Manual on the Basic Set of Environment Statistics of the FDES 2013

Mineral Resources
Statistics

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(**Bold Text - Core Set/Tier 1**; Regular Text - Tier 2; *Italicized Text - Tier 3*)

2. Introduction/ Relevance

Mineral resources represent a unique type of environmental asset in that they can be extracted and used in economic activity but cannot be renewed on any human time scale. There is therefore particular interest in understanding the rate at which these assets are extracted and depleted, the overall availability of these assets, and the sustainability of the industries that exploit them.[1]

Minerals are elements or compounds composed of a concentration of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust.[2] Mineral resources are those that are being used by the human sub-system or could be used as raw materials, contributing to material progress, as they are useful for construction, infrastructure and consumer products. Mineral resources consist of mineral reserves located on or below the earth's surface that are economically exploitable, given current technology and relative prices.[3]

There are three main environmental issues related to mineral resources. The first one is the depletion of mineral resources. By definition, mineral resources are not renewable so their extraction reduces their availability in the environment over time. The scale of their extraction can determine the amount of stress which is placed on the resources. Statistics on their stocks are required to assist in the sustainable management of these resources over time.

The second is the issue of the destruction of the environment. In order to extract mineral resources, modification of the environment is sometimes required. Extraction of mineral resources involves mining operations which disturb ecosystems, restructure the land, and remove soil and water.

Finally, the third issue is that the extraction and use of mineral resources can lead to the pollution of the environment in the form of air pollution, water pollution, soil pollution and waste.

Not all mineral resources are equally important in terms of environmental issues. The stocks of some minerals must be reported more carefully because they are more valuable, either because they are rarer, or because they are used a lot, and are thus in high demand. For these mineral resources it is extremely important to have some information available in order to evaluate their level of depletion.

FDES Sub-component 2.1 Mineral Resources covers statistics related to the environmental issue of the depletion of mineral resources. The statistics on the destruction of the environment related to the extraction of minerals are included in Sub-Component 1.2: Land Cover, Ecosystems and Biodiversity and Sub-Component 2.3: Land. Statistics on the generation, management and discharge of residuals related to the extraction and use of mineral resources are covered in Component 3: Residuals.

While stocks and changes in the stocks are measured in the same way for all minerals, mineral resources used for the production of energy (e.g., fossil fuels such as crude oil, coal and natural gas, nuclear fuels), due to their significance, are discussed in the FDES separately (under Topic 2.2.1: Stocks and changes of energy resources). Thus they are described in the methodology sheet on Energy Resources.

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[1] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 160 http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

[2] US Department of the Interior and US Geological Survey (1991) "Mineral Reserves, Resources, Resource Potential, and Certainty", pgs. 95-97 in *Suggestions to Authors of the Reports of the United States Geological Survey*, 7th edition, Washington, US Government Printing Office. Available from http://www.nwrc.usgs.gov/techrpt/sta13.pdf

[3] UN, EC, IMF, OECD and WB (2009) *System of National Accounts 2008*, pg. 214, http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

3. Definitions and description of the statistics

Mineral resources include a wide variety of metallic and non-metallic minerals found on the surface of the earth and in the subsoil. The Central Product Classification (CPC v2.1) covers mineral products under its Section 1: Ores and minerals, electricity, gas and water. Mineral products include: coal and peat (CPC Division 11); crude petroleum and natural gas (CPC Division 12); uranium and thorium ores and concentrates (CPC Division 13); metal ores including iron, copper, nickel, aluminium and precious metals and rare earths (CPC Division 14); stone, sand and clay and monumental or building stone, including limestone and other calcareous stone, sand, pebbles, gravel, natural bitumen and asphalt and clay (CPC Division 15); other minerals, such as chemical and fertilizer minerals, salt and precious and semi-precious stones, emery, natural abrasives and other minerals (CPC Division 16. See full classification in section 4A2.

Stocks of mineral resources refer to the amount of the resource by type of resources and categories of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) (see section 4A1). They are defined as the amount of known deposits of mineral resources. In the SEEA Central Framework, classes of known mineral and energy resources are defined according to combinations of criteria from the UNFC-2009. FDES 2013 uses the same classes as the SEEA. These classes are defined below.

(A) *Commercially recoverable resources* are subject to exploitation projects that have been confirmed to be technically, economically and socially feasible.

(B) *Potential commercially recoverable resources* are subject to exploitation projects that are expected to be developed in the foreseeable future, in that the quantities are assessed to have reasonable prospects for eventual economic extraction, but technical and/or commercial feasibility has not yet been confirmed. Consequently, not all potentially commercial projects may be developed.

(C) *Non-commercial and other known deposits* are either part of projects that are at an early stage of evaluation in addition to those that are considered unlikely to become commercially feasible developments within the foreseeable future, or may become recoverable in the future as technological development occurs[4]. For more information, see section 4A1 which gives a detailed description of the different classes in the UNFC-2009.

In the FDES the term mineral resources is used. Other sources such as the UNFC-2009 use the term mineral reserves.

A deposit is a concentration of a solid commodity in the subsoil.[5]

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[4] UNECE (2010) *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009.* ECE Energy Series No. 39, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf (accessed 1 March 2016).
[5] UNECE (2004) *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2004,* http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFCemr.pdf (accessed 1 March 2016).

Figure 3.1 Mineral Resources: Overview
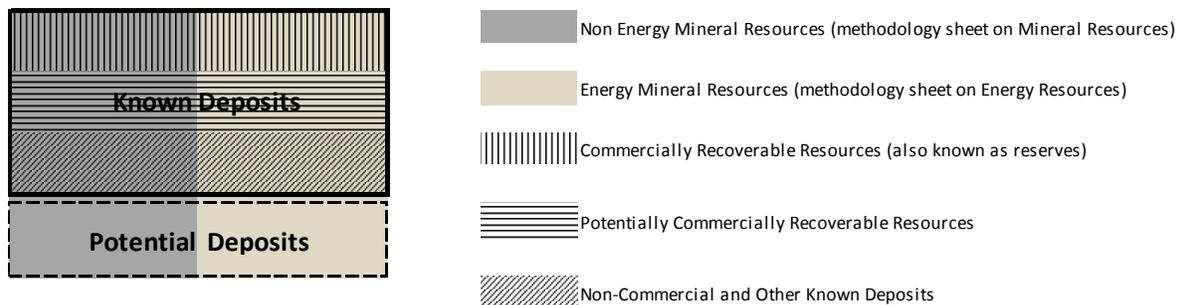
The quantities of mineral resources that are available are subject to change over time, either because they are being extracted, or because new discoveries or reclassification of previously unrecoverable resources are taking place, or finally because there may have been catastrophic losses. To estimate the total amount of these resources over time, the approach of stocks and flows is usually used. This means starting with opening balances of the stock, then both increments and decrements in flows affecting the amount of the stock are factored in, to come up with the final closing balance of the given stock of the resource. The stocks and flows approach usually considers all changes to the stock during a year. The initial amount or stock of mineral resources can change over time due to the combined effect of increases and decreases in the amount of the resource. Potential increases to the stocks occur through new discoveries, upward reappraisals and upward reclassifications. Decreases in mineral resource stocks occur because of extraction, catastrophic losses, downward reappraisals and downward reclassifications. In this manner, at the beginning of the year, the opening stocks will be calculated. After incorporating the increases and decreases throughout the year, the closing stocks at the end of the year can be calculated.

Sections 3A and 3B provide descriptions for the statistics of the FDES Sub-component 2.1 Mineral Resources: Topic 2.1.1 Stocks and Changes of Mineral Resources, and Topic 2.1.2 Production and Trade of Minerals.

3A. Stocks and changes of mineral resources (Topic 2.1.1)

3A1. Stocks

Stocks of commercially recoverable resources (FDES 2.1.1.a.1)

Amount (in mass or volume) of mineral resources corresponding to Class A of known deposits. See section 4A1 for more details.

Stocks of potentially commercially recoverable resources (FDES 2.1.1.a.9)

Amount (in mass or volume) of mineral resources corresponding to Class B of known deposits. See section 4A1 for more details.

Stocks of non-commercial and other known resources (FDES 2.1.1.a.10)

Amount (in mass or volume) of mineral resources corresponding to Class C of known deposits. See section 4A1 for more details.

The difference between the opening and closing stocks of mineral resources for a particular year results largely from extraction. New discoveries, reappraisals and reclassifications of stocks, as well as catastrophic losses, can also

influence the difference between opening and closing stocks. In the Basic Set of Environment Statistics (BSES), these statistics are only for commercially recoverable resources (Class A). However, they can also be produced for the other classes of known deposits (Classes B and C) if relevant. For details on Classes A, B or C see UNFC-2009 classification for minerals (section 4A1).

3A2. Addition to Stocks

New discoveries (FDES 2.1.1.a.2)

Discoveries (in mass or volume) of new minerals refer to findings of minerals previously unknown. Discoveries should incorporate estimates of the quantity of new deposits found during an accounting period. Discoveries should be recorded by type of resource and by class of resource.[6]

Remark:
- To be recorded as a discovery the new deposit must be a known deposit – i.e. in Class A, B or C.[7] In the BSES, new discoveries correspond only to Class A resources (commercially recoverable resources). However statistics about new discoveries of resources in Classes B and C can also be relevant.
- For more details on Classes A, B or C, see UNFC-2009 classification for minerals (section 4A1).

Upward reappraisals (FDES 2.1.1.a.3)

Reappraisals (in mass or volume) pertain only to known deposits. Upward reappraisals of mineral resources occur whenever there is an addition in the estimated available stock of a specific deposit or whenever there are changes in the categorization of specific deposits between Classes A, B or C resulting in an increment in the estimated available stock, based on changes in geological information, technology, product price or a combination of these factors.

Remark:
- In the BSES, upward reappraisals correspond only to Class A resources (commercially recoverable resources). However, statistics about upward reappraisals to resources in Classes B and C can also be relevant.
- For more details on classes A, B or C, see UNFC-2009 classification for minerals (section 4A1).

Upward reclassifications (FDES 2.1.1.a.4)

Upward reclassifications occur when certain mineral deposits are opened to mining operations due to regulatory (government) decisions concerning the access rights to a deposit. All other increments in the quantity of known deposits should be considered reappraisals. [8]

Remark:
- In the BSES, upward reclassifications correspond to Class A resources (commercially recoverable resources).
- For more details on class A, see UNFC-2009 classification for minerals (section 4A1).

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[6] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 164, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf
[7] The classes of known mineral energy resources are defined according to combinations of criteria from the "United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 " (UNFC-2009) are: i) *Class A: Commercially Recoverable Resources:* This class includes deposits for projects that fall in the categories E1 and F1 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2), or low (G3). ii) *Class B: Potentially Commercially Recoverable Resources*: This class includes deposits for those projects that fall in the category E2 (or eventually E1) and at the same time in F2.1 or F2.2 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2), or low (G3). iii) *Class C: Non-Commercial and Other Known Deposits:* are resources for those projects that fall in E3 and for which the feasibility is categorised as F2.2, F2.3 or F4 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2), or low (G3).
[8] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 165, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

3A3. Reduction of Stocks

Extraction (FDES 2.1.1.a.5)

Extraction of mineral resources is the quantity (in mass or volume) of the resource physically removed from the deposit during a period of time, usually one year. The difference between the opening and closing stocks of mineral resources for a particular year are mostly the result of extraction. It should exclude mining overburden, i.e. the quantity of soil and other material moved in order to extract the resource. Additionally, the quantity should be estimated before any refinement or processing of the resource is undertaken. Estimates of extraction should include estimates of illegal extraction, either by residents or non-residents, as these amounts reduce the availability of the resource.[9]

Mineral resources are extracted from the environment through mining and quarrying activities (ISIC Rev. 4 Section B - Mining and Quarrying, Divisions 07, 08 and 09 (Group 099)). Extraction involves methods such as underground or surface mining.

Remark:
- Extraction can only refer to Class A resources (commercially recoverable resources). It cannot refer to resources in Classes B or C.
- For more details on Class A, see UNFC-2009 classification for minerals (section 4A1).

Catastrophic losses (FDES 2.1.1.a.6)

Catastrophic losses (in mass or volume) of mineral resources may happen as a result of sudden events such as mine collapses, earthquakes, volcanic eruptions, and other extreme events such as flooding, as well as wars. Losses due to catastrophic events are rare in mineral resources. If a natural disaster changes the accessibility or conditions for extracting the natural resource this should be recorded as reappraisals and not as catastrophic losses.

In some cases, flooding and collapsing of mines does occur but the deposits continue to exist and can, in principle, be recovered. In these cases, the issue is one of economic viability of extraction rather than actual loss of the resource itself.[10]

Remark:
- In the BSES, catastrophic losses correspond only to Class A resources (commercially recoverable resources). However, statistics about catastrophic losses of resources in Classes B and C can also be relevant.
- For more details on Classes A, B or C, see UNFC-2009 classification for minerals (section 4A1).

Downward reappraisals (FDES 2.1.1.a.7)

Reappraisals pertain only to known deposits. Downward reappraisals of mineral resources occur whenever there is a subtraction in the estimated available stock of a specific deposit or whenever there are changes in the categorization of specific deposits between Classes A, B or C resulting in the reduction of the estimated availability of the stock based on changes in geological information, technology, product price or a combination of these factors. [11]

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[9] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 165, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

[10] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 165, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf.

[11] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 164, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf.

Remark:
- In the BSES, downward reappraisals correspond only to Class A resources (commercially recoverable resources). However, statistics about downward reappraisals of resources in Classes B and C can also be relevant.
- For more details on Classes A, B or C, see UNFC-2009 classification for minerals (section 4A1).

Downward reclassifications (FDES 2.1.1.a.8)

Downward reclassifications (in mass or volume) occur when certain mineral deposits are closed to mining operations due to regulatory (government) decisions concerning the access rights to a deposit. All other reductions in the quantity of known deposits should be considered reappraisals. [12]

Remark:
- In the BSES, downward reclassifications correspond to Class A resources (commercially recoverable resources). It cannot refer to resources in Classes B or C.
- For more details on Class A, see UNFC-2009 classification for minerals (section 4A1).

3B. Production and trade of minerals (Topic 2.1.2)

Production of minerals (FDES 2.1.2 a.)
Mineral production is defined in physical terms as the amount (in mass or volume) of the mineral extracted from the deposit within the national territory, in a period of time, usually a year. In general, the production in a given country will either be used internally, increase product inventories or be exported to other countries.

Imports of minerals (FDES 2.1.2.b.)
Imports are defined in physical terms as the amount (in mass or volume) of the minerals that is produced or extracted by non-residents outside the national territory and that is bought (bartered or transferred) by the residents of the national territory in a period of time, usually a year.

Imports of minerals calculated in term of currency correspond to the mass or volume imported times the price per mass or volume at which the commodities were bought from the rest of the world.

Exports of minerals (FDES 2.1.2.c.)
Exports are defined in physical terms as the amount (in mass or volume) of the minerals that is produced by the residents of the national territory and sold (bartered or transferred) to non-residents in other territories in a period of time, usually a year.

Exports of minerals calculated in term of currency correspond to the mass or volume exported times the prices per mass or volume at which the commodities were sold to the rest of the world.

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[12] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 165, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf.

4. International sources and recommendations

4A. Classifications and groupings

The three most relevant classifications pertaining to mineral resources are described below.

4A1. The UN Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC- 2009)[13]

This classification is useful to understand the different levels of stocks of available resources (or reserves) in different countries, as it is a flexible, universally applicable scheme for classifying and evaluating both energy and mineral reserves and resources. Since countries designate their layers of reserves with different denominations, this classification allows for a common and necessary international understanding of these classifications/evaluations. The classification is designed to allow the incorporation of current existing terms and definitions into the framework and thus to make them comparable and compatible. The specifications set out the basic rules that are considered necessary to ensure an appropriate level of consistency in application. They importantly provide additional instructions on how UNFC-2009 should be applied in specific circumstances.

Figure 4.1 UNFC-2009 Classes and sub-classes[14]

UNFC Classes Defined by Categories and Sub-categories					
Extracted	**Sales Production**				
	Non-sales Production				
	Class	**Sub-class**	**Categories**		
			E	F	G
Known Deposit	**Commercial Projects**	**On Production**	1	1.1	1, 2, 3
		Approved for Development	1	1.2	1, 2, 3
		Justified for Development	1	1.3	1, 2, 3
	Potentially Commercial Projects	**Development Pending**	2	2.1	1, 2, 3
		Development On Hold	2	2.2	1, 2, 3
	Non-Commercial Projects	**Development Unclarified**	3.2	2.2	1, 2, 3
		Development Not Viable	3.3	2.3	1, 2, 3
	Additional Quantities in Place		3.3	4	1, 2, 3
Potential Deposit	**Exploration Projects**	**[No sub-classes defined]**	3.2	3	4
	Additional Quantities in Place		3.3	4	4

Total Commodity Initially in Place

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[13] UNECE (2010) *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009.* ECE Energy Series No. 39, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf (accessed 1 March 2016)
[14] UNECE (2010) *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009.* ECE Energy Series No. 39, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf (accessed 1 March 2016)

Mineral resources can be classified by the UNFC-2009 classes which divides deposits into two main classes: known deposits and potential deposits. A known deposit is a deposit that has been demonstrated to exist by direct evidence. A potential deposit is a deposit that has not yet been demonstrated to exist by direct evidence (e.g. drilling and/or sampling), but is assessed as potentially existing based primarily on indirect evidence (e.g. surface or airborne geophysical measurements).

In the SEEA Central Framework, classes of known mineral and energy resources are defined according to combinations of categories from the UNFC-2009.

Both classifications categorise mineral and energy resources by looking at whether, and to what extent, projects for the extraction and exploration of the resources have been confirmed, developed or planned. Based on the maturity of the projects the underlying resources are classified. The UNFC-2009 and the SEEA Central Framework are based on a breakdown of the resources according to three criteria affecting their extraction:

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

Criterion **E** designates the degree of favourability of economic and social conditions in establishing the commercial viability of the project. Criterion **F** designates the maturity of studies and commitments necessary to implement mining plans or development projects, extending from early exploration efforts occurring before it has been confirmed that a deposit or accumulation exists, to projects involving extraction and sale of a product. Criterion **G** designates the level of certainty of geologic knowledge and of potential recoverability of quantities of the resource concerned.[15]

FDES 2013 uses the same classes as those of SEEA. The SEEA and FDES classes are defined below.

Class A: Commercially Recoverable Resources. This class includes deposits for projects that fall in categories E1 and F1 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2) or low (G3).

Class B: Potentially Commercially Recoverable Resources. This class includes deposits for those projects that fall in category E2 (or eventually E1) and at the same time in F2.1 or F2.2 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2) or low (G3).

Class C: Non-Commercial and Other Known Deposits are resources for those projects that fall in category E3 and for which the feasibility is categorised as F2.2, F2.3 or F4 and where the level of confidence in the geological knowledge is either high (G1), moderate (G2) or low (G3).

The criteria are reflected in the UNFC-2009 categories. Figure 4.2 provides a mapping of the UNFC-2009 categories which have been aggregated to the SEEA classes A, B and C.

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[15] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 161, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

Figure 4.2 SEEA Categories and Sub-categories of Mineral and Energy Resources[16]

	SEEA classes	Corresponding UNFC-2009 project categories		
		E	**F**	**G**
		Economic and social viability	**Field project status and feasibility**	**Geologic knowledge**
Known deposits	A: Commercially recoverable resources[a]	E1. Extraction and sale have been confirmed to be economically viable	F1. Feasibility of extraction by a defined development project or mining operation has been confirmed	
	B: Potentially commercially recoverable resources[b]	E2. Extraction and sale are expected to become economically viable in the foreseeable future[c]	F2.1 Project activities are ongoing to justify development in the foreseeable future Or F2.2 Project activities are on hold and/or where justification as a commercial development may be subject to significant delay	Quantities associated with a known deposit that can be estimated with a high (G1), moderate (G2) or low (G3) level of confidence
	C: Non-commercial and other known deposits[d]	E3. Extraction and sale are not expected to become economically viable in the foreseeable future or evaluation is at too early a stage to determine economic viability	F2.2 Project activities are on hold and/or where justification as a commercial development may be subject to significant delay Or F2.3 There are no current plans to develop or to acquire additional data at the time due to limited potential Or F4. No development project or mining operation has been identified	
Potential deposits (not included in SEEA)	Exploration projects Additional quantities in place	E3. Extraction and sale are not expected to become economically viable in the foreseeable future or evaluation is at too early a stage to determine economic viability	F3. Feasibility of extraction by a defined development project or mining operation cannot be evaluated due to limited technical data Or F4. No development project or mining operation has been identified	Estimated quantities associated with a potential deposit, based primarily on indirect evidence (G4)

Notes

[a] Including on-production projects, projects approved for development and projects justified for development.

[b] Including economic and marginal development projects pending and development projects on hold.

[c] Potential commercial projects may also satisfy the requirements for E1.

[d] Including unclarified development projects, non-viable development projects, and additional quantities in place.

Source: UNFC-2009, figures 2 and 3.

4A2. The Central Product Classification – CPC [17]

For the purposes of identifying which elements and compounds are considered minerals (excluding mineral energy resources that are covered in a separate methodology sheet), it is useful to consider the CPC ver. 2.1, which provides a detailed classification of the mineral products within its Divisions 14, 15 and 16.

Figure 4.3 CPC v 2.1

Group	Class	Subclass	Description
Division 14			**Metal ores**
141			**Iron ores and concentrates, other than roasted iron pyrites**
	1410	14100	Iron ores and concentrates, other than roasted iron pyrites
142			**Non-ferrous metal ores and concentrates (other than uranium or thorium ores and concentrates)**
	1421	14210	Copper, ores and concentrates
	1422	14220	Nickel ores and concentrates
	1423	14230	Aluminium ores and concentrates
	1424	14240	Precious metal ores and concentrates
	1429	14290	Other non-ferrous metal ores and concentrates (other than uranium or thorium ores and concentrates)
Division 15			**Stone, sand and clay**
151			**Monumental or building stone**
	1511	15110	Slate
	1512	15120	Marble and other calcareous monumental or building stone
	1513	15130	Granite, sandstone and other monumental or building stone
152			Gypsum; anhydrite; limestone flux; limestone and other calcareous stone, of a kind used for the manufacture of lime or cement
	1520	15200	Gypsum; anhydrite; limestone flux; limestone and other calcareous stone, of a kind used for the manufacture of lime or cement
153			Sands, pebbles, gravel, broken or crushed stone, natural bitumen and asphalt
	1531	15310	Natural sands
	1532	15320	Pebbles, gravel, broken or crushed stone, macadam; granules, chippings and powder of stone
	1533	15330	Bitumen and asphalt, natural; asphaltites and asphaltic rock
154			Clays
	1540	15400	Clays
Division 16			**Other minerals**
161			**Chemical and fertilizer minerals**
	1611	16110	Natural calcium phosphates, natural aluminium calcium phosphates and phosphatic chalk
	1612	16120	Unroasted iron pyrites
	1619	16190	Other chemical minerals

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[17] United Nations (2015) Central Product Classification (CPC) version 2.1. ST/ESA/STAT/Ser. M No. 77, http://unstats.un.org/unsd/cr/downloads/CPCv2.1_complete%28PDF%29_English.pdf

162			Salt and pure sodium chloride; sea water
	1620	16200	Salt and pure sodium chloride; sea water
163			Precious and semi-precious stones; pumice stone; emery; natural abrasives; other minerals
	1631	16310	Precious stones (including diamonds, but not industrial diamonds) and semi-precious stones, unworked or simply sawn or roughly shaped
	1632	16320	Industrial diamonds, unworked or simply sawn, cleaved or bruted; pumice stone; emery; natural corundum, natural garnet and other natural abrasives
	1633	16330	Chalk and dolomite
	1639	16390	Other minerals n.e.c.

4A3. The Standard Industrial Classification of All Economic Activities (ISIC), Rev.4 [18]

In terms of the relevant classification for activities related to mineral extraction, mineral resources are extracted or produced from the environment typically through mining and quarrying, therefore economic activities that fall under ISIC Rev. 4, Section B - Mining and Quarrying: Divisions 07, 08 (Group 081 and 089) and 09 (Group 099) apply.

Figure 4.4 ISIC Rev.4 Divisions, Groups and Classes Relevant to Mining and Quarrying

Division 07			Mining of metal ores
	071	0710	Mining of iron ores
	072		Mining of non-ferrous metal ores
...			
		0729	Mining of other non-ferrous metal ores
...			
Division 08			Other mining and quarrying
	081	0810	Quarrying of stone, sand and clay
	089		Mining and quarrying n.e.c.
		0891	Mining of chemical and fertilizer minerals
...			
		0893	Extraction of salt
		0899	Other mining and quarrying n.e.c.
Division 09			Mining support service activities
	099	0990	Support activities for other mining and quarrying

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[18] United Nations (2008) *International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4,* http://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4e.pdf

4B. Reference to international statistical recommendations, frameworks and standards

Currently, there are no internationally agreed statistical recommendations or frameworks specifically produced as methodological guidance for mineral resources statistics.

For general industrial commodity production statistics, indices of industrial production and general industrial statistics, methodological guidance, manuals, questionnaires and relevant classifications which include minerals are available on the UNSD website (http://unstats.un.org/unsd/industry/).

For trade statistics in general, which are applicable to imports and exports of minerals, international recommendations, compilers manuals and other methodological resources are available on the UNSD website (http://unstats.un.org/unsd/trade/methodology%20IMTS.htm).

4C. Sources of global and regional environment statistics and indicators series

In the area of industrial statistics, UNSD is engaged in the collection and dissemination of data on the production of major industrial commodities, both in physical quantities and in monetary value. Data are mainly collected through a questionnaire sent annually to national statistical offices (http://unstats.un.org/unsd/industry/questionnaire.asp). The commodities are classified according to the UN List of Industrial Products.

Collected data are disseminated in three major publications: the Industrial Commodity Statistics Yearbook that also feeds into the United Nations Statistical Yearbook, and the Monthly Bulletin of Statistics.

Data on Industrial Commodity Production including minerals can be obtained from UNSD in the following ways:
- The Industrial Commodity Statistics Yearbook of UNSD includes the production of minerals (mining and quarrying) for the products based on CPC.
- The complete dataset of Industrial Commodity Statistics (http://unstats.un.org/unsd/industry/ics_intro.asp).
- On-line through the UN Data portal (http://data.un.org/Browse.aspx?d=ICS).

The United Sates Geology Survey (USGS) offers various data systems and files including the Mineral Resources On-Line Spatial Data which includes interactive maps and downloadable data for regional and global geology, geochemistry, geophysics, and mineral resources; the Mineral Resources Data System (http://mrdata.usgs.gov/mrds/); and data on major mineral deposits of the world (http://mrdata.usgs.gov/major-deposits/).

Additionally, the British Geological Survey (BGS) (https://www.bgs.ac.uk/mineralsuk/statistics/worldStatistics.html) produces the World Mineral Production Statistics Dataset. The dataset is continuous from 1913 to the present day. The BGS also present regional publications for Europe, Africa, China and South East Asia and South America (https://www.bgs.ac.uk/mineralsuk/statistics/europeanStatistics.html).

5. Data collection and sources of data

In the field of mineral reserves and production (mineral stocks and extraction) most countries produce mineral statistics on a regular basis, provided that minerals are important for their economies, and long time series are usually available.

An exception may be in the estimation of stocks and their changes which, other than extraction, requires expert knowledge and assessment. Should the countries not produce or disseminate statistics on the stocks or reserves, efforts could be made with the proper institutional partners, including the mining and geological authorities, in order to be able to develop these statistics in the future.

It should be noted that stocks or reserves of mineral resources could be available but not necessarily made public, as these types of statistics are also of an economically strategic and therefore sensitive nature for countries.

Scope
All mineral stocks and flows, that is mineral resources, minerals extracted/produced, mineral products traded including all mineral products for each particular country

Statistical unit
The statistical units are the establishments extracting minerals, grouped under ISIC Rev. 4, section B: Mining and Quarrying, Divisions 07, 08 and 09 (Group 099) (see section 3A2 in this document), and those establishments that import and export mineral products.

The collection of information about the environment, particularly as it concerns environmental assets, requires consideration of appropriate statistical units for the environment, reflecting the parts of the environment for which statistics may be collected and presented. Examples include inland water bodies (lakes, rivers, etc.), specific deposits of mineral resources, forests and fish stocks. While, in some cases, it will be possible to align the environmental statistical unit and an associated economic unit, this should not be expected.[19]

Measurement unit
Production and trade of minerals are commonly expressed in mass (i.e. metric tons) and also in monetary units (nominal and real). Additionally, the countries may also produce mineral production/extraction and trade indexes of both volume and value.

Sources and institutions
A general description of the type of sources, the main institutional partners and availability of statistics are provided by grouping the individual statistics about minerals in four groups: mineral production or extraction; stocks of mineral resources; reappraisals, reclassifications and catastrophic losses of mineral resources; and trade of minerals.

a) Mineral production or extraction
The main statistics on minerals production or extraction are usually produced by the NSO and/or mining and geological authorities, and the industrial/economic authorities depending on the institutional set up of the country. Surveys, including economic surveys and/or industrial surveys, are a common form of data collection. Currently, most countries with important mineral production produce these statistics regularly and they are disseminated for public use. Levels of disaggregation and periodicity of the mineral production/extraction may vary, but quarterly and annual

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[19] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 31, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf.

statistics by products are usually produced in most countries. Production/extraction statistics are presented in both physical units and monetary units for the mineral products produced in each country.

b) Stocks of mineral resources

Mineral resources or stocks that are available in countries are usually estimated by the mining and geological authorities. The statistical source type can include a combination of geological surveys and studies as well as expert estimation. Currently, most countries with important mineral production produce estimates of stocks or reserves by mineral resource, as it is highly relevant for economic production prospects. Levels of estimated mineral stocks may vary over time, based on the geological, economic and technological knowledge of the known reserves.   Levels of disaggregation and periodicity of statistics on minerals stocks can vary, but annual statistics are usually produced. Estimations are usually presented on an annual, biennial or longer term basis, mostly in physical units, at least for the most important mineral resources in each country.

c) Reappraisals, reclassifications and catastrophic losses of mineral resources

Source of reappraisals, reclassifications and eventual catastrophic losses of mineral resources are usually estimated and reported by the mining and/or geological authorities in each country. They generally base these estimations on field observations and expert knowledge/assessment including geological, economic and technological factors, all of which can affect these variables. Levels of disaggregation and periodicity of these statistics on mineral stocks changes can vary, but annual statistics are usually produced. These statistics are usually presented in physical units.

d) Trade of minerals

Trade of minerals describing exports and imports are regularly produced within industrial commodities trade statistics by the NSO and/or the economic and/or trade authority. Statistics are based on administrative records produced by the international trade and/or the customs authorities in charge of recording all foreign trade flows in each country. The category of measure for trade in minerals includes both quantity and monetary value incorporating prices at which the mineral commodities were sold and purchased (i.e. Cost, Insurance and Freight (CIF), Free on Board (FOB)). Levels of disaggregation and periodicity of the minerals traded can vary, but quarterly and annual statistics are usually produced and disseminated in most countries. The most important mineral statistics in economies are share of the mining sector in the GDP and share of the trade of mineral resources in the imports and exports.

Aggregation

Some degree of aggregation and disaggregation of the mineral resources and the extraction will be necessary, depending on the information objectives of such statistical operations.

Temporal aspects

Mineral statistics are produced annually in most countries. Some statistics on production of key metals can be produced per quarter and even monthly, depending on their importance to the national economy. From the environment statistics perspective, the series to be selected and used in this sub-component can be aggregated to accommodate a yearly periodicity.

Spatial aspects

When administrative or geospatial dimensions are incorporated, mineral statistics can be disaggregated by subnational administrative area or the appropriate spatial unit.

Aggregation over commodities

Mineral statistics are collected according to individual minerals, which is needed to follow trends in resource depletion. Commodity data can be aggregated (e.g. in monetary terms) to produce indicators on the contribution of mineral resources to the GDP, their share in foreign trade or to calculate material consumption. For example, for countries that produce mineral production/extraction and trade indexes of both volume and quantum, these statistics can be aggregated to show long term trends in extraction of minerals. This is of interest as it impacts the resource stocks, particularly in countries where mineral resources and exports are key to development. Care must be taken when aggregating by groups of commodities to ensure that the groups created are meaningful. For example, a tonne of diamond has much more value than a tonne of marble.

Description of statistics - Metadata

When the mineral statistics data sets are validated, it is important to describe them to the extent possible using adequate metadata formats to contribute to geographical, conceptual and time comparability of the statistics series produced.

6. Uses and dissemination

6A. Potential presentation/dissemination formats

The following images illustrate some of the potential dissemination formats. Note that the statistics shown may reflect national classifications rather than the international classifications.

Figure 6.1 Australia's Identified Mineral Resources

Australia's Identified Mineral Resources Table 1

December 2014

Commodity	Units	JORC Reserves (a) (% of Accessible EDR)	Demonstrated Resources			Inferred Resources (c)	Accessible EDR (d)	Mine Production 2014 (e)	Economic Resources 2014 (f)	Mine production 2014 (g)
			Economic (EDR) (b)	Subeconomic						
				Para-marginal	Sub-marginal					
Antimony	kt Sb	62.6 (45%)	138.8	8.8	0	62.8	138.8	5.8	1800	160
Bauxite	Mt	2087 (34%)	6192	144	1429	2036	6192	78.6	28 000	234
Copper	Mt Cu	25.94 (29%)	88.48	1.28	0.43	50.77	88.48	0.97	700	18.7
Diamond	Mc	99.15 (45%)	219.51	0	0	35.99	219.51	9.288	730	138.1
Gold	t Au	3550 (39%)	9112	244	95	4562	9082	274	55 000	3114
Iron										
Iron ore	Mt	20 487 (38%)	54 412	1569	1727	82 167	54 412	735	190 000	3220
Contained iron	Mt Fe	9665 (39%)	24 639	799	570	36 173	24 639	424	87 000	
Lead	Mt Pb	12.82 (37%)	34.72	3.35	0.14	20.21	34.72	0.73	87	5.46
Lithium	kt Li	854 (56%)	1533	0	0	179	1533	*	13 533	36*
Manganese ore	Mt	121 (53%)	226.9	23.1	167	311.9	226.9	7.67	1520	51

Source: http://www.ga.gov.au/scientific-topics/minerals/table1 Accessed November 2015
(JORC: Joint Ore Reserves Committee, EDR: Economic Demonstrated Resources, AEDR: Accessible Economic Demonstrated Resources).

Shows statistics on stocks and production by commodity, using national classification for commercial feasibility of resource.

Figure 6.2 Chilean Copper Production and Prices

Average price refined and scrap copper (US$/lb 2015 dollars; Global Copper Production (1,000s metric tons/kMT Copper Content);
Chile Copper Production (1,000s metric tons/kMT Fine Content)
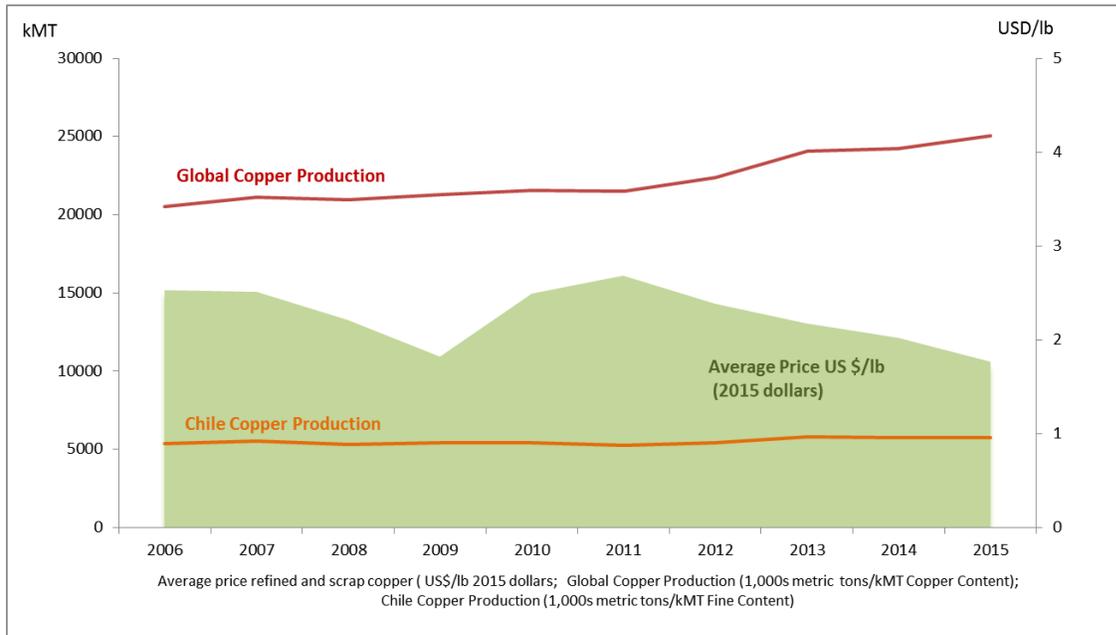
Source: Developed from data of 2015 Anuario de Estadisticas del Cobre y Otros Minerales 2006 -2015,
https://www.cochilco.cl/Paginas/Estadisticas/Publicaciones/Anuario.aspx

Time series from 2000-2013 of production volume and prices for copper, with national and global comparison

Figure 6.3: Western Australia Mineral Statistics Digest 2014

Figure 46. **Gold Production** Source: DMP and BREE
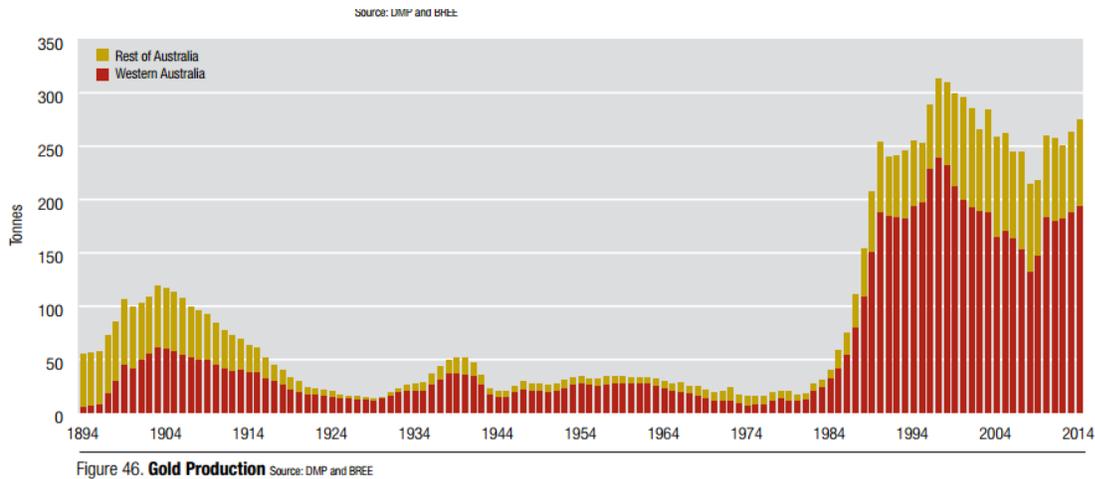
Source: Western Australia Mineral and Petroleum Statistics Digest 2014,
http://www.dmp.wa.gov.au/Documents/About-Us-Careers/Statistics_Digest_2014.pdf

Australia production of gold, in volume, with national and global comparison, time series 1894 to 2014

Figure 6.4: Mineral resources in the United States of America
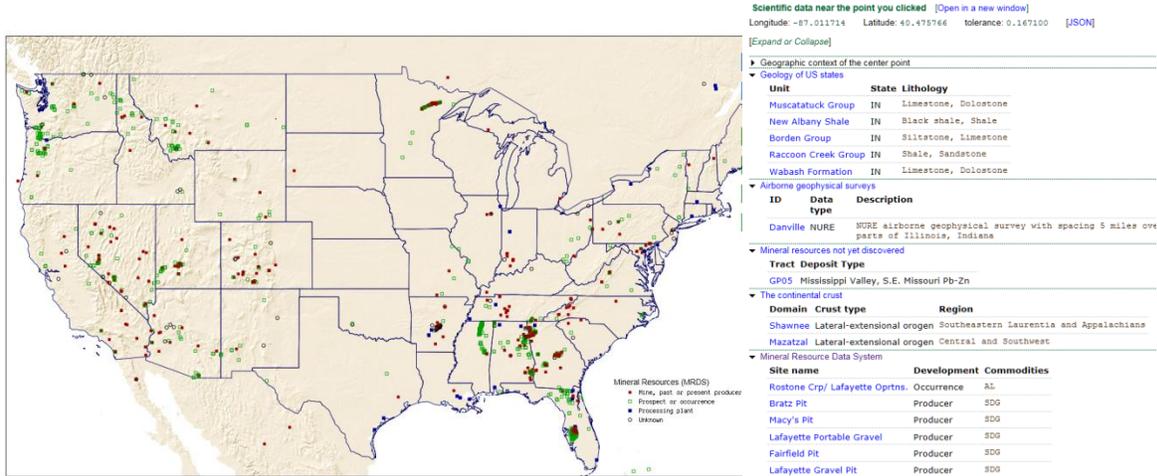
Source: USGS Mineral Resource Data System, https://mrdata.usgs.gov/mrds/ last modified 08 February 2016.

View of interactive map of mineral resource locations in the United States of America for one commodity: showing mines, prospects or occurrences, and processing plants. Further scientific data is available interactively for each site.

Figure 6.5 Canadian Mineral Production 2013 and 2014
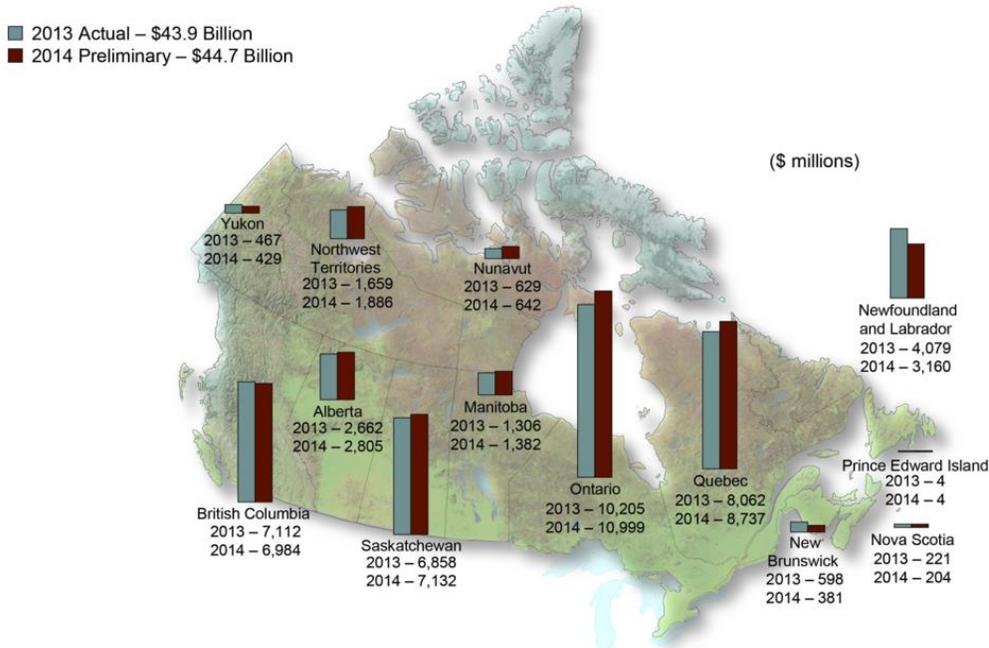
Source: Mineral and Metals Fact Book – 2015, Natural Resources Canada, http://www.nrcan.gc.ca/mining-materials/publications/18733

Map of mineral production value by province for 2013 and 2014, overlaying map and charts.

6B. SEEA accounts/tables that use these statistics

The statistics about mineral reserves/stocks and flows (extraction, reappraisals, reclassifications) are key for compiling the mineral asset accounts in the SEEA Central Framework 2012, Chapter 5.5. The classification used in table 5.1 of environmental assets in the SEEA CF includes: 1.4 Non-metallic mineral resources and 1.5 Metallic mineral resources.

In the SEEA Central Framework, mineral resources and non-renewable energy resources are discussed together under the asset accounts for mineral and energy resources[20]. The definitions and categorization used in the FDES for mineral and energy resources follows those of the SEEA Central Framework, and both are based on the UNFC-2009[21]. The statistics contained in the FDES Sub-component 2.1, Topic 2.1.1 support the SEEA Central Framework physical asset accounts for mineral and energy resources. They also support the physical supply and use tables   (natural input). Statistics contained in the FDES Sub-component 2.1, Topic 2.1.2 provide input to the supply and use tables of the SEEA Central Framework, necessary for assembling the physical and material flow accounts.

6C. Commonly used indicators that incorporate these statistics

- Resource extraction to stocks or reserves ratio

   This ratio represents the proportion of the stock or reserves that have been extracted during one year. It can be used to calculate the remaining period of availability of the resource if its extraction continues at the same path and its stocks or reserves are not modified through new discoveries, reappraisals or reclassification. This indicator gives an idea of the sustainability of the extraction of a specific energy resource. It is calculated as:

$$\frac{2.1.1.\,a.\,5\; Extraction, by\; mineral}{2.1.1.\,a.\,1\; Stocks\; of\; commercially\; recoverable\; resources, by\; mineral}$$

- Mineral export price index

   This index monitors the prices of the minerals exported. The following statistic is required to produce the indicator:

$$2.1.2.\,c\; Exports\; of\; minerals\; (Currency), by\; mineral$$

- Mineral import price index

   This index monitors the prices of the minerals imported. The following statistic is required to produce the indicator:

$$2.1.2.\,b\; Imports\; of\; minerals\; (Currency), by\; mineral$$

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[20] UN, EC, FAO, IMF, OECD and WB (2014) *System of Environmental-Economic Accounting 2012- Central Framework*, pg. 160, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf.
[21] UNECE (2010) *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009.* ECE Energy Series No. 39, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf (accessed 1 March 2016)

6D. SDG indicators that incorporate these statistics

- **Material footprint** (SDG Indicators 8.4.1 and 12.2.1: Material footprint, material footprint per capita, and material footprint per GDP).

  Material footprint (MF) is the attribution of global material extraction to domestic final demand of a country. It is calculated as raw material equivalent of imports (RMEIM) plus domestic extraction (DE) minus raw material equivalents of exports (RMEEX). It includes both energy resources (see methodology sheet on energy resources) and mineral resources.

  Material footprint of consumption reports the amount of primary materials required to serve final demand of a country and can be interpreted as an indicator for the material standard of living/level of capitalization of an economy. Per-capita MF describes the average material use for final demand.

  Statistics needed (among others) for this indicator:
  - 2.1.2.a Production of minerals
  - 2.1.2.b Imports of minerals
  - 2.1.2.c Exports of minerals

- **Domestic material consumption** (SDG Indicators 8.4.2 and 12.2.2: Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP).

  Domestic Material Consumption (DMC) is a standard material flow accounting (MFA) indicator and reports the apparent consumption of materials in a national economy. It is calculated as direct imports (IM) of material plus domestic extraction (DE) of materials minus direct exports (EX) of materials measured in metric tonnes. DMC measures the amount of materials that are used in economic processes. It does not include materials that are mobilized in the process of domestic extraction but do not enter the economic process. DMC is based on official economic statistics and requires some modelling to adapt the source data to the methodological requirements of the MFA. It includes both energy resources (see methodology sheet on energy resources) and mineral resources.

  DMC reports the amount of materials that are used in a national economy. DMC is a territorial (production side) indicator. DMC also presents the amount of material that needs to be handled within an economy, which is either added to material stocks of buildings and transport infrastructure or used to fuel the economy as material throughput. DMC describes the physical dimension of economic processes and interactions. It can also be interpreted as long-term waste equivalent. Per-capita DMC describes the average level of material use in an economy – an environmental pressure indicator - and is also referred to as metabolic profile.

  Statistics needed (among others) for this indicator:
  - 2.1.2.a Production of minerals
  - 2.1.2.b Imports of minerals
  - 2.1.2.c Exports of minerals

F D E S

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