEEA	UNFC codes
A.	Best estimate of reserves	111, 112
B.	Other reserves	113
C.	Other resources	121, 122, 123, 221, 222, 223
		311,312, 313, 321, 322, 323, 331, 332, 333

3.3. Mapping of other classifications against the suggested SEEA classification

Many countries have their own national systems based on the classification systems developed by the Society of Petroleum Engineers (SPE, 2007), the Committee for Mineral Reserves International Reporting Standards (CRIRSCO, 2007) or the International Atomic Energy Agency/International Energy Agency (IAEA/IEA). Thus, setting up the SEEA accounts for energy resources will often involve a conversion of the national classification system. However, the standard SEEA classification operates at a very high level of aggregation which facilitates the conversion.

Furthermore, the UN-ECE Ad Hoc Group of Experts on Harmonization of Fossil Energy and Mineral Resources Terminology, the custodian of the UNFC, has worked out mapping schemes, which show the link between the classifications of SPE and CRIRSCO on one hand and the UNFC on the other hand. A reference to the UNFC documents including examples of application of the UNFC in selected countries and descriptions of mapping between other systems and UNFC reference is: <http://www.unece.org/ie/se/reserves.html>.

For ease of reference Table 6 below shows a simple mapping of the SEEA-E against the relevant parts of UNFC, SPE and CRIRSCO classifications. The table also includes a mapping against the IAEA/NEA (International Atomic Energy Agency/Nuclear Energy Agency) classification for uranium.

The table shows, for example, that if the national classification system of petroleum resources is based on the SPE classification then the SEEA-E class A. *Best estimate of*

reserves is equivalent to the SPE categories proven and probable reserves. Class B. Other reserves is equivalent to possible reserves while class C. Other resources include other resources except what is classified as undiscovered resources by SPE.

Generally, the best estimate of reserves corresponds to proven and probable reserves, but these terms are not used in the UNFC. The reason for not using these terms to categorize resources generally is that, according to the UNFC, they may have slightly different meanings in different contexts. Thus, care must be taken when the national classifications are used to ensure that the specific classes of the national system are converted correctly into the suggested SEEA classification.

Table 6. Mapping of resource classifications

	Solid energy resources			Petroleum	
SEEA	UNFC	CRIRSCO	IAEA/NEA (Uranium)	UNFC	SPE
A. Best estimate of reserves	111 + 121 + 122	Proven + probable	Part of RAR + part of EAR II * /Inferred resources (costs < US \$ 80 / kg U)	111+112	Proven + probable
B. Other reserves	Not applicable	Not applicable	Not applicable	113	Possible
C. Other resources	Others, except G4	Others, except Reconnaissance	Others, except Speculative resources, SR	Others, except G4	Others, except Undiscovered
Non-asset resources	G4	Reconnaissance		G4	Undiscovered

SPE: Society of Petroleum Engineers

CRIRSCO: Committee for Mineral Reserves International Reporting Standards

IAEA/IEA: International Atomic Energy Agency/International Energy Agency).

UNFC: United Nations Framework Classification for Fossil Energy and Mineral Resources

RAR: Reasonable Assured Resources.

EAR: Estimated Additional Resources.

*The part included in A. Best estimate of reserves is those for which suggested extraction costs are lower than US\$ 80 per Kg U (1 January 2005).

Source: UNFC : <http://www.unece.org/ie/se/reserves.html>

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