**10th Meeting of the Advisory Expert Group on National Accounts,
13-15 April 2016, Paris, France**

Agenda item: 13

Classification and valuation of natural resources

Introduction

The inclusion of mineral and energy resources in national accounts' balance sheets is currently limited to "mineral and energy reserves located on or below the earth's surface that are economically exploitable, given current technology and relative prices" (2008 SNA, § 10.179). This definition could be made less ambiguous by referring to an internationally-agreed classification such as the United Nations Framework Classification 2009 (UNFC-2009), being applicable to both mineral and energy resources and already used in the SEEA-Central Framework. It should also be examined whether the SNA is right in excluding some known deposits that have a positive economic value, only because they are not currently profitable. Finally, giving additional guidance for the valuation of mineral and energy deposits is key to ensure international comparability. All these classification and valuation issues will be addressed in a forthcoming working paper summarising the work done under the auspices of the OECD Task Force on the implementation of the SEEA. The AEG is asked to consider clarifications that could be added to the 2008 SNA.

Documentation

Classification and delineation of mineral and energy resources in national accounts' balance sheets

Main issues to be discussed

Does the AEG agree that further clarifications of the 2008 SNA should be added by:

−   explicitly referring to the SEEA 2012 and relying on the same three resource classes, based on the UNFC-2009 classification, in order to delineate mineral and energy resources;

−   allowing the inclusion of the three classes of mineral and energy resources in national accounts' balance sheets in the case that reliable information on their value exists, with the additional requirement that separate accounts for the different classes, similarly to the SEEA 2012, should be distinguished;

−   explicitly referring to Chapter 5 in the SEEA 2012 when it comes to the computation of net present values of mineral and energy deposits, thereby underlining that the aim of the SNA (and the SEEA) is to compute market values, not social values, of mineral and energy deposits, and emphasising issues to which national accountants should pay particular attention: sensitivity of final results to the choice of the discount rate; heterogeneity of extraction costs across space; constraints imposed on mineral production at the micro level by initial investments in physical capital; and volatility in the value of mineral assets introduced by short-run price fluctuations of commodity prices.

I. Classification and delineation of mineral and energy resources in national accounts' balance sheets

1.   Now that the System of Environmental Economic Accounting 2012 (SEEA 2012) has been adopted as an international statistical standard by the UN Statistical Commission (UNSC), it is crucial to ensure that the 2008 System of National Accounts (2008 SNA) and the SEEA 2012 give fully consistent guidelines when it comes to environmental economic accounting. The purpose of this note is to indicate how both manuals could be perfectly aligned for the accounting of mineral and energy resources.

2.   Two necessary conditions are used to define economic assets in the 2008 SNA. An economic asset needs (i) to be owned by an institutional unit, and (ii) to provide economic benefits to its owner. Key references in the 2008 SNA are §3.18 to §3.49[1]. In this respect, it should be noted that the 2008 SNA explicitly acknowledges that future economic benefits involve risks for the owner of the asset because not only economic and technical conditions but also assumed interest rates for discounting future benefits may evolve over time[2].

3.   The conditions required for mineral and energy resources to be included in national accounts' balance sheets are more stringent than for other economic assets. Indeed, an exception for these assets is made in Chapters 10 and 12 of the 2008 SNA, where it is stated that only mineral and energy resources that are "economically exploitable, given current technology and relative prices" are to be included in national accounts' balance sheets[3]. This condition is more restrictive than requiring that these assets have an economic value on the market (see below).

4.   In the following, we argue that the 2008 SNA criteria for delineating mineral and energy resources in national accounts' balance sheets (i) are imprecise and prone to diverging interpretations by countries, (ii) are not fully consistent with SEEA 2012, and (iii) lack economic justification.

5.   The definition of the asset boundary for mineral and energy resources in the 2008 SNA is imprecise, because it does not make reference to any internationally-agreed classification system. It is true that different classification systems relevant for mineral and energy resources co-exist around the world. Some of them are only relevant for specific resources such as minerals (e.g. CRIRSCO classification) or oil and gas resources (e.g. SPE-PRMS classification). Nevertheless, the convergence and mapping between the different classification systems is now well advanced. An overarching classification relevant for all types of mineral and energy resources, known as the United Nations Framework Classification-2009 (UNFC-2009), has recently been developed under the auspices of the UNECE and its Expert Group

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[1] See in particular 2008 SNA, **§3.18**: "In order to discuss stocks, it is necessary to define assets and liabilities and these definitions depend crucially on the <u>concepts of benefit and ownership</u>."; **§3.21**: "The legal owner of entities such as goods and services, natural resources, financial assets and liabilities is the institutional unit entitled in law and sustainable in law to claim the benefits associated with the entities."; and **§3.22**: "<u>No entity that does not have a legal owner</u>, either on an individual or collective basis, <u>is recognized in the SNA</u>.".

[2] See 2008 SNA, **§3.23**: "The acts of production, consumption and accumulation involve varying degrees of risk. Two main forms of risk can be identified. The first sort refers to production. These arise because of such <u>uncertainties as the demand for goods and services once produced, developments in the economy in general and technical innovation that affects the benefits to be earned from capital and natural resources</u>. The consequence is that benefits from capital, natural resources and labour in the form of operating surplus and income from employment are not wholly predictable in advance, but embody a degree of risk."; and **§3.24**: "The second type of risk refers to the process of transferring benefits between time periods. It arises because of <u>uncertainty over interest rates in future periods</u>, which in turn affects the comparative performance of different types of benefits."

[3] See 2008 SNA, **§10.179**: "<u>Mineral and energy resources consist of mineral and energy reserves located on or below the earth's surface that are economically exploitable, given current technology and relative prices</u>."; and **§12.17**: "In the SNA, subsoil assets are defined as those proven subsoil resources of coal, oil and natural gas, of metallic minerals or of non-metallic minerals that are economically exploitable, given current technology and relative prices.".

on Resource Classification (EGRC)[4]. It can be mapped with the main other classification systems. The UNFC-2009 distinguishes three dimensions for classifying mineral and energy resources: socio-economic viability, project feasibility and geological knowledge of the available underground stock and relies on an unambiguous codification of deposits (see Figure 1).

Figure 1: UNFC-2009 classification system
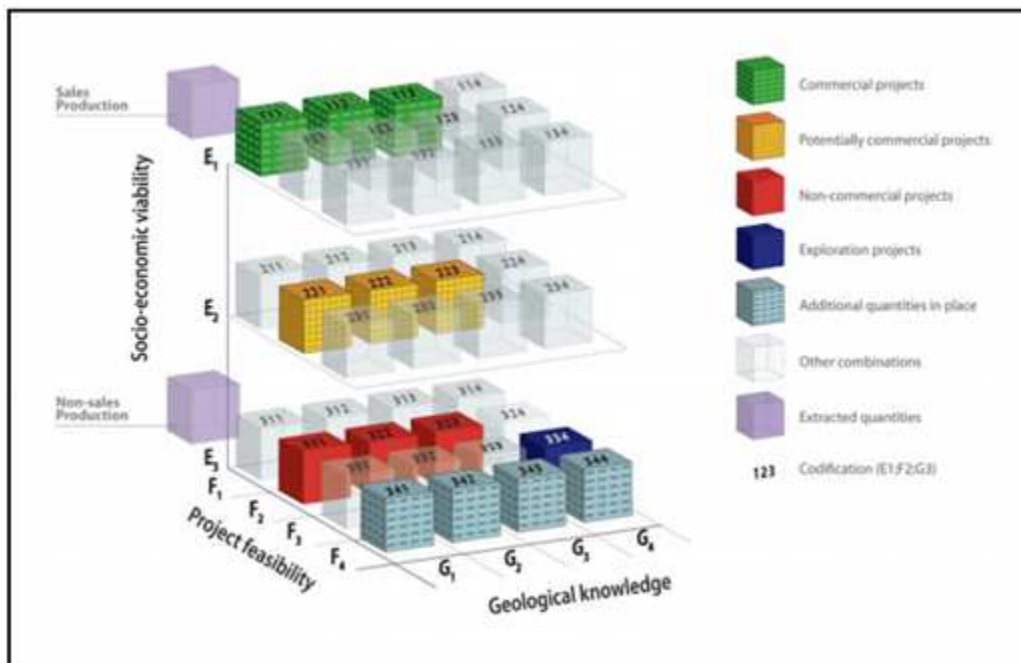
6.   The SEEA 2012 already makes reference to the UNFC-2009 classification in order to delineate mineral and energy resources. It distinguishes three classes of resources, namely Class A ("commercially recoverable resources"), Class B ("potentially commercially recoverable resources"), and Class C ("non-commercial and other known deposits"). Note that these three classes of resources cover all known resources in a country.

7.   The current definition of the mineral and energy asset boundaries in the 2008 SNA is ambiguous and prone to diverging interpretations by countries. For instance, Tables 1 and 2 at the end this paper show how it is currently interpreted by Australia and Canada, which are among the few countries in the world to account for mineral and energy resources in their national accounts' balance sheets. Note that both countries refer to specific terminologies in their balance sheets, namely "Economic Demonstrated Resources" (EDRs) for Australia and established reserves / recoverable reserves for Canada. In the tables, these national definitions have been mapped with the UNFC-2009 classification and the SEEA-2012 Classes[5].

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[4] See http://www.unece.org/energy/se/reserves.html and UNECE (2013): United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 incorporating Specifications for its Applications. *Energy Series N°42* http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/pub/UNFC2009_Spec_ES42.pdf

[5] This mapping has been carried out with the OECD Task Force on the Implementation of the SEEA-Central Framework (OECD SEEA Task Force) and validated by countries.

8.   Our first recommendation is that further clarifications are added to the 2008 SNA, by explicitly referring to the SEEA 2012 and relying on the same three resource classes, based on the UNFC-2009 classification, in order to delineate mineral and energy resources. This would increase the consistency between both accounting manuals and make the SNA definition of economic asset more precise in the case of mineral and energy resources.

9.   A related point to clarify is which SEEA-2012 classes of mineral and energy resources are to be included in the national accounts' balance sheets. Here, both theoretical and practical considerations have to be taken into account.

10.   From an economic point of view, it makes perfect sense to attribute a non-zero value to deposits that are not economically viable under current resource prices, if price volatility is high enough to make future extraction profitable with a positive probability. As also advocated in *Nature's Numbers*, a report on environmental-economic accounting published in 1999 by the US National Research Council[6], "Petroleum companies, for example, pay millions of dollars for offshore leases to explore for oil deposits that are not yet proved reserves. […] The option of developing such deposits in the future has a positive value because the price may rise, or some other development may make the deposits economic. Thus, a full accounting of subsoil assets should consider not only reserves, but also other mineral resources with a positive market value."

11.   From a practical point of view, it is admittedly more difficult to value deposits that are currently non-profitable. Nevertheless, that should not be a reason for the SNA to exclude them as a matter of principle from the national accounts' balance sheets. On the contrary, realising that deposits may have a significant value on the market even if they are not currently profitable should provide an incentive to improve valuation techniques (see below). At a minimum, the same position could apply for these deposits as for goodwill and marketing assets in the 2008 SNA, i.e. to give the possibility to include them in the national accounts' balance sheets as soon as reliable information on their value exists by the evidence of sales/purchases[7].

12.   Actually, the SEEA 2012 already allows to include all three classes of mineral and energy resources, i.e. all known resources, in the monetary asset accounts, contrary to the 2008 SNA. The SEEA 2012 only recommends keeping separate accounts for these three classes[8], because valuation is more uncertain for Classes B and C and because Classes B and C are not available for immediate extraction, which looks like a reasonable answer to a practical measurement problem.

13.   Our second recommendation is that further clarifications are added to the 2008 SNA, by allowing the inclusion of the three classes of mineral and energy resources in national accounts' balance sheets in the case that reliable information on their value exists, with the additional requirement that separate accounts for the different classes, similarly to the SEEA 2012, should be distinguished. This proposal is

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[6] See Chapter 3 on subsoil assets: http://www.bea.gov/scb/pdf/national/niparel/2000/0200srm.pdf

[7] See 2008 SNA, **§10.199**: "The value of goodwill and marketing assets is defined as the difference between the value paid for an enterprise as a going concern and the sum of its assets less the sum of its liabilities, each item of which has been separately identified and valued. Although goodwill is likely to be present in most corporations, for reasons of reliability of measurement it is only recorded in the SNA when its value is evidenced by a market transaction, usually the sale of the whole corporation. Exceptionally, identified marketing assets may be sold individually and separately from the whole corporation in which case their sale should also be recorded under this item."

[8] See **SEEA 2012 §5.193**: "While the measurement boundary extends to all known deposits in physical terms, it may not be possible to value all of these deposits in monetary terms owing to degrees of uncertainty regarding expected extraction profiles and incomes. Consequently, the resource rents for deposits in classes B and C cannot be determined with confidence. It is therefore recommended that valuation be undertaken only for deposits in class A: Commercially recoverable resources. If valuation of deposits in classes B and C is undertaken, the values for each class should be clearly distinguished."

flexible enough for countries to decide what type of assets they prefer to value depending on local specificities and priorities. On the other hand, it adds clarity and allows more meaningful international comparisons of balance sheets. Coming back to the previous examples for Australia and Canada, it can be noted that this recommendation is consistent with current practice in Canada, and only implies that Australia disentangles resource Classes A and B in its national accounts' balance sheets.

II. Valuation of mineral and energy resources in national accounts' balance sheets

14.   When it comes to the valuation of mineral and energy deposits in practice, it can be noticed that the 2008 SNA only gives limited guidance, even for deposits that are profitable under current conditions[9]. Similar to the 2008 SNA, Chapter 5 on asset accounts in the SEEA 2012 recommends to rely on net present value (NPV) computations, but the SEEA clearly gives much more guidance on how the monetary accounts relate to the physical accounts, how to compute resource rents based on national accounts' aggregates, and how to choose discount rates for the computation of NPVs.

15.   The OECD Task Force on the Implementation of SEEA also worked recently on the valuation of stocks of mineral and energy resources based on net present values. The starting point for the work of the Task Force were the research priorities identified in Nature's Numbers (1999). These research priorities are as follows: (i) the valuation of mineral resources that are not reserves (i.e. valuation of currently non-profitable deposits); (ii) the impact of ore-reserve and extraction cost heterogeneity on valuation calculations; (iii) the distortions resulting from the constraints imposed on mineral production by associated capital; (iv) the volatility in the value of mineral assets introduced by short-run price fluctuations; and (v) the difference between the market and social values of subsoil mineral assets.

16.   The OECD Task Force mainly worked on the first four topics. As one of the results, the heterogeneity of extraction costs across space has been identified as one of the most important issues for valuation. As working at the mine (i.e. establishment) level is the best way to take this heterogeneity into consideration, the possibility to do so in practice is currently being explored with national statistical offices. According to the mining engineering literature, output at the mine level remains broadly constant due to constraints imposed by initial investments in fixed capital, thus simplifying NPV computations[10].

17.   In respect of the impact of the volatility of commodity prices on the stock values of reserves, the OECD Task Force explored the financial literature where assets are commonly valued taking into account not only the expectation of future revenues, but also their statistical distribution, leading to asset values that may be less sensitive to volatility in current revenues and thus resource rents[11]. However, trying to implement such valuation techniques is not being considered as a priority for national statistical offices, because it would require high quality data on how mining revenues, investments and extraction costs are determined at the micro level. In the short run, using long-term averages of resource prices seems to be the easiest way forward to tackle the volatility issue. Nevertheless, the work of the Task Force shows that more sophisticated tools already exist and are currently used, including by mining companies to value their own projects.

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[9] See 2008 SNA. **§13.49**: "The value of subsoil mineral and energy resources is usually determined by the present value of the expected net returns resulting from the commercial exploitation of those resources […]."

[10] The intuition here is that given convex investment costs, mining companies have an incentive to make all necessary investments in physical capital (infrastructure, machinery) before extraction starts. The initial level of investment then constraints output at the mine level.

[11] See document prepared for the 9th meeting of the Advisory Expert Group on National Accounts (8-10 September 2014, Agenda Item 7.1: http://unstats.un.org/unsd/nationalaccount/aeg/2014/M9-71.pdf). In theory, these techniques could be applied for the valuation of currently non-profitable deposits. Valuing these assets would eliminate the part of the volatility in balance sheets related to the fact that assets can switch from currently non-profitable to currently profitable, and vice-versa, depending on market conditions.

18.   Our third recommendation is that clarifications are added to the 2008 SNA, by explicitly referring to Chapter 5 in the SEEA 2012 when it comes to the computation of net present values of mineral and energy deposits, thereby underlining that the aim of the SNA (and the SEEA) is to compute market values, not social values, of mineral and energy deposits, and emphasising issues to which national accountants should pay particular attention: sensitivity of final results to the choice of the discount rate; heterogeneity of extraction costs across space; constraints imposed on mineral production at the micro level by initial investments in physical capital; and volatility in the value of mineral assets introduced by short-run price fluctuations of commodity prices.

Table 1: Coverage of mineral and energy resources in the <u>Australian</u> balance sheets

Fundamental Characterization	CRIRSCO Template for Solid Mineral Classes	SPE-PRMS Classes	SPE-PRMS Sub-Classes		UNFC Class	UNFC Sub-class	UNFC E axis	UNFC F axis	UNFC G axis — Proved Measured (IP/1C Low Estimate)	Probable Indicated (2P/2C Best Estimate)	Possible Inferred (3P/3C High Estimate)	
Discovered and Commercially Recoverable	Mineral Reserves	Reserves	On Production		Commercial Projects	On Production	1	1.1	1	2	3	SEEA-2012 Class A
			Approved for Development			Approved for Development	1	1.2	1	2	3	
			Justified for Development			Justified for Development	1	1.3	1	2	3	
Discovered and Not Commercially Recoverable	Mineral Resources	Contingent Resources	Development Pending		Potentially Commercial Projects	Development Pending	1.1	2.1	1	2	3	SEEA-2012 Class B
							2	1.3	1	2	3	
							2	2.1	1	2	3	
			On Hold			Development On Hold	2	2.2	1	2	3	
	Inventory (not defined in template)		Development Unclarified or on Hold	Unclarified	Non-Commercial Projects	Development Unclarified	3.2	1.3	1	2	3	SEEA-2012 Class C
							3.2	2.1	1	2	3	
							3.2	2.2	1	2	3	
			Development not Viable			Development Not Viable	3.3	1.3	1	2	3	
							3.3	2.1	1	2	3	
							3.3	2.2	1	2	3	
							3.3	2.3	1	2	3	
		Unrecoverable	Unrecoverable		Additional Quantities in Place		3.3	4	1	2	3	
Undiscovered	Exploration Results	Prospective Resources	Prospect		Exploration Projects	(No sub-classes defined)	3.2	3.1	4.1	4.2	4.3	
			Lead				3.2	3.2	4.1	4.2	4.3	
			Play				3.2	3.3	4.1	4.2	4.3	
			Unrecoverable				3.3	4	4.1	4.2	4.3	

<u>Australia's Natural Resource System</u>

[blue] Economically Demonstrated Resources (EDRs)

<u>Reported Categories</u>

JORC Reserves and JORC Resources (measured and indicated) Development

<u>E axis</u> <u>F axis</u> <u>G axis</u>

Table 2: Coverage of mineral and energy resources in the <u>Canadian</u> balance sheets

Fundamental Characterization	CRIRSCO Template for Solid Mineral Classes	SPE-PRMS Classes	SPE-PRMS Sub-Classes	UNFC Class	UNFC Sub-class	UNFC E axis	UNFC F axis	Proved Measured / IP/IC Low Estimate	Probable Indicated / 2P/2C Best Estimate	Possible Inferred / 3P/3C High Estimate	
Discovered and Commercially Recoverable	Mineral Reserves	Reserves	On Production	Commercial Projects	On Production	1	1.1	1	2	3	SEEA-2012 Class A
			Approved for Development		Approved for Development	1	1.2	1	2	3	
			Justified for Development		Justified for Development	1	1.3	1	2	3	
Discovered and Not Commercially Recoverable	Mineral Resources	Contingent Resources	Development Pending	Potentially Commercial Projects	Development Pending	1.1	2.1	1	2	3	SEEA-2012 Class B
						2	1.3	1	2	3	
						2	2.1	1	2	3	
			Development Unclarified or on Hold — On Hold		Development On Hold	2	2.2	1	2	3	
			Development Unclarified or on Hold — Unclarified	Non-Commercial Projects	Development Unclarified	3.2	1.3	1	2	3	SEEA-2012 Class C
						3.2	2.1	1	2	3	
						3.2	2.2	1	2	3	
	Inventory (not defined in template)		Development not Viable		Development Not Viable	3.3	1.3	1	2	3	
						3.3	2.1	1	2	3	
						3.3	2.2	1	2	3	
						3.3	2.3	1	2	3	
		Unrecoverable	Unrecoverable		Additional Quantities in Place	3.3	4	1	2	3	
Undiscovered	Exploration Results	Prospective Resources	Prospect	Exploration Projects	(No sub-classes defined)	3.2	3.1	4.1	4.2	4.3	
			Lead			3.2	3.2	4.1	4.2	4.3	
			Play			3.2	3.3	4.1	4.2	4.3	
		Unrecoverable				3.3	4	4.1	4.2	4.3	

Canada's Natural Resource System

	E axis	F axis	G axis
Economically Recoverable Reserves **or**	Established Reserves (crude oil, natural gas), Proven and Probable Reserves (metals & potash)		
	Recoverable Reserves in active mines (coal), Remaining established reserves under active development (bitumen)		

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