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Handbook on Statistics for Economies Based on Natural Resources

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HANDBOOK ON STATISTICS FOR ECONOMIES BASED ON NATURAL RESOURCES

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PREFACE

In many countries, the mining industry is rapidly developing, generating substantial revenue and resulting in significant growth in those economies based on natural resources. The mining industry's impact on the environment is expected to increase over time. This new wave of development of the mining industry is posing new challenges to national statistical institutions of both developed and developing countries with significant natural resources. Furthermore, there are deficiencies in the availability of mining statistics that are comparable across countries.

The Ulaanbaatar City Group (UBCG) on statistics for economies based on natural resources was established to address methodological issues related to statistics on natural resources and contribute to improving international standards and methods for producing such statistics, by pooling expertise from various countries.

This handbook is a joint product of a number of National Statistical Offices, UNIDO, IMF, UNESCAP & CISSTAT. The National Statistics Offices include Australia, Mongolia, Mexico, Russia, India, China, Kazakhstan, and Vietnam. This report would not have been possible without the leadership of the joint chairs of the late Mr Gerelt-Od Ganbaatar (National Statistical Office of Mongolia) and Mr Bruce Hockman (Australian Bureau of Statistics). The group would also like to acknowledge the work of Ms Badamtsetseg Batjargal (formerly of the National Statistical Office of Mongolia) who also steered the work of handbook. Section 6.4 on the external sector was drafted by Alicia Hierro from the Statistics Department of the IMF. The staff at the National Statistical Office of Mongolia provided secretariat support for the group, without whom this handbook would not have been produced. For a full list of participants see Annex 3.

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Chapter 1.

Introduction

1.1. Background

1. In many countries, the mining industry is rapidly developing, generating substantial revenue and resulting in significant growth in those economies based on natural resources. The mining industry's impact on the environment is expected to increase over time. This new wave of development of the mining industry is posing new challenges to the national statistical institutions of both developed and developing countries with significant natural resources. Furthermore, there are deficiencies in the availability of mining statistics that are comparable across countries.

2. The Ulaanbaatar City Group (UBCG) on statistics for economies based on natural resources was established to address methodological issues related to statistics on natural resources and contribute to improving international standards and methods for producing such statistics, by pooling expertise from various countries. There are a number of other initiatives that are also collecting data in resource industry. Two of them are International Monetary Fund and the Extractive Industries Transparency Initiative.

3. The handbook outlines statistics on direct and indirect activities related to mining. Direct activities of mining are those associated with the extraction process itself, including specialised support services. Indirect activities are those associated with downstream processing, as well as mining-related components of other activities that are closely associated with mining, such as construction, transportation and the provision of technical services. The handbook outlines statistics to measure the economic, environmental and social impact from mining.

4. Since the turn of the century the world's appetite for natural resources has grown exponentially. Since 2000 China's GDP growth has been on average greater than 7%, India's has been greater than 5%. This growth has been predominantly in infrastructure but also in dwelling investment as well. There has been significant expansion in many countries' manufacturing sectors, all of which drives the increase in demand for natural resources. This demand for natural resources impacts those economies that are based on natural resources. Many of the resource based countries are small and changes in commodity prices can impact their income streams.

5. In order to understand how this increase in demand for natural resources is impacting on economies, it is necessary to develop a suite of statistics that will assist decision making. Countries whose economies are dependent on natural resources would benefit from the material in this handbook. While the handbook is applicable to all countries, it is worth emphasising that they are not expected to implement everything. They should target the needs of decision makers within their own country.

6. Appropriate and timely statistics are essential to inform governments, businesses and communities about the decisions that must make to ensure that they make the best use of their natural resources. Against this background the Ulaanbaatar City Group (UBCG) was formed. The UBCG was formed to provide leadership in defining international best practices in statistical measurement for economies based on natural resources. The UBCG also serves as a forum for sharing expertise among statistical organisations, both national and international, as well as other stakeholders. The UBCG is also collaborating with the United Nations in developing and improving statistical methodologies and standards for natural resources.

7. The objectives for UBCG are to develop methodological and practical guidelines to accurately track mining activity. These guidelines will assist in measuring and assessing mining's contribution to the economy, its impact on society and the environment. This handbook is one of the main objectives of the group, and is focused on providing recommendations and best practice to ensure coverage, reliability, accuracy and relevance of statistical data.

8. The work of the UBCG aligns with other city groups. City groups are formed to address selected problems in statistical methods. The work of these groups could result in proposals to change international standards. City groups determine their own individual mechanism of work, their agendas and outputs. City groups are informal groups of experts primarily from national statistical agencies. Participation by representatives is voluntary as is the existence of the group itself.

1.2. Rationale for the handbook

9. The main reason for producing the handbooks is to enable National Statistical Offices (NSOs) to produce a suite of statistics that would be beneficial to decision makers. These statistics would cover mining and related activities. The set of statistics would provide information on the impact of mining on the economy, society and the environment. The handbook addresses a number of issues that were considered when establishing the UBCG.

10. The handbook aims to be consistent across the many frameworks. Specific consideration has been given to the system of National Accounts, the system of Environmental- Economic Accounting, and Government Finance Statistics. The purpose is to harmonise statistics across these frameworks and the many after. This is discussed in Chapter 3.

11. The importance of understanding the impact of the mining industry on a country's economy needs to be articulated and analysed. Mining enterprises carry out additional functions apart from their main activities. Mining enterprises also engage in the development of infrastructure, including roads, transportation and communications. Some of these activities are not currently classified to the mining sector. An assessment of the contribution made by the mining sector could include these indirect contributions.

12. The mining sector plays an important role in total production. As such, the prices of mining products are also important as these affect the contribution to the national economy. For instance, volatile mining products impact estimates of Gross Domestic Product (GDP).

13. Investment is one the main components of GDP estimates. Foreign investments are also a large factor that requires quality estimate. There is an urgent need to define an efficient methodology for collecting data on the capital expenditure of mining industries and for information on foreign direct investment.

14. For many countries the informal mining sector plays a large role in their economies. Methodologies and recommendations for determining the size of the informal mining sector are needed. Due to the specific nature of the mining industry, workers engaged in the informal mining sector are likely to be constantly migrating, moving from site to site, which could hinder their involvement in household surveys. Therefore, the handbook will address the issue of how to calculate the economic contribution from the informal mining sector.

15. Some mining products are handled by a single company. This means many NSOs will have to deal with data confidentiality. This is linked with the issue of the classification and identification of activities of transnational companies. Dealing with transnational enterprises is also important for measuring GDP and associated income flows.

16. The handbook will also provide statistics to assist users in examining the impact of mining on society. Measuring the benefits arising from and the income generated by the mining sector on the living standards is important. The social impact is

reflected by employment opportunities and social services, mining sites are often located in isolated areas. This means that development of residential infrastructure, and other services need to occur.

17. Despite the positive benefits that may flow to the economy from mining activity it is also important to measure its impact on the environment. The handbook will improve indicators to estimate the sustainable development of affected countries. Recommendations regarding the development of economic accounting systems for the environment and on the development of relevant data sources will also be addressed. There is also an increasing demand for the development of methodologies and the identification of indicators for measuring desertification due to the inappropriate use of mining procedures that the handbook will discuss.

18. The rationale for producing the handbook is to address these issues. To do this the handbook will provide guidelines that will deliver consistency across countries. The handbook will also establish best practices in collection and dissemination for mining and related statistics.

19. As the target audience for the hand book is NSOs it is important the work of the UBCG reflects the *Fundamental Principles of Official Statistics* (UN 2014).

1.3. Scope and coverage of the handbook

20. The handbook's primary focus is on mining and its impact on the economy, environment and broader society. The handbook will not be examining other natural resources. The reason is that very few, if any, countries' economies are driven by non-mining natural resources. While natural resources, such as forests and water are important, they are not likely to drive an economy's output. This is an important distinction to make, as this is an area where the UBCG is interested in examining the impact of mining on the environment. The London city Group, via SEEA, is examining broader natural resources.

21. Recommendations will be limited to the highest priority statistics and methods to produce those statistics related to the mining industry and related activity. Recommendations are based on the contents of 2008SNA.

1.4. Links with other Relevant Groups

22. With the scope of UBCG focusing on mining, it is worth noting that it has links with other city groups. The two most directly linked are the Oslo Group (Energy statistics) and the London Group (Environmental statistics). Both of these groups have been active longer than the UBCG and have given many of the issues the UBCG face considerable analysis, which the UBCG can draw upon.

Oslo Group on Energy Statistics

23. The Oslo Group is a forum for countries to address challenges related to the collection and dissemination of complete, comparable and quality energy statistics. Some of the topics considered are:

- User needs for energy statistics
- Scope of official energy statistics
- Country best practices in the collection and dissemination of energy statistics
- Selected methodological and data quality challenges in energy statistics
- Needs for harmonization of important energy statistics systems
- Key content provider for the new UN manuals on energy statistics, International Recommendation on Energy Statistics (IRES) and Energy Statistics Compilers Manual (ESCM)
- Methods for improving consistency in different statistic systems and reducing response burden

London Group on Environmental Accounting

24. The London Group plays a leadership role in defining international best practices in the theory and practice of environmental accounting within the framework of the System of Environmental-Economic Accounting (SEEA). Some of the topics considered are:

- Physical flow accounts (materials, water and energy);
- Asset accounts for natural resources and land;
- Environmental activity accounts and related flows;
- Ecosystem accounts;
- Applications and extensions of environmental accounts;
- Training and implementation material.

25. The London Group is responsible for *System of Environmental-Economic Accounting 2012*. This is the Central Framework that was adopted at the forty-third session of the United Nations Statistical Commission as an international statistical standard. The UBCG as part of its handbook will incorporate these standards.

Wiesbaden Group on Business Registers

26. The Wiesbaden Group is an expert group engaged in the further development of business registers, survey frames and associated topics. The group's work supports an integrated approach to structural economic statistics addressing globalisation related analytical needs. The need for quality business registers is important for mining statistics. The handbook recognises this requirement but does not discuss details for establishing business registers. NSOS that may want to establish or improve their business registers should read documents from the Wiesbaden Group[1].

The Extractive Industries Transparency Initiatives

27. The Extractive Industries Transparency Initiative (EITI) is a global standard to promote the open and accountable management of oils, gas and mineral resources. The EITI seeks to strengthen government and company systems, inform public debate and promote understanding. In each of the implementing countries, the EITI is supported by a coalition of government, companies, and civil society.

28. The EITI standard requires information along the extractive industry value chain from the point of extraction, to how the revenue makes its way through the government, to how it benefits the public. This includes how licenses and contracts are allocated and registered, who are the beneficial owners of those operations, what are those revenues allocated, and what is the contribution to the economy, including employment. The EITI data can be used to compare international trends and evaluate consistency of the recommendations for countries.

1.5. Structure of the handbook

29. The contents of the handbook are structured in accordance with its objectives. The handbook will be structured as follows.

30. Chapter 2 will examine the existing definitions and classification that the UBCG will use, covering industry and product classifications. Classifications such as the Central Product Classification and the International Standard Industrial Classification will be examined and potentially extended to provide further detail if necessary.

[1] https://unstats.un.org/wiesbadengroup/

31. Chapter 3 will draw on international frameworks and principles to ensure that the handbook produces guidelines that are internationally comparable. These would primarily cover the System of National Accounts, the Balance of Payments Manual, the Government Finance Statistics Manual, and the System of Environmental Economic Accounting and the International Labour Organisation's Prices and Labour manuals.

32. Chapter 4 will discuss data sources and general methodology requirements for producing Mining and related statistics. The chapter will cover the different types of enterprise surveys, household surveys and potential administrative data sources. Chapter 5 details the set of standard indicators and potential survey questions that NSOs should produce. The chapter discusses how the indicators are used to address various policy questions that government and users might face.

33. Chapters 6, 7 and 8, will develop the analytical and contextual frameworks for the indicators, by grouping them into impacts on the Economy, Society and the Environment. The chapters will also discuss dissemination strategies along with country experiences. These three chapters will also highlight particular measurements issues that NSOs are likely to face in collecting, compiling and producing statistics.

34. Chapter 9 will develop some of the rationale for NSOs to prioritise their mining statistics and Chapter 10 will examine areas for further research.

35. Mining activities make considerable impact on the development of a country as a whole. The economic impact is measured in terms of their contribution to GDP and other macroeconomic indicators. The social impact is reflected by employment opportunities and public services created by these activities. The mining sites are often located in a geographically isolated area with the considerable distance from other settlements. Operation of mining activities may require development of residential facilities with other basic social services such as health, education, water and sanitation and transportation and communication. Earning from mining activities contribute to household income and affect the living standards of families where the main breadwinner is a mining worker. The impact on environment is measured by indicators related to the use of natural resources and emissions of mining industry to air, water, and soil.

Chapter 2.

Definitions and classifications

2.1. Definitions of mineral resources

1. The System of National Accounts 2008 (SNA 2008) and the System of Environmental Economic Accounting 2012 (SEEA 2012) provides the general definition of natural resources with respect to their different roles in economy. To ensure the methodological uniformity with existing recommendations, this manual is broadly based on the conceptual framework of the SNA 2008, the Central framework of SEEA 2012, International Recommendations for Industrial Statistics, 2008 (IRIS,2008) and other related publications.

2. Natural resources comprise of mineral and energy resources, biological resources, water resources and land and soil resources. The scope of this manual is confined to the mineral resources, which refer to concentration (or occurrence) of material of economic interest in or on the Earth's crust in such form that there are reasonable and realistic prospects for eventual economic extraction. Such mineral resources form a subset of environmental assets defined in SEEA covering subsoil resources of coal, oil and natural gas, metallic and non-metallic minerals. Through economic activities these resources are brought as natural input in the production process. The extraction of mineral resources also depletes the environmental assets reflected in the balance sheets.

3. From the perspective of the natural inputs into the economy mineral resources can be broadly classified into following groups:

- Oil resources,
- Natural gas resources,
- Coal and peat resources,
- Non-metallic mineral resources (excluding coal and peat resources),
- Metallic mineral resources.

4. Mineral resources enter the economy as natural inputs. The point they enter the economy is different by type of resources. ISIC, revision 4, notes that mining activities also include exploration and geological observations that generally precede the extraction activities. However, the main outcome of mining activities is the conversion of mineral resources to mineral products.

5. According to the SEEA 2012 "Natural resources include all natural biological resources (including timber and aquatic resources), mineral and energy resources, soil resources and water resources." The 2008 SNA considers natural resources from the perspective of the production boundary, and are subject to ownership rights. The 2008 SNA definition include: land, water resources, uncultivated forests and deposits of minerals that have economic value (10.15).

6. The handbook primarily focuses on mining activities, which links with industry classifications. However, the output from mining activity is products of which there are numerous classifications and hence multiple definitions. Table 2.1 highlights some examples where product definitions can differ between two international manuals. While this manual recommends the use of the UN Central Product Classification version2 (CPC v.2), some countries may have developed their own product classifications to meet their data requirements.

Table 2.1 Definition of Mining Products

Product name	International Recommendations on Energy Statistics (IRES)	Energy Statistics Manual
Hard coal	Coals with a gross calorific value (moist, ash-free basis) which is not less than 24 MJ/kg or which is less than 24 MJ/kg provided that the coal has a vitrinite mean random reflectance greater than or equal to 0.6 per cent. Hard coal comprises anthracite and bituminous coals.	Hard coal refers to coal of gross calorific value greater than 23 865 kJ/kg (5 700 kcal/kg) on an ash-free but moist basis and with a mean random reflectance of vitrinite of at least 0.6.
Brown coal	Coals with a gross calorific value (moist, ash- free basis) less than 24 MJ/ kg and a Vitrinite mean Random Reflectance less than 0.6 per cent.	Lignite/brown coal: Non-agglomerating coals with a gross calorific value less than 17 435 kJ/kg (4 165 kcal/kg) and greater than 31% volatile matter on a dry mineral matter-free basis
Peat	A solid formed from the partial decomposition of dead vegetation under conditions of high humidity and limited air access (initial stage of coalification). It is available in two forms for use as a fuel, sod peat and milled peat.	Combustible soft, porous or compressed, fossil sedimentary deposit of vegetal origin with high water content (up to 90% in the raw state), easily cut, of light to dark brown colour.
Natural gas	A mixture of gaseous hydrocarbons, primarily methane, but generally also including ethane, propane and higher	It comprises gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly

Product name	International Recommendations on Energy Statistics (IRES)	Energy Statistics Manual
	hydrocarbons in much smaller amounts and some noncombustible gases such as nitrogen and carbon dioxide.	of methane. It includes both "nonassociated" gas originating from fields producing hydrocarbons only in gaseous form, and "associated" gas produced in association with crude oil as well as methane recovered from coal mines (colliery gas).
Crude oil	A mineral oil of fossil origin extracted by conventional means from underground reservoirs, and comprises liquid or near-liquid hydrocarbons and associated impurities such as sulphur and metals.	Crude oil is a mineral oil of natural origin comprising a mixture of hydrocarbons and associated impurities, such as sulphur. It exists in the liquid phase under normal surface temperature and pressure and its physical characteristics (density, viscosity, etc.) are highly variable. This category includes field or lease condensate recovered from associated and non-associated gas where it is commingled with the commercial crude oil stream.

7. According to ISIC Rev. 4 (p.85), the mining activities also include exploration and geological observations which generally precede the extraction activities. Entering point to economy might be exploration for some resources but extraction for others. In any case, the main outcome of mining activities is the conversion of mineral resources to mineral products. Even though, mineral products are identified CPC, there are definitions of mineral products in Standard International Energy Product Classification (SIEC) and Harmonized System of World Trade Organization.

8. To measure mining activity, a set of established accounts with standard concepts of flows and stocks need to be developed. Mining and quarrying as an economic activity produces goods and services that have economic value. Flows, according to SNA 2008, consist of transaction and other flows, which reflect the creation, transformation, exchange, transfer or extinction of economic value. Stocks arise from accumulation of prior transactions and other flows, however in case of environmental assets most of the increment occurs naturally, while the rate of extraction, determines the volume flow, impacts on the stock of assets. SEEA defines different types of physical flows such as natural inputs, products and residuals. Mineral resources as physical inputs are moved from their location in the environment as a part of production processes or can be directly used in production. Residuals refer to

the part of extracted minerals that are not retained in economy, as it is considered to have returned immediately to the environment. These issues are discussed in more detail in Chapter 3.

9. Changes in the stocks of mineral resources are determined by the amount of deposit arising from new discoveries and extraction of resources physically moved from the deposit. Some changes between the opening and closing stock in monetary terms are more accounting-related in nature and comprise those due to improved measurement (reappraisals) and those involving the categorization of the asset (reclassifications).

10. Flows and stocks enter either the accounts of the institutional units that own the goods and assets involved, the accounts of units that deliver or take delivery of services, or in the accounts of units that provide labour and capital or use them in production. An institutional unit in its capacity as a producer of goods and services is known as an enterprise. For its role as a legal entity in the business the enterprise is normally registered with the government authority. A business register compiled from the administrative data lists all enterprises, which will eventually compose a statistical frame for data collection. Institutional units in the context of a statistical unit are described in the next section.

2.2. Identifying statistical units

11. Identification of a proper statistical unit is essential to collect and compile relevant data. An institutional unit is defined in the SNA as well as in International Recommendations for Industrial Statistics, which among other covers mining and quarrying activities. An institutional unit is an economic entity capable, in its own right, of owning assets, incurring liabilities and engaging in economic activities and in transactions with other entities. An institutional unit in its capacity of a producer of goods and services is known as an enterprise.

12. The enterprise is the basic statistical unit for which all information relating to its production activities and transactions, including financial accounts and balance-sheets. However, an enterprise may be engaged in one or more economic activities at one or more locations. Therefore, for collecting detail data on more homogeneous categories of economic activities the establishment is a recommended statistical unit. The establishment is the appropriate statistical unit for collection of data on production of goods and services, employment and remuneration, stock of non-financial capital used and changes in inventories and gross fixed capital formation.

13. An establishment is defined as an enterprise or part of an enterprise that is primarily engaged in one kind of activity with a single physical location and the primary activity accounts for the most of the value added of establishment. Small businesses operate as a single-establishment enterprise and the difference between the enterprise and establishment is rarely relevant. In case of larger business, an enterprise may own two or more establishments. In such cases production and employment data are collected at the establishment level. Establishments of the same enterprise may be grouped into different industries as defined by ISIC. Nevertheless, the enterprise is suitable for the compilation of financial statistics as it is the enterprise that has legal authority to own the assets and incur liabilities.

14. The business register is instrumental in creating a statistical frame for regular data collection operation. IRIS-2008, discusses that it is desirable to derive the frame for every list based enterprise from a single general-purpose activity business register maintained by the statistical office. Such register generally provides exhaustive and exclusive list of statistical units in order to ensure that there is no omission or duplication in any enterprise/establishment – based survey. However, informal activity will not be recorded on the business register. The business register should contain information on name, address, main activity (ISIC code), location (area code) and other relevant information.

2.3. Mining and quarrying activities

15. Mining activities are defined in ISIC revision 4 as extraction of minerals occurring naturally as solids (coal and ores), liquids (petroleum) or gases (natural gas). Extraction can be achieved by different methods such as underground or surface mining, well operation, seabed mining etc. Enterprises engaged in mining activities during a reference period and territory form the target population for data collection. Descriptions and codes of mining activities as per ISIC revision 4 are given Table 2.2.

Table 2.2 Activities related to mining and quarrying by ISIC revision 4

Division	Group	Class	Description
Division 05			**Mining of coal and lignite**
	051	0510	Mining of hard coal
	052	0520	Mining of lignite
Division 06			**Extraction of crude petroleum and natural gas**
	061	0610	Extraction of crude petroleum
	062	0620	Extraction of natural gas
Division 07			**Mining of metal ores**
	071	0710	Mining of iron ores

Division	Group	Class	Description
	072		Mining of non-ferrous metal ores
		0721	Mining of uranium and thorium 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
		0892	Extraction of peat
		0893	Extraction of salt
		0899	Other mining and quarrying n.e.c.
Division 09			**Mining support service activities**
	091	0910	Support activities for petroleum and natural gas
	099	0990	Support activities for other mining and quarrying

16. While the activities in table 2.2 refer to extraction of mineral resources they are further processed in manufacturing. A number of manufacturing activities are almost entirely dependent on mining for their intermediate input. Therefore, the analysis of the economic activities related to mineral resources could include selected manufacturing activities. The manufacturing activities based on mineral resources are listed below by ISIC in table 2.3. The list does not include manufacturing activities processing other natural resources such as timber and aquatic resources.

Table 2.3 Manufacturing activities based on processing of mining and quarrying products

Division	Group	Class	Description
Division			**Manufacture of coke and refined petroleum products**
	191	1910	Manufacture of coke oven products
	192	1920	Manufacture of refined petroleum products
Division			**Manufacture of other non-metallic mineral products**
	231	2310	Manufacture of glass and glass products
	239		Manufacture of non-metallic mineral products n.e.c.
		2391	Manufacture of refractory products
		2392	Manufacture of clay building materials
		2393	Manufacture of other porcelain and ceramic products
		2394	Manufacture of cement, lime and plaster
		2395	Manufacture of articles of concrete, cement and plaster
		2396	Cutting, shaping and finishing of stone
		2399	Manufacture of other non-metallic mineral products
Division			**Manufacture of basic metals**
	241	2410	Manufacture of basic iron and steel

Division	Group	Class	Description
	242	2420	Manufacture of basic precious and other non-ferrous
		2431	Casting of iron and steel
		2432	Casting of non-ferrous metals

2.4. Mineral products

17. Products, according to SNA, are goods and services that result from a process of production in the economy. Mineral products emerge from the extraction of the mineral resources from the environment and their transfer to economy. Not all resources extracted subsequently become products. This means that the residuals of the production process, such as losses or unused items which return to environment immediately should not be included. Mining overburden, which refers to a quantity of soil, stone or materials that are removed from the original places during extraction, should also be excluded. Mineral products refer only the actual amount of mineral resources transferred to economy.

18. Flows of products between economic units are generally recorded in the account of the enterprises for their own business purpose. When a mining establishment produces crude oil and supplies it to a refinery unit for producing petrol or other related products such a transaction is recorded by both entities. The amount of mineral products is therefore obtained from production data of all institutional units engaged in mining activity. The amount of mineral products used as intermediate input is derived from the data of other economic activities such as manufacturing and construction.

19. The Central Product Classification (CPC) provides the detail list of mineral products. CPC version 2.0 has direct correspondence with ISIC revision 4.0. Therefore, the CPC is quite helpful in determining the main activity of an enterprise based on the produced. In the broad economic category (BEC), mineral products mostly fall under the primary industrial supplies. The list of mineral products by CPC is given in Table 2.4.

20. Standard international classifications exist for commodities, industries and trade. A very large number of countries have their own national classifications designed to meet their own particular needs and can differ from the international standards. The various international classifications exist because of the need for international comparisons.

BOX 2.1 : The classification of mining activities and products in Russia

The Russian statistics applies the Russia Classification of Minerals and Underground Waters (RCMUW), developed by the Ministry of Natural Resources and Ecology of the Russian Federation. RCMUW was accepted and put into operation in December 2002.

RCMUW is obligatory for application by federal enforcement authorities at creation of the state information systems and resources. State balances of mineral stocks that reflect the condition of mineral and raw material resource base of the country were used for creation of RCMUW. Objects of RCMUW classification are minerals (natural accumulation of minerals, rocks, oil, gases) and underground water.

RCMUW is intended for:

- Normalization of geological and economic information on minerals and underground waters;
- Maintenance of classification and coding of minerals and underground waters;
- Development of reporting about condition and use of mineral and raw-material resources of the Russian Federation;
- Maintenance of federal and regional balances of mineral stocks;
- Supply of information on minerals and underground waters to the users who carry out industrial and commercial activity in the field of investigation of deposits of minerals and underground water.

In the RCMUW each position is identified by codes between four and twelve digits. A feature of the coding is that for the first four categories the integrated groupings of minerals corresponds to the sequence of groupings of kinds of economic activities on extracted minerals, according to the Russia Classification of Economic Activities (RCEA).

Kinds of economic activities that are specified or RCEA groupings correspond to RCMUW of minerals extracted as result of the activity. For example, economic activity groupings in RCEA correspond to integrated groupings of minerals in RCMUW:

RCEA	**RCMUW**
10.10 Extraction, cleaning and agglomeration of coal	10.10 Coal
11.10 Extraction of crude oil and natural gas	11.10 Crude oil & natural gas

RCEA was constructed by harmonizing the official version of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 1.1) using NACE 4-digit codes in RCEA. The detailed features of Russian economic activities are reflected in the fifth and sixth digits.

The Russian Classification of Products by Economic Activity (RCPEA) was constructed by harmonizing with the Statistical Classification of Products by Activity in the European

Economic Community (CPA 2002) by using CPA 2002 codes (up to six digits) in RCPEA. The detailed features of Russian economy are reflected in digits seven to nine.

The transit codes from RCPEA groupings to the Harmonized System (HS) were also developed.

2.5. Linkage between products and activities

21. Mining and quarrying as an economic activity produces goods and services that have economic value.

Table 2.4 Industry to product

ISIC Rev.4	CPC 2.1	ISIC Rev.4	CPC 2.1	ISIC Rev.4	CPC 2.1	ISIC Rev.4	CPC 2.1	ISIC Rev.4	CPC 2.1
0510	11010	0710	14100	0729	86229	0810	86229	0893	16200
0510	86229	0710	86229	0810	15110	0891	16110	0893	86229
0520	11030	0721	13000	0810	15120	0891	16120	0899	15330
0520	86229	0721	86229	0810	15130	0891	16190	0899	16310
0610	12010	0729	14210	0810	15200	0891	34639	0899	16320
0610	12030	0729	14220	0810	15310	0891	34654	0899	16390
0610	86221	0729	14230	0810	15320	0891	86229	0899	86229
0620	12020	0729	14240	0810	15400	0892	11050	0910	86211
0620	86221	0729	14290	0810	16330	0892	86229	0990	86219

Table 2.5 Product to industry

CPC 2.1	ISIC Rev. 4	CPC 2.1	ISIC Rev. 4	CPC 2.1	ISIC Rev. 4	CPC 2.1	ISIC Rev. 4
11010	0510	14210	0729	15320	0810	16330	0810
11020	1920	14220	0729	15330	0899	16390	0899
11030	0520	14230	0729	15400	0810	17100	3510
11040	1920	14240	0729	16110	0891	17200	3520
11050	0892	14290	0729	16120	0891	17300	3530
12010	0610	15110	0810	16190	0891	17400	3530
12020	0620	15120	0810	16200	0893	18000	3600
12030	0610	15130	0810	16200	1079		
13000	0721	15200	0810	16310	0899		
14100	0710	15310	0810	16320	0899		

2.6. Data items

22. The choice of data items for questionnaire design for surveys, who include mining activities in its scope, should develop a priority list. A complete list of data items are given in IRIS-2008. A large and small version of the model questionnaire based on data items recommended by IRIS-2008 is presented *Industrial Statistics: Guidelines and Methodology*. (UNIDO 2010) However, implementation of these recommendations depends on the purpose of the survey, available resources and the individual circumstances of each country. One important aspect to be considered is that the main source of data for any industrial survey is the records maintained by businesses for their own accounting purpose. Therefore, selection of data items should be made with a clear understanding of the accounting rules and practises that exist in each country.

Table 2.6 Mineral products by CPC, version 2.0

Division	Class	Subclass	Description
Division 11			**Coal and lignite; peat**
	1101	11010	Coal, not agglomerated
	1102	11020	Briquettes and similar solid fuels manufactured from coal
	1103	11030	Lignite, not agglomerated
	1104	11040	Lignite, agglomerated
	1105	11050	Peat
Division 12			**Crude petroleum and natural gas**
	1201	12010	Petroleum oils and oils obtained from bituminous minerals, crude
	1202	12020	Natural gas, liquefied or in the gaseous state
	1203	12030	Bituminous or oil shale and tar sands
Division 13			**Uranium and thorium ores and concentrates**
	1300	13000	Uranium and thorium ores and concentrates
Division 14			**Metal ores**
	1410	14100	Iron ores and concentrates, other than roasted iron pyrites
	1421	14210	Copper, ores and concentrates
	1422	14220	Nickel ores and concentrates
	1423	14230	Aluminum 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**
	1511	15110	Slate
	1512	15120	Marble and other calcareous monumental or building stone
	1513	15130	Granite, sandstone and other monumental or building stone

Division	Class	Subclass	Description
	1520	15200	Gypsum; anhydrite; limestone flux; limestone and other calcareous stone, of a kind used for the manufacture of lime or cement
	1531	1531	Natural sands
	1532	1532	Pebbles, gravel, broken or crushed stone, macadam; granules, chippings and powder of stone
	1533	15330	Bitumen and asphalt, natural; asphaltites and asphaltic rock
	1540	15400	Clays
Division 16			**Other minerals**
	1611	16110	Natural calcium phosphates, natural aluminium calcium phosphates and phosphatic chalk
	1612	16120	Unroasted iron pyrites
	1619	16190	Other chemical minerals
	1620	16200	Salt and pure sodium chloride; sea water
	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.

23. Data collected from surveys are to be used to compile the set of indicators discussed in Chapter 5 and 6. A minimal set of data items should be considered for most of the surveys. A full list of data items is given in IRIS-2008 which among others includes following major data items:

- Characteristics of the statistical unit:
  - Principle activity, location, type of unit (single establishment enterprise or the part of multi-establishment enterprise)
- Number of persons employed:
  - By sex; number of employees by categories such as production workers and other workers; number of employees engaged in mineral exploration and evaluation,
- Compensation of employees:
  - Wages and salaries by sex and by categories such as production workers and other workers
- Purchase of goods and services:
  - Disaggregated by goods and services

- Value of shipments, receipts for services and other revenues
  - Disaggregated by goods and services
- Quantity of mineral resources extracted by type
- Quantity of mineral products by CPC
- Quantity of total energy consumed (terajoules), water consumed (cubic meters)
- Inventories
- Gross fixed capital formation, by type of assets:
  - Including capital expenditure on mineral exploration and evaluation

24. The above data items are listed for the purpose of questionnaire design, which may also include the indicators to be derived, for example wage rate, total output or intermediate inputs for the purpose of checking consistency of reported data.

2.7. International comparability

25. International comparability is one of the important dimensions of data quality produced by national and international statistical offices. It allows users to perform cross country analysis of social and economic performance. Where countries compile data for international reporting, this is subject to scrutiny in terms of the compliance of the reported data with international standards and classifications.

26. International comparability of data depends on uniformity of basic statistical methods and classification structures and codes. A certain degree of deviation is unavoidable due to the national conditions and practices. However, countries are encouraged to comply with internationally accepted methods and standards as it improves the data quality in general and ensures international comparability. With respect to mining statistics the basic standards to be complied with are ISIC revision 4 (some regional classification code such as NACE and NAICS are compatible to ISIC), SNA 2008, SEEA and IRIS 2008.

27. The practice of different units of measurement is another challenge to international comparability. This involves physical units, valuation methods (basic prices or producer's prices) and currency units. A standard unit of measurement by commodities is available in the UN Comtrade database. The questions related to basic prices, producer's prices and other methods of valuation are discussed in 2008SNA. Market prices are recommended for the valuation of mineral exploration. There is a whole range of questions related to valuation of the different asset items under the gross fixed capital formation.

28. There are a number of data items that are subject to international reporting on annual basis. For example, UNIDO currently collects the data for following variables of mining and utility sectors on annual basis:

- Number of establishments/enterprises,
- Number of persons employed/employees,
- Wages and salaries of employees,
- Gross output,
- Value added.

29. However, the above set of variables has been at time inadequate to meet the demand of data users for policy relevant analysis. In the context of increased relevance of environment related data, it is recommended to add following variables for international reporting.

- Quantity of mineral resources extracted,
- Quantity of mineral products produced,
- Gross fixed capital formation,
- Quantity of energy consumed.

Chapter 3.

General frameworks

3.1. Introduction

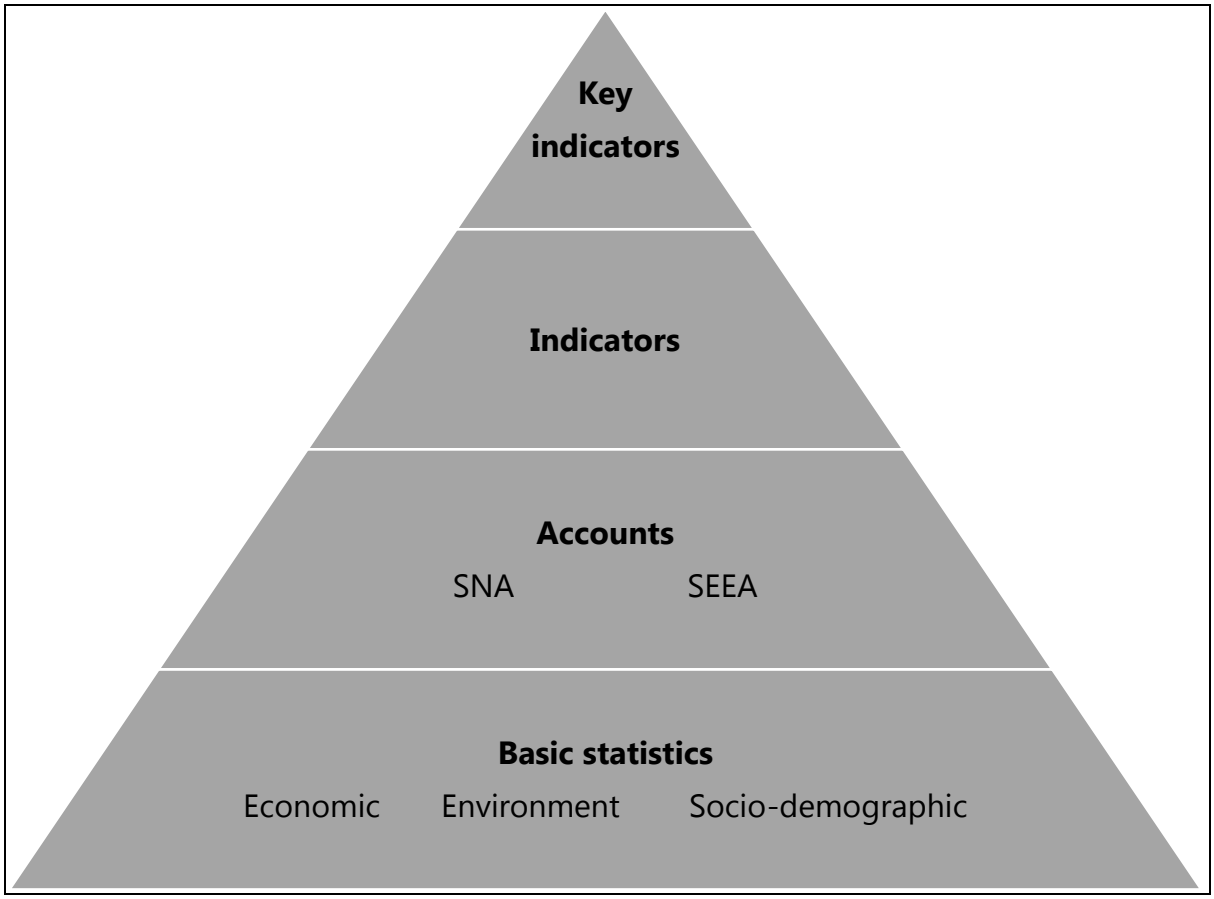
1. This chapter is based on the *2008 System of National Accounts* as it provides the economic accounting framework that is considered appropriate to use in such handbooks. This is because it is considered an international standard agreed to by the United Nations statistical system. The handbook also presents SEEA Central Framework, particularly relating to mineral resources, which provides the overall framework for integrated environmental statistics and economics section.

2. The aim of this chapter is to provide an overview of the main accounting frameworks. The chapter also comments on the conceptual and technical resources necessary to develop economic, social and environmental indicators related to mining activities.

3.2. General frameworks

3. In this section, several main international statistical standards are taken as the main frameworks used in this handbook; namely, the System of National Accounts 2008, UN, and the System of Environmental-Economic Accounting Framework 2012. Both documents provide statistical frameworks that integrate statistical systems and environmental-economic accounts. Current trends are that the documents related to the economy and the environment will increasingly align to these two international standards.

Fig 3.1: The information pyramid: Integrated statistics



4. Figure 3.1 presents the integrated statistical production process, from basic statistics to indicators and links policy needs with statistics. To achieve this integration requires consistency between basic data, accounts, tables and indicators.

5. The 2008 SNA emphasizes the way to record the economic activities in general, and thus, does not go into detail about mining activities. However, some parts from the 2008 SNA can be considered relevant to the construction of indicators for this handbook.

6. The 2008 SNA considers the structure of the assets that are fundamental to access information on availability of mineral resources. This is also important to understand the flows that occur during the year, such as new discoveries, and losses from disasters.

7. The 2008 SNA manual addresses the issue of mineral exploration, which consists of the value of expenditures on exploration for petroleum, natural gas and non-petroleum deposits and subsequent evaluation of the discoveries made. These expenditures include the costs of obtaining the prior licenses, license costs and acquisition costs of feasibility studies, the costs of actual test drilling and boring, as

well as the costs of aerial or other type of survey, and transportation costs. After commercial exploitation of the reserve, revaluations can take place and the cost of these reassessments is also included in gross fixed capital formation. (2008, SNA, 10.106). This serves as a conceptual basis for the development of the indicator Mineral exploration and evaluation.

8. Another issue to be covered is intellectual property products. These are characterized by the fact that most of their value is attributed to intellectual effort. Products of intellectual property are the result of research, development or innovation leading to knowledge that researchers can sell on the market or use for their own benefit in the production. This knowledge can be incorporated into a single independent product or into another product. Knowledge continues to be an asset as long as its use can create some form of returns for its owner. When there is no protection, it becomes obsolete and no longer is an asset. (2008,SNA,10.98)

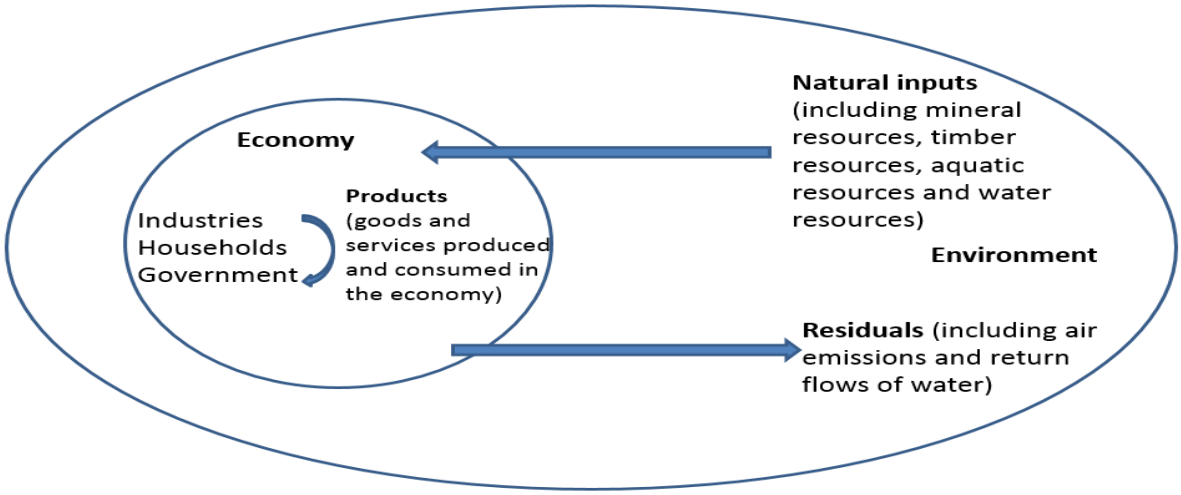
3.3. Central framework of the System of Environmental-Economic Accounting (SEEA Central Framework) 2012

9. The central framework of the System of Environmental and Economic Accounting 2012 (SEEA-CF) is a statistical framework consisting of a comprehensive set of tables and accounts that guide the compilation of statistics and provides a comparable and consistent policy for indicators, analysis and research.

10. SEEA-CF provides a statistical framework that permits quantifying in physical and monetary terms the interactions between the economy and the environment, particularly through the description of stocks and flows of natural capital over a period of time. The framework allows for the development of aggregates and indicators on a wide range of environmental and economic issues. Particular examples include the measurement of trends in the use and availability of natural resources, the level of emissions and discharges to the environment as a result of economic activity.

11. Figure 3.2 is a simplified representation of the interaction between the economy and the environment. In general, flows from the environment to the economy are recorded as entries (e.g. flows of minerals, wood, fish and water). Flows within the economy are recorded as product flows (including additions to the stock of fixed assets) and cash flows from the economy to the environment are recorded as residuals (e.g. solid waste, air emissions and water return flows).

Figure 3.2 Physical flows of natural inputs, products



12. Mineral and energy resources are a unique type of environmental asset that can be extracted and used in economic activities but are not renewed on a human time scale. Since these cannot be renewed, it is of particular interest to understand the rate of extraction and depletion of these assets, their availability, and the sustainability of industries that exploit them. Mineral and energy asset accounts organize the relevant information including quantities and values of the stock of resources and their variations in the accounting periods. Flows as extraction (depletion) and discoveries are critical to asset accounts and these, in turn, can provide valuable information on the availability of each resource. The valuation of the stock and flows of mineral and energy resources can establish important links with monetary aggregates, such as value added and the operating surplus from the extractive industries. These measures provide an overview of mining activity that recognizes a more complete set of production costs.

Figure 3.3 Basic structure of assets account

Physical asset account	**Monetary asset account**
Opening stock	**Opening stock**
Additions ○ Growth ○ Discoveries ○ Reclassifications	Additions ○ Growth ○ Discoveries ○ Reclassifications
Reductions ○ Extractions ○ Normal and catastrophic losses ○ Reclassifications	Reductions ○ Extractions ○ Normal and catastrophic losses ○ Reclassifications
	Revaluation

Physical asset account	Monetary asset account
Closing stock	**Closing stock**

13. Mineral and energy resources include deposits of oil resources, resources of natural gas, coal and peat, and metallic and non-metallic minerals. Since these resources are usually found underground (often called underground assets), the amount of resources that can reasonably be expected to extract is not known precisely. Consequently, a key factor in measuring the mineral and energy resources is the degree of concentration and quality of the resources contained in the deposits, as this factor influences the probability of extraction and its cost, and the degree of confidence of any amount that could be extracted in the future. The framework used to define the scope of the known deposits is the framework of the United Nations *Classification for Fossil Energy and Mineral resources and reserves 2009* (UNFC-2009) (United Nations Economic Commission for Europe, 2010). The UNFC-2009 is a generic and flexible system to classify and evaluate quantities of mineral resources and fossil energy.

14. Many countries have their own national classification systems. For example, the systems developed by the Society of Petroleum Engineers (SPE, 2007), the Committee for Mineral Reserves International Reporting Standards (CRIRSCO, 2007) and the International Atomic Energy Agency (IAEA) and International Energy Agency (IEA). Therefore, it may be necessary to adapt individual classifications to facilitate international comparisons.

15. Potential deposits that are not expected to become economically viable and for which the necessary information to determine the feasibility of extraction is missing are not included in measurement. The scope of the known deposits is broader than the sites that support the measurement of mineral and energy resources in the SNA. In this, the scope is limited to the economically exploitable deposits, given current technology and relative prices. SEEA considers a wider scope to ensure a more complete understanding of the availability of the stock of mineral and energy resources.

16. There are several different types of mineral and energy resources, including oil, natural gas, coal and peat, and metallic and non-metallic minerals, although there is no detailed breakdown, internationally agreed and appropriate for statistical purposes, of these resources.

17. Asset accounts should be compiled for mineral and energy resources in physical units per resource type, with stock estimates, opening and closing, and their

variations during the accounting period. The units of measurement used to compile and present information vary according to the type of resource. They are likely to be tons, cubic meters or barrels. For accounting purposes, the same unit of measure should be used to record the stock opening and closing and its variations during the period for each resource.

18. Ideally, the opening and closing stock of each mineral and energy resource should be classified by type of application, namely:

- Class A: economically recoverable resources;
- Class B: Resources with economic potential recovery; or
- Class C: no economic sites and other known deposits.

19. It is not recommended to compile totals including all individual resources, since each class has a different probability of being extracted. The simple sum of available resources of a particular resource (coal, for example) can provide a misleading estimate of the total available resources. In this context, it is important to specify those resources for which monetary valuations can be made. If such a distinction is not made, the subsequent comparison between accounts expressed in physical or monetary units for individual resources can generate misleading data on average prices and on the relative availability of those resources.

20. When measuring changes in stock, there are a number of activities to consider. These are:

- Discoveries. Discoveries should be incorporated in the amounts of new deposits found during the accounting period. To register as a discovery, the new site should be known, that is, belonging to A, B or C resource class. The findings should be recorded by type and the class.
- Re-evaluation. Reassessments can be upward or downward. They must correspond to known deposits. Generally, reassessments shall refer to increases or decreases in available stocks of certain deposit or estimated changes in classification of certain deposits between classes A, B and C, based on changes of geological information, technology, price of resource or some combination of these factors.
- Extraction. Estimates of the extraction must correspond to the amount of physical withdrawal at the resource site. They should not include amounts of soil and other materials that are removed in order to extract the resource. Furthermore, the amounts must be estimated before any working or processing of the resource. Removal estimates should include illegal extraction, either by

residents or non-residents, as these amounts reduce the availability of the resource. It should be noted that for the extraction of natural gas it may be more difficult to measure the amount extracted due to the nature of the extraction process in some fields. Where natural gas is extracted with oil, it is the pressure of the natural gas which expels the oil well (as well as some natural gas). Some of the expelled gas can be burned instead of being sold. Some of the natural gas, especially if extraction has been occurring for some time, can be reinjected back into the well to accentuate the pressure of oil left, making possible its extraction. In such cases, if the natural gas along with oil is computed, the reinjected quantities should be considered too.

- Catastrophic losses. Catastrophic losses are exceptional in relation to most of the mineral and energy resources. The flooding and the collapse of mines sometimes occur, but the sites still exist and, in principle, can be recovered. The question is the economic viability of the real loss to the extraction of the resource itself. An exception to this general principle, are oil wells, which can be destroyed by fire or become unstable for other reasons, with significant loss of oil resources. The loss of oil and other related resources in these cases should be considered catastrophic losses.

- Reclassifications. Reclassifications may occur when certain fields are enabled for mining activity, or closed down by government decisions. All other quantitative changes of the known deposits should be treated as revaluations. Reclassification can be also registered when asset accounts of mineral or energy resources are compiled for the institutional sector.

21. There is a growing interest in the ability to obtain different metals and other minerals, produced by recycling goods (vehicles and computers, for example). The stock of the corresponding metals and minerals that is implicitly included in the economy is not considered within the scope of the asset accounts presented in this section. However, as the field of recycling undertaken in a country, you can compile information on recycled metals and other minerals to provide a more complete picture of the availability of those resources.

22. Asset accounts for mineral and energy resources expressed in monetary units are based on the availability of information on the physical stock of resources. Therefore, the structure of the asset accounts expressed in monetary units is very similar to that of the asset accounts expressed in physical units. The additional expenditure account of assets expressed in currencies refers to revaluations due to changes in resource prices during the accounting period or changes in the assumptions on which the

method of net present value (NPV). This is commonly used to assess mineral resources and valuations. While the measurement in physical units covers all known sites, it may be impossible to evaluate all deposits in currencies due to the uncertainty of the expected extraction and income profiles. Consequently, income from deposits of resources corresponding to the B and C resource classes cannot be determined with certainty. It is recommended, to compile only the value the deposits of resource class A; economically recoverable resources. If deposits of B and C resource classes are valued, the value of each must be clearly distinguished. In assessing sites in each class it is important to have the probability and the time of extraction in order to determine the expected trends in mining and resource rent.

23. Given that there are only a few transactions in situ on mineral and energy resources, the valuation of these assets requires the use of the NPV method. Calculations must be made at the level of each resource type, preferably for specific fields, and then adding all the different resources for the total value of mineral and energy resources. Applying the NPV method for valuation of mineral and energy resources requires, most of them concerning the estimate of income from these resources. NSOs to estimate resource rent, extraction rates and resource life. This is because these directly affect income from a mineral resource.

24. Resource rent should be estimated on the basis of information on revenues and operating costs of the extractive industry. The aim is to define a specific income for a particular type of resource; several factors to achieve this goal must be taken into account.

25. The scope of the operations is one such factor. Consistent with the definition of the amount withdrawn, the scope of revenues and operating costs to be considered for calculating the resource rent should be limited to the extraction process itself and should not include any additional income or costs incurred in later refinements or processing of the extracted resource. It is considered that the extraction process include exploration and mining activity assessment, and these costs should be deducted to derive resource rent.

26. For certain minerals and energy resources, a single site may contain several types of resources. For example, an oil resource often contains gas; and often silver, lead and zinc are extracted together. In these cases, the income used to calculate the value of resources must be allocated to each commodity. However, as data are usually available for only a single mining unit, calculating the resource rent by type, based on costs known for each type of resource extraction, may not be possible unless detailed knowledge of the activity or practice rules is used to allocate the total extraction costs.

27. While the operating costs of resource extraction can be relatively stable, it is likely that revenue from the sale of extracted resources fluctuate due to price change. Consequently, the resource rent, may be volatile. In addition, at any time the aggregate income of a resource amount may be affected by extraction rates, which, in turn suffer the effects of sporadic factors, such as the collapse of a mine. As the objective is to define a resource rent that can be estimated, it is recommended to first, divide the corresponding unit by an amount determined by the resource extracted in the period for which income is earned. Second, in the absence of any other information about the future price of the resource, a proxy for the price as a basis for estimating future resource rents can be used. As an aid to the interpretation of the information all the assumptions on expected future prices and costs should be made explicit.

28. Mineral exploration is carried out with the purpose of discovering new deposits of mineral and energy resources that can be commercially exploited. That examination may be carried out by companies dedicated to mining, on own account, or performed by specialized companies. The information obtained from exploration and evaluation, influences the production activities of the extracting firm. Therefore, exploration expenses are considered a type of gross fixed capital formation. This is considered to be an intellectual property product.

29. Mining exploration and evaluation consists of the value of expenditures on exploration for petroleum and natural gas. These expenses include the costs of obtaining the prior licenses, license costs and acquisition costs of feasibility studies, the costs of actual test drilling and boring, as well as transportation costs and other development aimed at making the exploration possible. The reassessment may be made after the commercial exploitation of the reserve has begun and the cost of these reassessments is also included. Consumption of fixed capital must be calculated for this asset, in a way similar to those used by a mining or an oil company in its own accounting service life.

30. For the purpose of estimating resource rent the user cost of the produced assets must be deducted, including both consumption of fixed capital, as well as the return on produced assets. Of course, the resources acquired as a result of the mining exploration, and therefore the value of these resources on the balance sheet can be considered due partly to mining exploration. However, in accordance with the SNA, it is considered that the result of exploration activity is a product of intellectual property and not a natural resource. The deduction of the user costs of mineral exploration and evaluation, in determining the resource rent, ensures that the

carrying value of mineral and energy resources is applicable only to the value of environmental resources that were not extracted.

31. In accordance with the *2008 SNA*, it is recognized that in many cases companies have decommission costs at the end of the productive life of a reservoir, usually to restore the natural environment. These costs should be considered, when it is possible to estimate them, in order to reduce the rent of the resource even if the actual costs probably take place after the end of exploitation activity.

32. Aggregating the existing resource in different fields needs to be taken into account. Generally mineral and energy resources are at unique sites, hence any extraction or discovery is captured appropriately. In practice, of course, this is not the case. Some oil fields are depleted in a relatively short time and mining companies transfer to other fields.

33. Many reassessments apply to fields where extraction is in operation. Quantitative upward revisions extend the life of resources and increases in value correspond largely to changes that are attributed to the resource at different times. In certain cases without new investment it is unlikely that the extraction rate remains.

34. Completely new discoveries can pose a different situation for statistical measurement. If a deposit has an expected life of 20 years, equal to the existing reserves of a country. It is unrealistic to assume automatically that new resource must necessarily be drawn in years 21 to 40. Furthermore, it is not realistic to assume automatically that must be exploited in 1-20 years, doubling the total removals of those years. For these reasons it is desirable, when possible, to make projections to the effect of the discoveries and reassessments separately and ideally to do it individually for each site.

35. Despite the assumptions on resource rent, it is necessary to establish the correct extraction rate that is used in the operations. The most commonly used rate of extraction is one that is constant in physical terms over the life of the mine, although there is no reason why this should occur. When resources are close to being fully depleted, production will be lower if there is nothing to replace them. It can also happen that a company can set the rate of extraction for the same income every year, or reduce the amount extracted as the resource decreases. It is possible that information provided by the government or by companies about the projected extraction rates can be used, although estimates tend to be conservative.

36. In the absence of any precise data, a reasonable assumption is that the rate of extraction will remain constant in physical terms. In practice this means that the efficiency of the extraction process is constant. The volume of production derived from the extraction will have the same ratio to the available stock of the resource.

37. At any given point in time, the life of a resource is equivalent to their stocks at that time, divided by the expected rate of extraction. In the course of a year, the life of the resource declines due to withdrawals and is updated taking into account discoveries and reassessments over the period, divided by the average rate of extraction. If the balance sheet sheds more downward revaluations than the increase and discovery, the life of the resource will be reduced. The amount of inventories that is used to calculate the life of the resource must be in accordance with the amount valued. Given that only resources class A are assessed, the lifetime of the resource must be calculated solely on the basis of the resources of that class and not the total known deposits (including the resources of classes B and C).

38. There are two types of flows of mineral and energy resources to consider. The first of these are the discoveries, reassessments, extractions, depletion and catastrophic losses. The value of the increases and decreases in inventories should be calculated using the average price of the in situ resource during the period multiplied by the quantity of discovered, ree-valued, drawn, exhausted or lost resource.

39. Second, acquisitions and disposals of mineral and energy resources also impact on flows. These transactions tend to rarely occur, but when they do occur they should be recorded. The cost of transfer of ownership of non-produced assets should be recorded as an acquisition of a produced asset.

40. A general feature of the mineral and energy resources is that revenues from extraction are distributed among economic units. The income of those who have extracted the resources is in the form of operating surplus. Government also earns income through various means, but predominately through resource rents. The government gets that income on behalf of the company, allowing access to resources. Depending on the nature of the provisions in force, the unit which extracts the resource and the government often have significant assets in the form of future anticipated revenues from the extraction of resources. Changes in the value of assets for each unit correspond to decreases due to exhaustion. The performance of environmental assets will be reflected in the accounts of generation and distribution of income. In the SEEA, one of the specific objectives is to show, within the general framework of national accounts, how depletion costs affect the income obtained from the extraction of natural resources. In particular, SEEA seeks to define estimates adjusted for depletion with respect to the operating surplus, added value and savings, both in terms of the whole economy and with respect to the institutional sectors. Since the amount corresponding to the depletion of each mineral or energy resource is one, it must be distributed among the respective units within the accounting framework.

41. Under the conditions set, the posting of such income and the corresponding depletion is problematic in the common framework of national accounts for two main reasons. First, the revenue streams are recorded on separate accounts, consigning the added value and the operating surplus generated by the extraction and production accounts for income generation, and the income earned by the government in the distribution account as primary income. Second, any cost of exhaustion in relation to income earned in the common structure of the accounts (unlike what happens with the cost of produced assets, which is recorded as consumption of fixed capital) is recorded. In contrast, in the SNA depletion is recorded in the other changes in volume of assets account. SEEA recommends an alternate treatment in the income account. Record the total costs associated with exhaustion in the production account and income generation of the unit that performs the extraction.

42. When presenting the accounts, the sum of the entries in the institutional sector corresponding to aggregates adjusted for depletion and calculation of these aggregates at the level of the whole economy. Irrespective of the presentation of the incomes, NSOs need to be transparent of the approach taken. This position in the balance sheet can be made in different ways depending on the nature of the analysis and institutional arrangements that affect each country. With any presentation, asset allocation and the resulting estimates of the net assets of the institutional sector should correspond to the expected revenue streams for the future for each unit extracting resources. This method of allocation of income and the exhaustion resulting from the extraction of mineral and energy resources can also be used to compile other accounts relating to natural resources subject to depletion.

3.4. System of Environmental-Economic Accounting (SEEA-Energy)

43. SEEA-Energy consists of a coherent, consistent and integrated set of tables and accounts related to energy. SEEA-Energy informs on the role of energy within the economy, the state of natural inputs for energy and various energy-related transactions of environmental interest. The tables and accounts of SEEA-Energy may be produced in both physical and monetary terms and are based on internationally agreed concepts, definitions, classifications and accounting rules. However, it is worth recognising that this approach predominantly applies to environmental accounts and is yet to be fully adopted into the full sequence of national accounts.

44. Although SEEA-Energy is presented as an internally consistent and complete system, its design is such that it can be implemented equally well in part or in whole. A country may choose to implement only a selection of the accounts included in SEEA-Energy, with such decisions dependent upon the extent and type of its natural

inputs of energy. Consideration needs to be made of the characteristics of its energy production and use, and any specific energy-related issues faced. Even if a country wants to eventually implement the full system, it may decide to focus its initial efforts on those accounts that are most relevant to the issues it wants to address.

45. The consistent use of classifications in the compilation of data in physical and monetary terms is a central feature of SEEA-Energy. International comparability of data is enhanced through the collective use of standard international classifications where these are available.

46. Several classifications used in SEEA-Energy are central to integrated environmental and economic analysis including the classification of economic units to industries, the International Standard Industrial Classification for All Economic Activities (United Nations, 2008); and the Standard International Energy Product Classification (SIEC)[2]. These classifications are used throughout SEEA-Energy and the SEEA Central Framework.

3.5. Internal recommendations for industrial statistics 2008

47. The international recommendations for industrial statistics constitute an agreed framework of a coherent set of internationally agreed principles, concepts and definitions of data items to be collected and published for measuring industrial activity. The framework is confined to encompassing a system of regular annual and sub-annual general purpose inquiries covering production-related activities.

48. IRIS provides recommendation of terms of industrial activities of ISIC. This covers scope of the industrial statistics, statistical units for collection of industrial statistics and data items. IRIS also recommends a set of main indicators, main data sources and methods. A strategy for data collection, quality and metadata and dissemination guidance is also presented in IRIS and these guidelines are recommended by this manual.

3.6. Spatial and temporal references

49. The mining statistics can potentially provide data in various geographical levels, depending on the statistical practices in each country, starting with the local, regional up to national and multinational levels. The choice of the spatial reference for the compilation of statistics ultimately depends on what mining data are needed by the users in the special data dissemination service and the resources available to data producers.

50. When collecting, compiling or integrating data on mineral resources, it is important that the reference periods for the various data are aligned. In the national accounting outline, the special data disseminate service recommended time reference is quarterly and annual estimates for environmental accounts, annual presentation date is recommended. The temporal framework for the different types of data must be defined in the data collection strategy.

3.7. Alignment with the SDG and other initiatives

51. One of the main outcomes of the Rio+20 Conference was the agreement of the member states to launch a process to develop a set of sustainable development goals (SDG) that would be useful for focused and coherent actions for development. The final document of Rio+20 states that the development process of the SDG must be coordinated and consistent with the assessment process of the development agenda beyond 2015. The process to support the consultations on the post-2015 development agenda was launched. National consultations will complement eleven thematic consultations, which are organized jointly by various entities of the United Nations family with the support of civil society and other international organizations that will guide how to include urgent and emerging issues in the post-2015 development agenda.

52. Given the importance of the SDG, it is considered important to outline strategies to harmonize the issue of the impact of mining with this initiative. In this sense, Goal 7: Ensure access to affordable, reliable, sustainable, and modern energy for all, aligns with this handbook.

54. The mining industry has the opportunity and potential to contribute to all 17 SDGs. However, mining can impact positively and negatively across the SDGs. Mining can foster economic development by providing opportunities for decent employment, business development, increased fiscal revenues, and infrastructure linkages.

55. Mining activities typically cause impacts on land, water, the climate and the flora, fauna and people that depend on these resources. Therefore mining will impact the environmental sustainability. For instance, mine development requires access to land and water. This can present significant adverse impact on the environment, which could be mitigated or avoided. Two SDGs, SDG6 – Clean Water and Sanitation and SDG15 – Life on Land, will require statistics.

56. Mining activity is energy and emissions intensive, which presents opportunities for greater efficiency as well as expanding access to energy. Two SDGs to consider are SDG7 – Affordable and Clean Energy and SDG13 – Climate Action.

57. Mining can also significantly impact local communities, bringing economic opportunities, but also challenges relating to livelihoods and human rights that affect social inclusion. There are four SDGs that cover this are SDG1 – End Poverty, SDG5 – Gender Equality, SDG10 – Reduced Inequalities and SDG16 – Peace, Justice and Strong Institutions.

58. Mining can have a local, regional and national impact on economic development and growth that can be leveraged to build new infrastructure, new technologies and workforce opportunities, influencing the economic development. Three SDGs to be considered are SDG8 – Decent Work and Economic Growth, SDG9 – Infrastructure, Innovation and Industrialization and SDG12 – Responsible Consumption and Production. For more details on the mapping between Mining and SDGs see *Mapping Mining to the Sustainable Development Goals: An Atlas*.

3.8. Use of indicators in public policy

59. The indicators can serve many purposes based on the scale at which they apply, audience reach, and quality of the underlying data. The indicators are useful tools for monitoring progress against the environment, and to raise the profile of these issues in the public debate. They help to promote accountability by forming the basis of the policy objectives and reporting on how well the policies work, and support policy development and integration by drawing attention to key trends and structural changes. The challenge is to find a comprehensive way so that the indicators are exploited to support decision-making in countries. It is therefore important that the indicators are communicated in a way that is understandable and meaningful, and that reduces the complexity and detail of the original data.

Chapter 4.

Data sources and general methodological notes

4.1. Introduction

1. Mining industry statistics are based on numerous sources of information and apply different methods of data collection and compilation. Overall, the data are divided into two distinct categories; data on the physical environment (flows, stocks and emissions) and monetary data on mining and economic indicators (production value, wages and salaries.). Information sources and collection methods depend on the practices used by each country, including both institutional arrangements and the level of human and financial resources.

2. To develop the necessary data, a statistical office collects and transforms basic data of institutional units (firms, government agencies, households and institutions) in their role as producers, consumers and investors, employees, and so on. There are two basic aspects of the collection of economic data: it guarantees access to data already collected for administrative purposes and that the statistical office conducts a direct survey or censuses.

3. Note that this chapter takes as its main references from the IRIS, developed by United Nations Statistics Division, through an international consultative process involving experts from national and international institutions.

4. The IRIS designed to provide a comprehensive methodological framework for the collection and reporting of industrial statistics in all countries, irrespective of the level of development of their statistical systems. It is intended primarily for the producers of industrial statistics in particular the staff of national statistical offices involved in the collection and compilation of industrial statistics.

5. A comprehension list of data items is prepared as part of the questionnaire design for the survey that includes mining activities in its scope is recommended. A complete list of data item is given in IRIS-2008, countries should determine the priority for this. A large and small version of the model questionnaire based on data items recommended by IRIS-2008 is presented in the UNIDO publication *Industrial Statistics: Guidelines and Methodology* (UNIDO, 2010).

6. However, implementation of these recommendations depends on the purpose of the survey and available resource. One important aspect to be considered is that the

main source of data for any industrial survey is the records maintained by businesses for their own accounting purpose. Therefore selection of data items should be made in clear understanding of the accounting rules and principles existing in the country of reference.

7. Data collected from the survey are to be used to compile the set of indicators will be discussed in later sections. Therefore, the information requirement for selected indicators pre-defines the list of data items from the survey. Nevertheless, there can be a minimal set of data items that could be considered for most of the surveys. A full list of data items is given in IRIS-2008,

8. The data items listed in IRIS-2008 can be used for the purpose of questionnaire design, which may also include the indicators to be derived. For example this could include the wage rate, total output or intermediate inputs for the purpose of checking consistency of reported data. Other establishment level data items like exports and financing items such debt and foreign direct investment and mineral explorations could also be included in the mining related data items.

4.2. Data Sources

4.2.1 Overview of data Sources

9. The main data sources that can be used to produce the data topics in these recommendations could include the following:

- Establishment and household surveys,
- Economic and population census,
- National accounts and environmental accounts,
- Administrative data of government and non-government agencies in charge of natural resources as well as other ministries and authorities,
- Remote sensing and thematic mapping (e.g., satellite imaging and mapping of land use and land cover, water bodies or forest cover),
- Monitoring systems (e.g., field-monitoring stations for water quality, air pollution or climate),
- Scientific research.

10. Surveys and administrative records are mainly used to produce data on economic units, while the information about environmental impacts can be derived mainly from environmental accounts. Traditionally, National Statistical Offices are the institutions responsible for collecting data through surveys and administrative records, although

this can vary from country to country. In many countries the Ministry of Industry or a similar institution is responsible for collection of statistical data on industry.

11. Survey data are collected directly from the economic units selected for the study. The data are gathered from all units of the population (census) or only from some representative data units selected through sampling (sample survey). The information about the "physical" aspects of mining may be obtained by some other statistical tools such Energy Balances or institutions or publications of companies that perform the extraction of resources, like oil or gas.

12. The official administrative processes are established to monitor and enforce laws and regulations, which sometimes includes keeping a record of economic units. These records may consist of household or establishment units and may contain various information items about them. Usually the administrative data for statistical purposes are received from government agencies. However, administrative data can also come from non-governmental organizations, such as industry associations.

13. It is also possible to obtain data from collected for some research at the universities, research institutes or non-governmental organizations, which can have different projects and research programs related to mining and social or environmental studies.

14. Table 4.1 provides an overview of the data items that can be obtained from the different data sources. Statistical surveys and administrative records provide data on economic and social variables of mining, and some specialized exercises provide information on the physical conditions of the deposits and mines.

Table 4.1: Example of different data sources for construction of the mining indicators

Data sources	Economic impact	Social impact	Environmental impact
Surveys	√	√	√
Administrative registers	√	√	
Economic census	√	√	√
Population census		√	
National accounts	√	√	
Environmental accounts			√

15. The most common source for compilation of statistical data on mining are the national accounts and the economic census providing a specific section with data for some variables of interest. However, depending on the population of interest, the available resources and the particular conditions in a country, performing a specific census can be a viable option for collecting the most complete and detailed mining statistics. A complete census of the units in the mining industry may be appropriate when, for example, a country does not maintain an updated business register (directory of companies). Sample surveys are tools for gathering information from a part of the total population (a sample) to infer about the whole population. They are almost always less expensive than censuses. There are different types of surveys that can be used in mining statistics depending on the units: (i) business or household surveys to be sampled, that is. In general, it is recommended that countries establish a program of sample surveys to meet the needs of mining statistics in an integrated manner, as part of a comprehensive national program of sample surveys to businesses and households, to avoid duplication of work and minimizing the burden on respondents. (IRES2008)

4.2.2. National accounts

16. The National Accounts are an organizational scheme for statistical information on macroeconomic aspects of the country. Box 4.1 highlights the Mexican system of national accounts as an example of the data presented in that country

Box 4.1 : The System of National Accounts of Mexico (SNCM)[3]

SNCM is the summary of the activities of the national economy that took place in Mexican society for a certain period. The derivation of this information is from censuses, surveys and administrative records.

The following list presents the topics covered by SNCM:

Base 2008

- Gross Domestic Product (GDP)
    - Quarterly
    - Annual, by economic activity
    - Annual, by state
    - Annual, for public and private sector
    - Annual for state and local governments
    - Value added of total manufacturing exports
    - Measuring the informal economy
- Short term
    - By industrial activity
    - Total Economic Activities
    - Gross Fixed Investment
    - Quarterly supply and use
    - Monthly indicator for electricity by state
    - Monthly Indicator for manufacturing by state
    - Industrial activity by state
    - Quarterly Indicator of economic activity by state
    - Quarterly indicators of tourism
    - Private consumption in the domestic market
- Supply and Use Tables
- Input-Output
    - Input-Output 2012 - Update
    - Input-Output 2008
- Tables Origin-Destination of the gross fixed capital formation
- Total Factor Productivity
- Institutional Sectors
- Satellite accounts

Base 2003

- Satellite accounts

[3] http://www.inegi.org.mx/est/contenidos/proyectos/cn/

4.2.3. Environmental accounts

17. System of Environmental-Economic Accounting Central Framework 2012 recommends NSOs construct three set of accounts. These are the physical flow accounts, the environmental activities accounts, and the related flows and asset account. In this set of accounts, there are over 20 independent accounts.

Box 4.2 : The Economic and Ecological Accounts of Mexico

The Economic and Ecological Accounts of Mexico (commonly known as SCEEM) provide information on the impact on the environment and natural resources as a result of anthropogenic activities, linking the main macroeconomic variables of the country and obtaining the Environmentally Adjusted Net Domestic Product (PINE). This is done by determining the amount of the costs for the depletion of natural resources and environmental degradation. This indicator also presents the spending by the public sector in favour of the environment for the prevention, control, reduction or elimination of pollution generated by the activities of production, distribution and consumption. The above is compiled in the framework of satellite accounts using their links with the central framework of National Accounts.

The change of base year in all SCNM publications preserves the methodological and conceptual improvements in environmental accounting and incorporates the latest available in the country information[4].

Since environmental accounting uses the same accounting conventions, it is in general consistent with the system of national accounts. Here we will refer the SEEA Central framework with its specific analytical focus on the environment and its linkages with the economy, as well as with its focus on the measurement of stocks and flows in physical and monetary terms will provide specific reference.

The above standard for environmental accounting includes:

Asset accounts:

Stocks and changes in stocks (flows) of natural resources such as land, forest, water, fish, soil and mineral and energy resources in land, forest, water, fish, soil and mineral and energy resources in physical and monetary terms.

Wealth accounts and calculation of depletion.

Combining the accounts:

Combine modules of SEEA to form a full sequence of accounts and integrate physical and monetary accounts.

Aggregates such as GDP (e.g. PINE in Mexico), or Net Saving and productivity indicators.

[4] http://www.inegi.org.mx/est/contenidos/proyectos/cn/ee/default.aspx

4.2.4. Economic census

18. An economic census is used to determine the characteristics of establishments producing goods, companies merchandising the goods and service providers, nationally, with a high level of geographical and industrial breakdown. They are composed of several procedures, corresponding to the various sectors of economic activity.

Box 4.3 : The Economic census in Mexico

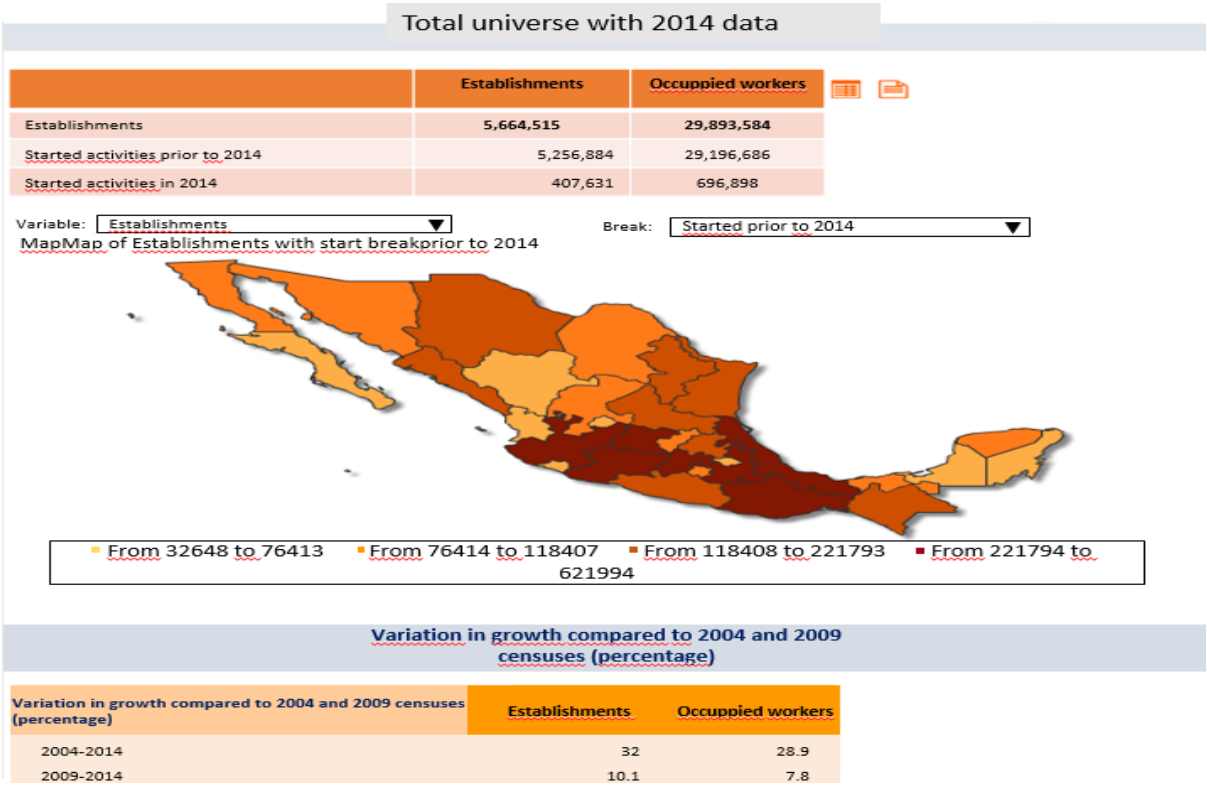
The most recent economic census in Mexico was conducted in 2014 was the eighteenth census event in the country. The purpose of the census was to obtain basic statistical information relating to the year 2013 on all goods-producing establishments, retailers and service providers. This would enable Mexico to generate economic indicators at a detailed level on geographical, sectoral and thematic information.

These censuses capture the basic economic information virtually for all economic activities that take place in the country, except for agriculture, livestock and forestry, since the latter are covered by the Agricultural Census.

In the recent census new items were incorporated, such environment, global value chains and supply services, with the aim of measuring the current economic events. In total more than 1.4 million blocks throughout Mexico were traversed to capture information from a population of 5.6 million establishments.

Graph: Results of Economic census 2014, Mexico

Figure 4.1 Results of the Economic Census of Mexico



4.2.5. Establishment surveys

19. Establishment surveys are used to efficiently capture comprehensive statistical information from enterprises of all sizes operating in the country. They are used to determine the characteristics and conditions of the establishments of the various sectors. Depending on their frequency they will also capture changes in economic development. Surveys are carried out more often than censuses and can provide information at sub-national level. The target population (respondents) and the frequency depend on the nature of each survey and intended information to be collected. They might take place monthly, quarterly, annually, biennially, five year spans, or, on special occasions at the request of the government or other agencies.

20. An important tool is a directory (or inventory) of economic units that provides information related to the financial institutions, to support decision-making in both the public and in private. The sampling frame should contain all the units that are in the target population of the survey, without duplication or omissions. A statistical business register can provide a comprehensive list of all enterprises and other units, together with their characteristics, that are active in a national economy. The Wiesbaden group has developed methodologies for constructing a business register[5].

21. Apart from being a tool for conducting statistical surveys, a business register is a source for statistics in its own right. The establishment and maintenance of a statistical business register in most cases is based on legal provisions, since its scope and coverage are determined by country specific factors. For countries that do not maintain up-to-date business registers of companies, it is recommended to build one based on the last economic census and amend it as needed, based on the relevant information obtained from other statistical sources. (IRES, 2001, p 117).

4.2.6. Household surveys

22. While household surveys are not designed specifically for collecting data on the mining industry, they may contain data related to the social impact, such as the number of employees. Household surveys are the only tool to collect data for estimating the informal activities of mining which is important for many developing countries.

[5] http://unstats.un.org/wiesbadengroup/

23. The frequency of these surveys is key to obtaining information on a regular basis. These studies should reflect not only nationally, but also sub national including in rural and urban splits in order to achieve an adequate analysis of the data.

BOX 4.4 : Description of the data of the household survey of Mexico used for defining the indicators

National occupational and employment survey[6] (ENOE)

The National Survey of Occupation and Employment in Mexico aims to obtain statistical information on the occupational characteristics of the population nationwide, as well as other demographic and economic variables to deepen the analysis of the labour market.

In compliance with the international recommendations and the amendment made in 2014 to the Constitution of the United Mexican States, which raised the minimum legal working age from 14 to 15 years, ENOE covers all of the inhabitants 15 years and older.

The information is adjusted to demographic projections by the National Population Council updated on April 16, 2013, which is based on the results of the Census of Population and Housing 2010.

The ENOE results are presented on a quarterly basis, at national level, for the 32 states, 32 self-representing cities and towns in five ranges of number of inhabitants (less than 2 500, 2500-14999, 15000-99999 and more than 100000).

Table 4.2 Population and Employment data for Mexico

Indicator	National					
	Total	Urbanized areas	Less urbanized areas			
			Total	Medium urbar	Low urban	Rural
I. Total population	**1 08 292 131**	**54 367 888**	**53 924243**	**15 584 194**	**14 734 400**	**23 603 649**
2. Population from 14 years or more	**79 669 989**	**41 773 707**	**37 896 282**	**11 311 458**	**10 453 107**	**16 131 717**
Economically active population	47 137 757	25 315 245	21 822 512	6 809 200	6 109 592	8 903 720
Employed	44 651 832	23 689 099	20 962 733	6 471 984	5 860 376	8 630 373
Unemployed	2 485 925	1 626 146	859 779	337 216	249 216	273 347
Economically inactive population	32 532 232	16 458 462	16 073 770	4 502 258	4 343 515	7 227 997
Available	5 597 546	2 493 392	3 104 154	793 409	760 352	1 550 393
Unavailable	26 934 686	13 965 070	12 969 616	3 708 849	3 583 163	5 677 604
3. Employed population per:	**44 651 832**	**23 689 099**	**20 962 733**	**6 471 984**	**5 860 376**	**8 630 373**
3.1 Position in employment	**44 651 832**	**23 689 099**	**20 962 733**	**6 471 984**	**5 860 37**	**8 630 373**
Subordinates and remunerated	29 280 772	17 170 538	12 110 234	4 372 153	3 601 825	4 136 256
Salary compensated	27 227 323	15 922 476	11 304 847	4 081 762	3 351 224	3 871 861
Non-salary compensates	2 053 449	1 248 062	805 387	290 391	250 601	264 395
Employers	2 117 984	1 184 418	933 566	324 956	302 081	306 529
Self-employed	10 262 054	4 465 502	5 796 552	1 426 070	1 452 463	2 918 019
Unpaid workers	2 991 022	868 641	2 122 381	348 805	504 007	1 269 569
Unspecified	0	0	0	0	0	0

4.2.7 Administrative data

24. Administrative records are established in accordance with the laws and regulations. Each regulation (or related group of regulations) results in a register of institutional units that are subject to those regulations, together with the data resulting from application of this regulation. Statistical offices refer collectively to this

[6] For more detail, it is suggest see:
http://www.inegi.org.mx/est/contenidos/proyectos/encuestas/hogares/regulares/enoe/default.aspx

data administrative source. Administrative authorities keep records of the units in accordance with legislated administrative requirements or simply for internal purposes in order to assist the units in managing their operations. Statistical offices can use this data from an administrative source with relatively low cost.

25. Different administrative registers are established to serve different roles in response to legislation and /or regulations. Some of these services are:

- To monitor activities related to production of goods and services, including mining and utilities;
- To enable regulatory activities and audit actions and;
- Assess outcomes of government policies, programmes and initiatives.

26. This data is collected by diverse governmental agencies, mainly for the purpose of carrying out various non-statistical programs. A wider definition could also include organizations operating in the private sector. The data originating from administrative sources can be effectively used to compliment the compilation of statistics on mining activities. Examples for such administrative registers are tax register, social security database, and register of companies (industrial register), register of Economic Chamber.

27. The main benefits of administrative data are:

- Cost reduction, since surveys and censuses can be expensive, while administrative data can have a potentially lower cost
- Reduced burden on data suppliers; Statistics can be compiled more frequently with no extra burden;
- Potential full coverage of target population;
- No survey errors and lower non-response;
- Better small-area data;
- Timelines may be improved for some types of data.

28. Administrative data also has some disadvantages, limitations and issues that have to be considered.

- Administrative units do not always coincide with statistical units,
- Are known to contain inactive units,
- Administrative and statistical priorities are often different;

- There can be different definitions and classifications, which mean conversion tables are needed for different classifications,
- Necessary to perform data parsing and conversion,
- Enterprises are not broken down into establishments (as recommended in IRIS 2008);
- Timeliness
- Data from multiple sources: matching/linking issues, data conflicts.

4.2.8. The Extractive Industries Transparency Initiatives

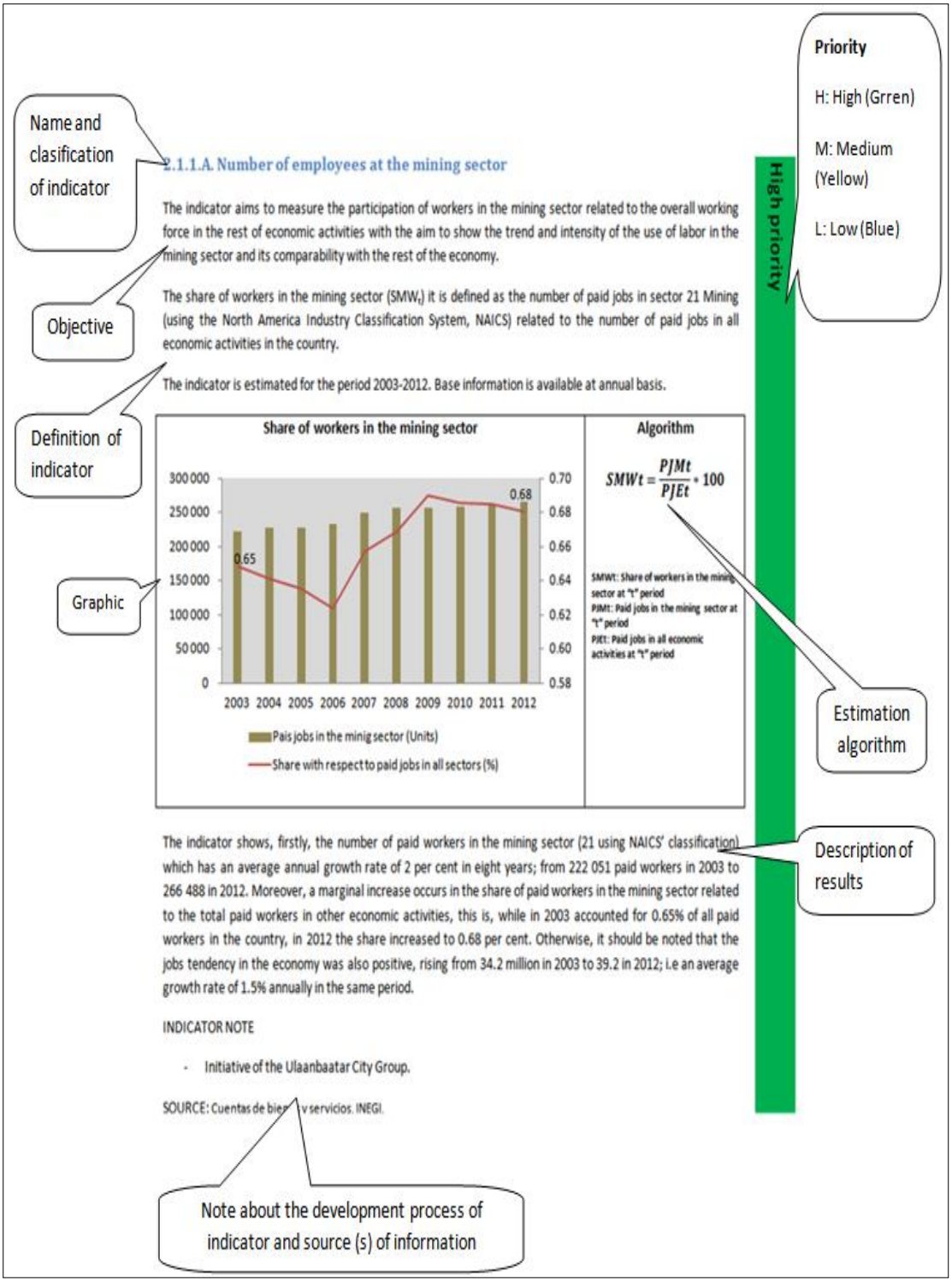
29. The Extractive Industries Transparency Initiative (EITI) is a global standard to promote the open and accountable management of oil gas and mineral resources. The EITI seeks to strengthen government and company systems, inform public debate and promote understanding. In each of the implementing countries, the EITI is supported by a coalition of government, companies, and civil society.

30. The EITI Standard requires information along the extractive industry value chain from the point of extraction, to how the revenue makes its way through the government, to how it benefits the public. This includes how licenses and contracts are allocated and registered, who are the beneficial owners of those operations, what are the fiscal and legal arrangements, how much is produced, how much is paid, where are those revenues allocated, and what is the contribution to the economy, including employment. The EITI data can used to compare international trends and evaluate consistency of the recommendations for countries.

4.3. Proposed schematic methodological sheet

31. We propose a methodological sheet that contains elements such as the definition and purpose of the indicator, its calculation algorithm. Figure 4.2 provides a view on these proposed indicators. It is expected that this proposal allows, among other things, to facilitate the recognition of the indicators by their presentation in their respective countries.

Figure 4.2 Example schematic methodological sheet



4.4. Metadata and data quality

32. Usually when referring to quality and quality dimensions only statistical data are considered. But since metadata undergo the same life cycle as statistical data, the same quality dimensions can be equally applied to metadata. On the other hand, metadata is the most important driver that can leverage each of the quality dimensions. The availability of standardized statistical metadata is central to inter-

operability and can be a powerful tool. Metadata enables the user to discover and select relevant data quickly and easily. Poor quality metadata, for its part, can cause a dataset to become essentially invisible within a repository or archive. Clearly high quality metadata has an important role to play in realizing the goals set for dissemination of statistical data. Much effort has already gone into developing standardized approaches to metadata, For example see http://www.unece.org/stats/cmf/.

33. The simple definition of metadata is “data that defines and describes other data” and, respectively, statistical metadata are “data about statistical data". According to the definition given in UNECE (1995) statistical metadata provide information on data and on processes for producing and using data. Metadata describe statistical data and - to some extent - processes and tools involved in the production and usage of statistical data. Although this definition is easy to remember and understand, it does not make much sense if taken out of context - that is, in order to identify particular data as metadata one needs to specify the purpose of its use. For whom and why is metadata necessary? First of all these are the users of the data but not less important are the needs of the producers of the data and finally although often neglected, metadata is necessary to control the proper functioning of the software tools used in the statistical production process. Statistical metadata documents a data set so that users can find, understand and evaluate whether the data are appropriate for their intended use, that is, the user can judge the relevance of the data with regard to the problem at hand. Statistical metadata also provides information on accuracy (precision, reliability) of the statistical data (background, purpose, content, collection, processing, and related information). It is also important for the user to know where and how the data can be found, that is, availability of statistical data. This aspect becomes extremely important in today’s age of internet and information technology, since metadata can facilitate the discovery. All of this information allows researchers to find, understand and manipulate statistical data in the proper way. The availability of such metadata extends the number and diversity of people who can successfully find and use statistical data.

34. Well managed metadata reduces the time lag (reuse of software, content, procedures, etc.) and thus contributes to the timeliness of statistical data. An even more positive impact on the timeliness of statistical data is due to the simultaneous management of data and metadata in one integral production process. Good statistical data must be well defined in order facilitate comparability within each of the defined dimensions (such as countries, branches of industry, years), which is actually one of the main challenges to the statistical production process of any

National Statistical office. Proper use of statistical data can be ensured only through accurate metadata. Without metadata, the user might misinterpret the difference in country coverage or classification as a change in the measured economical phenomenon. It is therefore necessary to manage metadata on:

- Different and changing classification systems,
- The computation and processing methods of the principle indicators (for example, number of establishments or enterprises, number of employees or persons engaged),
- The difference in valuation of output measure (basic prices, producer prices or factor prices).

35. Applying data estimation using supplementary information as well as econometric techniques also increases the timeliness and completeness of the data. Keeping track simultaneously of the sources and methods used through automatically generated metadata is of primary importance.

Chapter 5.

Standard indicators

5.1. Introduction

1. This chapter contains the basic metadata on the agreed list of standard indicators for measuring the impacts of mining on the economy, society and the environment. The choice indicators determined to inform policy makers and the community on issues faced by policy-makers in economies with significant mining activity, including assisting international comparability. The list of standard indicators are based on the following criteria. They should be:

- Consistent with goal of the Ulaanbaatar city group with the potential to measure economic, society, and environmental impacts of mining.
- Based on internationally accepted methodologies and simple to interpret.
- Able to use identical methodology with a scientific basis that are consistent with international classifications and standards.
- Generally measurable (statistically feasible) over time.

2. The chapter is developed to provide countries and national and international stakeholders with guidance on the definitions, methodological concepts and data sources for the indicators that are being used to measure the impacts of mining. The list is composed of a total of 95 indicators that mean the impact of mining the economy, 29 indicators for the impact on the society, and 18 indicators for the impact on the environment. The list of indicators is not fixed. Countries can be selective and can complement a national list that suits their needs. Country data should be the basis for compiling the indicators where such data are available and of reasonable quality.

3. The scope of the indicators covered measure the mining's contribution to the economy, impacts on the human well-being (human health, education, income), social equity and environmental sustainability. There are 142 recommended indicators that examine the impact of mining. The indicators were prioritized by consensus to guide agencies with limited resources those that were considered to provide the most benefit. This prioritised list was achieved through the workings of the Ulaanbaatar city group. The indicators were put into three categories:

- **High priority:** Indicators were presented to demonstrate the impact on official statistics, for countries' economies depend on natural resources (mining production).
- **Medium priority**: Indicators that would be good to have.
- **Low priority:** Indicators that countries might like to have to provide greater analysis of the impact on official statistics.

The full list of indicators is presented in Annex 1.

5.2. The indicators to measure impacts of mining activities on the three pillars as economy, society and the environment

4. This section provides the measurement issues to define impacts of mining and mining-related activity from an economic, social, and environmental perspective.

5.2.1 Indicators relating to the impact of mining on the economy

5. The following list are the measurement areas that countries should address.

- Mining production in both of quantity and value,
- Price of mineral commodities and the impact of mineral prices on the terms of trade, as well as mining-induced terms of trade impacts on the rest of the economy,
- Intermediate consumption of the mining industry, including energy inputs,
- Mining gross operating surplus,
- Mining inventories,
- Mining fixed capital investment, including current and expected expenditure, capital stock, capital services, consumption of fixed capital expenditure,
- Financial investment (including foreign investment, both direct and portfolio) and associated incomes, including retained earnings,
- Measurement of impact of mining on trade statistics, including coherency with production statistics,
- Measurement of mineral exploration, discoveries and sub-soil reserves,
- Measurement of the impact of mining on government finances, including measuring of taxes on mining,
- Measurement of productivity in the mining industry,

- Measurement of construction activity associated with the mining industry,
- Measurement of impact of mining on transportation,
- Measurement of other economic activity to support the mining industry, including role of input-output analysis,
- Measurement of 'down-stream' economic impacts of mining, including the manufacturing of mineral products,
- Measurement of infrastructure to support mining activity,
- Measurement of mining impact on national income, including balance of payments incomes associated with mining and measures of real gross domestic income and real net national disposable income,
- Measurement of national wealth,
- Measurement of impact of mining on regional economies (including regional prices and regional housing markets),
- General measurement issues, including dealing with multinational enterprises, dealing with confidentiality issues, correction of 'off year' reporting, ensuring coherence of information from different sources and consistency thereof, by developing a coordinated approach to large mining projects, measuring informal mining activity),
- Procurement of nationally produced goods and services.

5.2.2. Indicators relating to the impacts of mining on society

6. There are a number of areas to consider when measuring the impacts of mining on society. These have been arranged into four themes.

Labour force

- Employment in the mining industry,
- Demographic characteristics of the mining labour,
- Employment in mining related activities,
- Impact of mining demand for labour on supply of labour to other parts of the economy.

Income

- Mining wages and salaries,
- Distribution of mining incomes, including gender distributions.

Health and productivity

- Workers' conditions and industrial relations in the mining industry,
- Mining skills and capabilities, including job vacancies and skill shortages,
- Impact of mining on workers' health and the health of the community generally.

Measurement of the impact of mining on social issues

- Fly-in /fly-out and drive-in/drive-out workers, including impacts in demands for services,
- Internal and international migration flows associated with mining activity, or
- Impact of mining on education and training.

5.2.3 Indicators relating to the impacts of mining on the environment

7. The indicators need to address a number of areas. These are:

- Direct and indirect demand from the mining industry for environmental inputs, both market and non-market, incorporating measurement in terms of value,
- Emissions and waste products from the mining industry,
- Environmental impact of economic activity 'downstream' from the mining industry.

5.3. Summary of indicators

8. Annex 1 presents all indicators for each area. The annex provides a detailed definition for each indicator, counted with its priority ranking. Detailed practical recommendations for measuring the impact of the mining industry on the economy, social sector and environment are provided in chapters 6 to 8 of this handbook.

9. For many agencies it is difficult to compile estimates using guidelines from handbooks directly. Appropriate data sources and metadata must be entered from the guidelines. This handbook proposed to develop methodological sheets for each of the indicators. The sheets would contain the appropriate metadata and suggested data source.

10. Figure 5.1 is an example for the number of employees in the mining industry.

- The definition and purpose of the indicators,
- The calculation algorithm,
- A graph showing the trend of the indicator, and;
- One possible interpretation of the result.

11. The methodological sheet can also indicate the priority visually, such as sharing a green label for high priority.

Figure 5.1. Example of methodological sheet

Name of the indicator: Number of employees of the mining sector

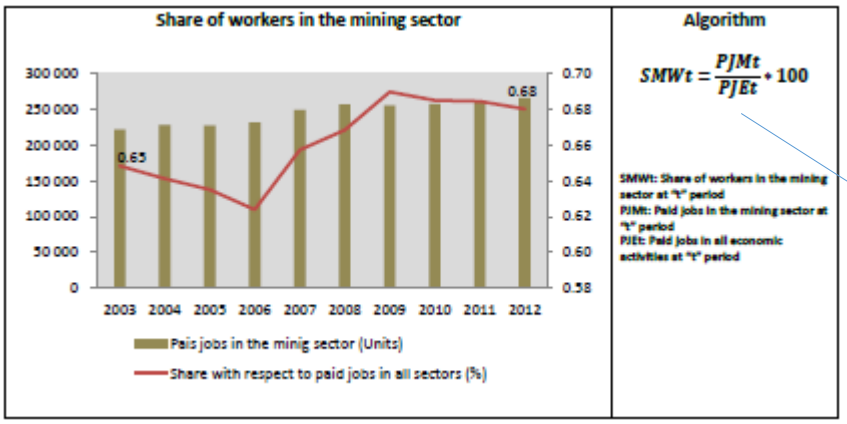
Objective of indicator: The indicator aims to measure the participation of workers in the mining sector related to the overall working force in the rest of economic activities with the aim to show the trend and intensity of the use of labor in the mining sector and its comparability with the rest of the economy.

Priority
H: High (Green)
M: Medium (Yellow)
L: Low (Blue)

High priority

Definition of indicator: The share of workers in the mining sector (SMWt) is defined as the number of paid jobs in sector 21 Mining (using the North America Industry Classification System, NAICS) related to the number of paid jobs in all economic activities in the country.

Graph: The indicator is estimated for the period 2003-2012. Base information is available at annual basis.



Estimation algorithm

Description: The indicator shows, firstly, the number of paid workers in the mining sector (21 using NAICS' classification) which has an average annual growth rate of 2 per cent in eight years; from 222 051 paid workers in 2003 to 266 488 in 2012. Moreover, a marginal increase occurs in the share of paid workers in the mining sector related to the total paid workers in other economic activities, this is, while in 2003 accounted for 0.65% of all paid workers in the country, in 2012 the share increased to 0.68 per cent. Otherwise, it should be noted that the jobs tendency in the economy was also positive, rising from 34.2 million in 2003 to 39.2 in 2012; i.e an average growth rate of 1.5% annually in the same period.

Indicator note: Initiative of the Ulaanbaatar City Group.

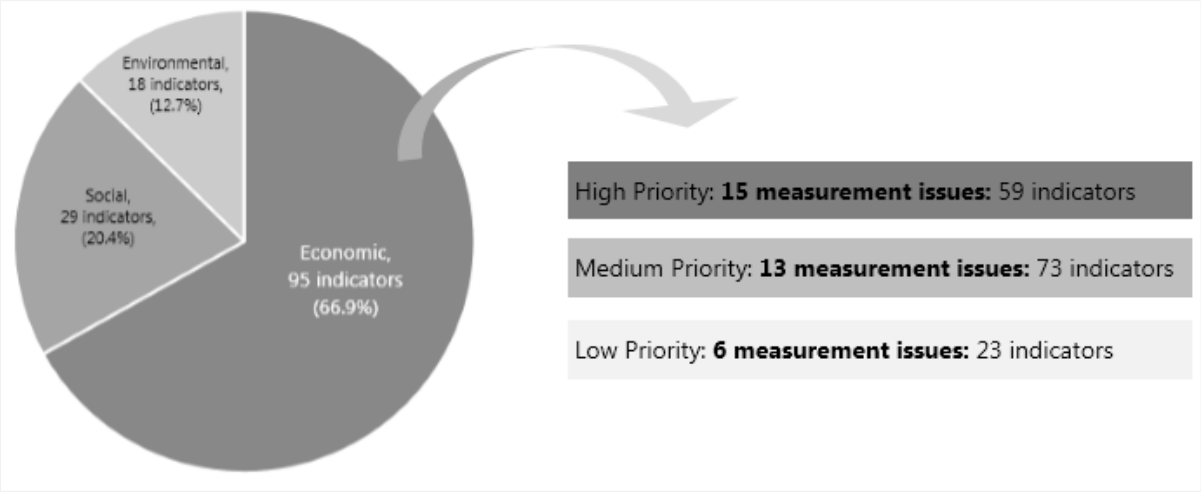
5.3.1. Economy indicators

12. The Ulaanbaatar City Group developed more than 90 indicators for measuring the contribution of mining to the economy, far outweighing the indicators that examine the impacts on society and the environment (figure 5.2).

These indicators have been placed into four broad categories:

- Production, stock and investment statistics,
  - Total production of mining products, by value,
  - Total production of mining products, by quantity,
  - Inventories, fixed capital and investment.
- Expenditure statistics,
  - Expenditure by intermediate goods used for production processes,
  - Expenditure of electricity, fuel and water,
  - Expenditure of the transport vehicles and other transport running.
  - Expenditure of waste and air emissions management,
  - Other service cost.
- Trade & Price statistics,
  - Exports and imports,
  - International trade price indexes,
  - Producer price indexes,
  - Consumer price indexes.
- Analytical statistics & transformations,
  - Gross Domestic Product, Gross National Income, Gross Domestic Income,
  - Productivity, and other Government revenues,
  - Taxes.

Figure 5.2. Indicators for measuring contribution of mining to the economy



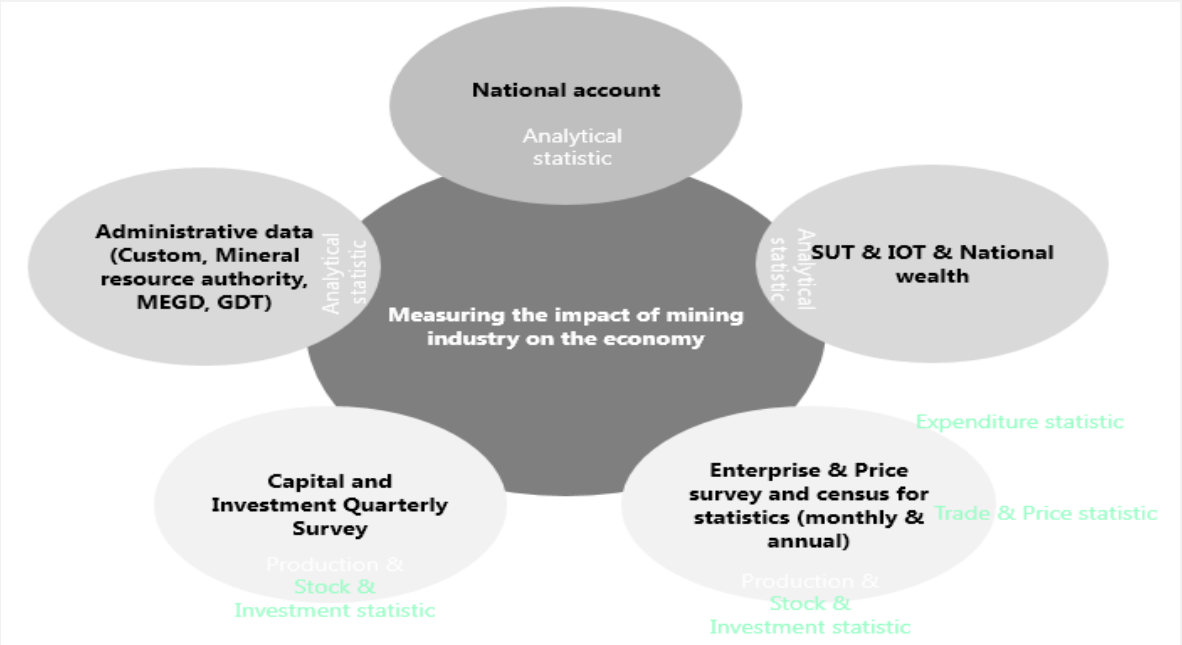
There two main data sources are from official statistics and administrative data (figure 5.3).

13. Official statistics include:

- National accounts,
- Capital and investment quarterly survey,
- Enterprise and price survey,
- Other surveys such as mining sites' survey and artisanal and small scale mining survey.

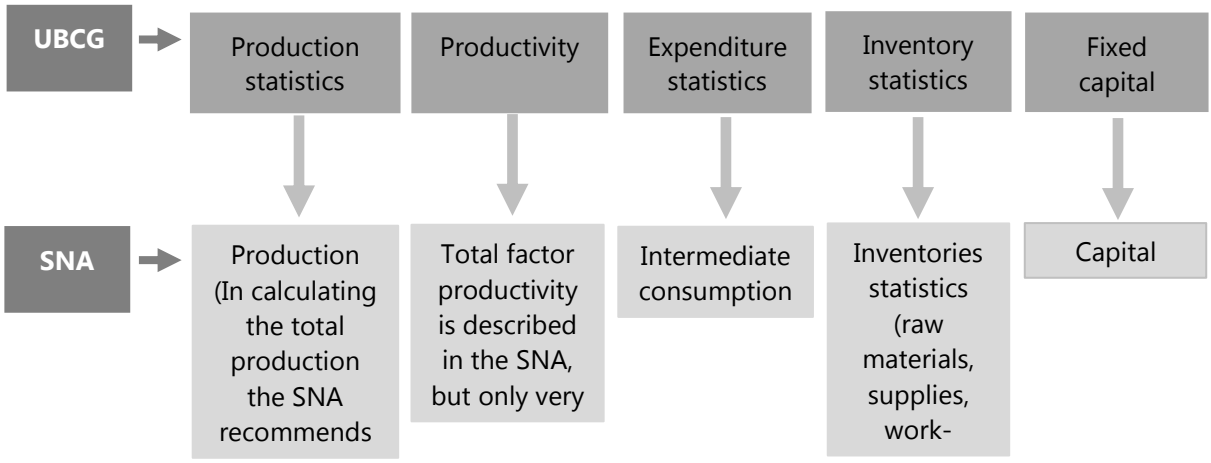
14. Administrative data can come from a number of sources, such as Customs, and Revenue and Taxation authorities.

Figure 5.3. Data sources of economic indicators



15. Figure 5.4 shows the alignment of the handbook on measuring economic impacts of mining with System of National Accounts (SNA). For example, the list of production indicators aligns with the production account of the SNA. The difference is that the handbook allows for a quantity indicator estimating production whereas SNA recommends using volumes.

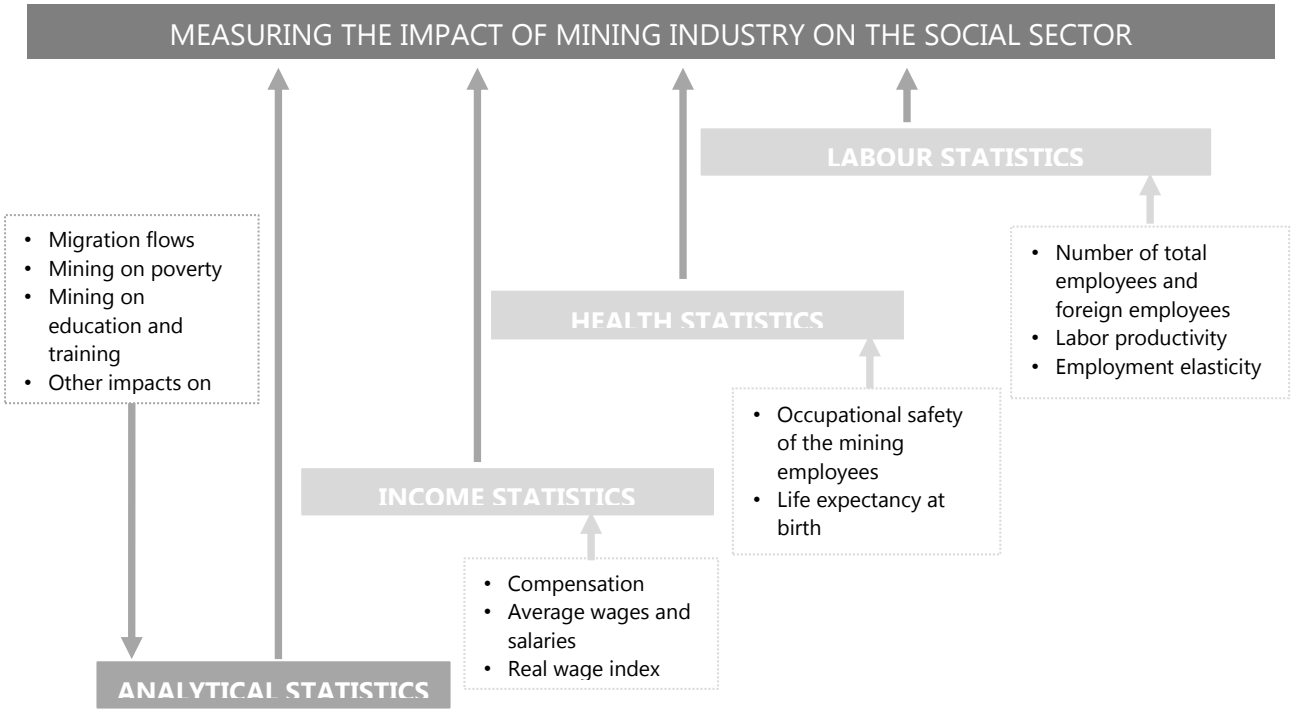
Figure 5.4. Data sources of economic indicators



16. The handbook has identified 29 indicators for measuring impacts of mining on society. Of the 29 indicators were classified as high priority, 11 indicators as medium, and 3 as low priority.

17. These indicators have been categorised as labour statistics, health statistics, income statistics and other statistics. Figure 5.5 shows the indicators under each statistics and data sources. Social indicators can be derived from various sources such as household socio-economy survey (HSES), labour force survey (LFS), wage and salary surveys and other special surveys. Other official statistics that could capture the necessary data used for measuring impacts on society include, gender statistics, population and vital statistics reports. There is also a range of administrative data that could be used for measuring impacts on society; this includes data from the Ministries of Health and Education.

Figure 5.5. Measuring the impact of mining industry on social sector



5.3.2. Environment indicators

18. There are 18 indicators for measuring the impact of mining on the environment. Seventeen indicators are of a high priority. The data to measure the impacts of mining on the environment are compiled from a wide range of administrative data sources. Administrative data collected and integrated by the related ministries and agencies of environment is an important source for deriving statistical indicators on the environment. Figure 5.6 shows a methodological sheet for the cost of environmental protection.

Figure 5.6 An example of the methodological sheet for an environment indicator

High priority

Name of the indicator: Cost of environmental protection

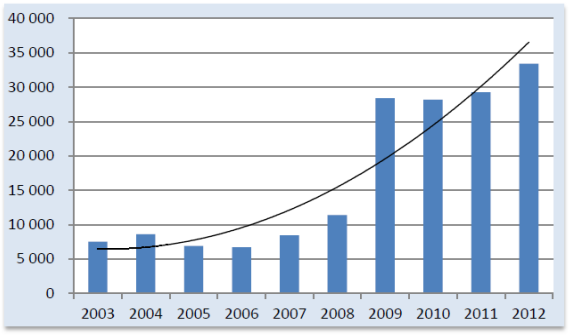
Objective of indicator: The Environmental Protection Expenditures (EPE) represents monetary expenditures for prevent, measure, control and remedy or abate pollution or any form or environmental degradation; as well as to protect, manage and promote the environment.

Definition of indicator: The indicator aims to measure the environmental expenditures incurred by the mining sector (expenditures related to public sector) in related activities to environmental protection.

The Environmental protection expenditures by the mining sector (EPEM) are defined as the sum of current and investment expenditures.

Graph: The indicator is estimated for the period 2003-2012. Base information is available at annual basis.

EPE by the mining sector in related activities to environmental protection (Million of pesos)



Algorithm

$$EPEMt = OEt + IEt$$

EPEMt: Environmental protection expenditures in the mining sector at period "t"
OEt: Current expenditures at period "t"
IEt: Capital expenditures at period "t"

Description: The indicator shows the amount spent for environmental protection activities on mining activities incurred by the public sector, such as the operation and maintenance of basic infrastructure in ecology and economic infrastructure projects of hydrocarbons, among other sectors, it has a tendency to increase in the period 2003 and 2012 as it passes 7 516 million pesos in 2003 to reach 33,396 million in 2012, that is an average annual increase of 18 percent. The most pronounced growth was in 2009, being able to maintain and even increase this kind of expenditures in subsequent years.

Chapter 6.

Measuring the impact of the mining industry on the economy

6.1. Introduction

1. In order to measure the impacts of the mining industry on a country's economy it is necessary to be aware of the main determinants of mining, the measurement framework, related concepts and methodology. Good data sources are also necessary to estimate and analyse the results.

2. By its very nature, such a process is not easily captured by a single indicator, and a small set of measures are needed. These indicators should be based on internationally comparable data.

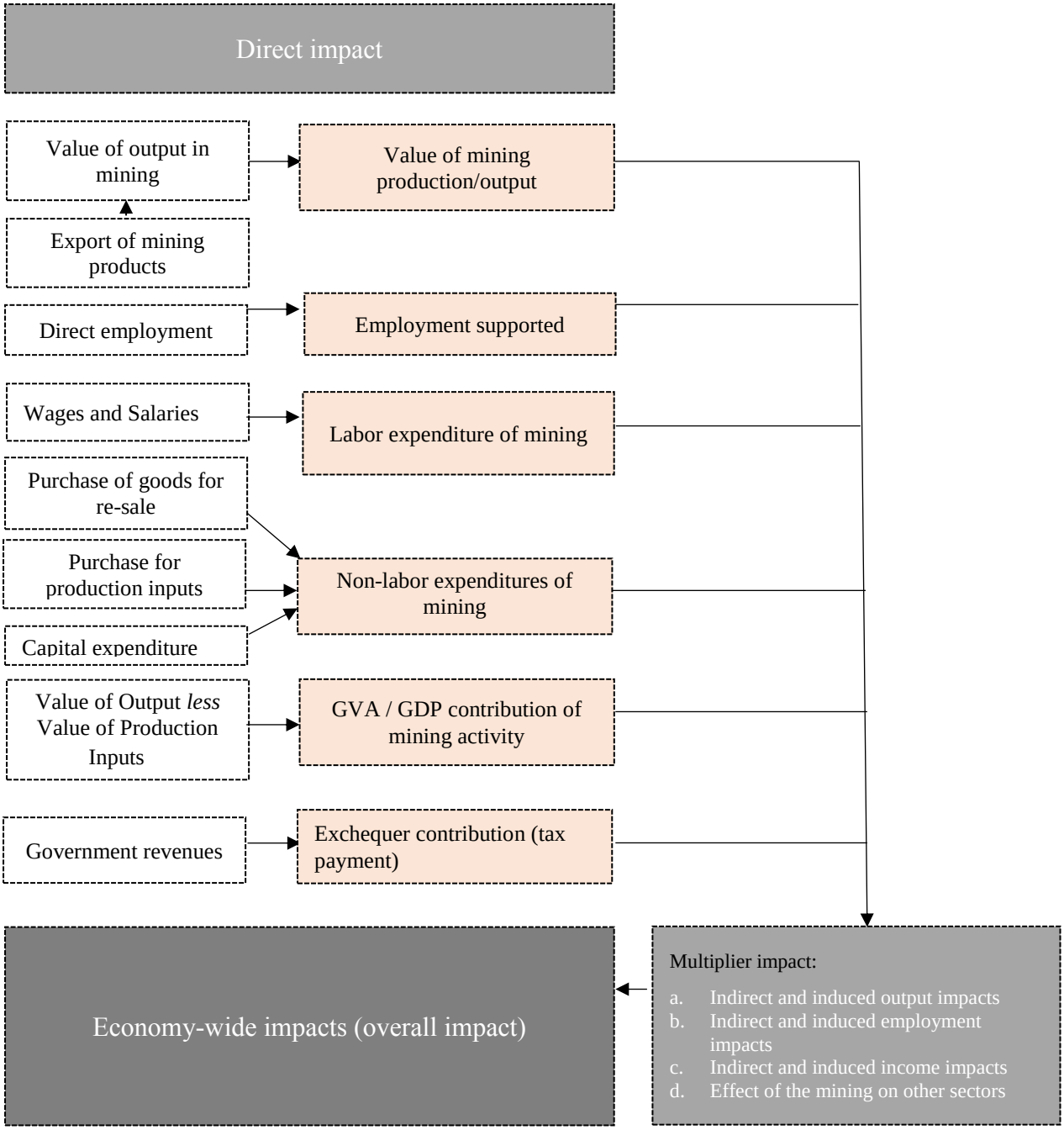
3. This chapter deals with an assessment of the impacts of the mining industry on the economy and finance in terms of measurement of natural resource revenues and estimation of related indicators. The handbook provides an overview of the scope of core indicators and estimation methods.

6.2. Conceptual Framework

4. Mining activities include exploration activity, mine development, mineral production, and mine remediation exploration. Industrial products include coal, copper, molybdenum, gold, zinc, silver, lead, concentrates and industrial minerals.

5. Before any analysis of the impacts of the mining activity on the national economy occur, consideration must be given to the linkages and channels through which the direct and indirect impacts take place and to the fact that how they are measured. The framework for measuring the contribution of these flows involves three types of group statistics, namely **production, expenditure and revenue.**

Figure 6.1: Component of the impact of the mining industry on economy and finance



Source: INDECON International Economic Consultants

6. As in the case of any assessment of economic impact at the industry level, it is important that caution is exercised in interpreting results. All economic activities will generate impacts. However, these activities give rise to associated opportunity costs of resource utilization. In the context of this paper, this means that if the mining industry did not exist, the reduction in economic activity would not equate with the impacts shown.

7. Figure 6.1 provides a description of the components of the direct and indirect impacts which are captured in this assessment. The key measurable outcomes of the direct and indirect impacts are as follows:

- Mining sales as a value of the mining production;
- Persons employed in the mining as a measure of employment;
- Mining expenditure;
- Gross value added of the mining output and its contribution to the economy's gross value added.
- Government revenues as a measure of the exchequer contribution of the industry.
- Impact of mining on external sector statistics

8. The mining industry provides jobs, pays wage and generates value added. Governments at national, provincial, and local levels collect taxes on these activities. The economic benefits resulting from the ***value added, income from goods and services, revenue, operational expenditure, employment, tax revenues*** of the mining industry are discussed in the following section. This section examines core indicators that measure the direct impact of the mining industry.

9. The economic contribution of the mining is larger than these direct effects. This is where the indirect contribution to the economy has an important role and needs estimating. For example, the mining operator purchases inputs from suppliers, and then re-sells the goods purchased from other companies to the supplier. As the result, the impact through or from mining may occur in other industries. This is discussed in further in section 6.4.

6.3. Core indicators that measure the direct impact of the mining industry

10. This section shows discussed internationally accepted standards for the most commonly used indicators. The core indicators are discussed in this chapter while, more detailed indicators, their description and estimation methods for measuring the economic impact can be found in Annex 1.

11. The analysis includes the following components of the indicators that measure the impact of the mining activities:

- Production/Output in the mining industry and extent of export sales,
- Direct employment of the mining industry, (note that this is discussed in Chapter 7, Impacts of Mining on Society).
- Gross Value Added/GDP contribution of the mining industry,

- Expenditures, including on wages and salaries, and on non-labour inputs and capital spending/investment; and
- Government revenue impacts, including tax payments and payments to local authorities, and receipts from prospecting license and mining facility holders through royalties, dead rent and license fees.

12. Determining the impacts of the mining industry on the whole economy requires internationally comparable indicators. These must be compiled within a suitable conceptual framework and should follow certain criteria. Finally, these indicators must be able to provide important and clear signals to policy makers and economic agents. Table 6.1 outlines the structure for the core indicators.

Table 6.1: Core indicators for the direct impact of the mining industry

Main indicator groups	Issues/indicators/derived indicators
Production/Output	**1. Measurement of impact of the mining industry on total output**
	1.1. Total output in the mining industry
	1.2. The share of output in the mining industry
	1.3. Export of the mining products
	1.4. Export as % of total sales in the mining industry
	1.5. Export in the mining industry as % of total export sales
Employment	**2. Measuring direct employment in the mining industry**
	2.1. Employed in the mining activities
	2.2. Employed in other support activities (estimated mining-related)
	2.3. The share of direct employment in the mining activities
	3. Measuring industry labour force in mining-related occupations
	3.1. Number of people which has been lied off from the mining-related occupations
	3.2. Unemployment rate resulting from the mining-related occupations
Gross Value added/ GDP	**4. Measurement of the mining impact on national income, including balance of payments incomes associated with mining and measures of real gross domestic income and real net national disposable income**
	4.1. Value of gross sales in the mining industry
	4.2. Gross value added of the mining industry, at current and constant prices
	4.3. The share of value added of the mining industry to the GDP
	4.4. GVA as % of turnover in the mining industry
	4.5. GVA per employee in the mining industry

Main indicator groups	Issues/indicators/derived indicators
	4.6. Annual change of value added of the mining industry
	4.7. Gross national income per capita
	4.8. Annual change of GNI per capita
	4.9. National disposable income
Expenditure	**5. Measuring direct expenditure in the mining industry**
	5.1. Total direct expenditure on wages & salaries in the mining industry
	5.2. The share of expenditure on wages and salaries in the mining industry
	6. Measurement of non-labour input in the mining industry, including energy inputs
	6.1. Intermediate consumption of the mining industry
	6.2. The share of expenditure on non-labour input in the mining industry
	7. Measurement of direct capital expenditure associated with mining industry
	7.1. Total direct capital expenditure in the mining industry
	7.2. The share of capital expenditure / investment in the mining industry
Government tax revenues	**8. Measurement total direct payment contributions of the mining industry**
	8.1. Total tax payments
	8.2. Total social contributions
	8.3. Total direct payment contribution
	8.4. The share of total direct payment of the mining industry to the general government revenue
	9. Measurement of state receipts from mining license/lease holders
	9.1. Property income
	9.2. Dividends
	9.3. Rent and royalties
	9.4. Sales of goods and services
	9.5. Fines, penalties and forfeits
	9.6. Transfers non elsewhere classified
	9.7. Premiums, fees and claims related to nonlife insurance and standardized guarantee schemes
	9.8. Total receipts
	9.9. The share of state receipts *of the mining industry to the general government revenue*

Estimation of the statistics that measure the direct impact of the mining industry on the economy shows the following:

6.3.1. In the mining industry and export sales

13. A starting point for the output of the mining industry can be measured by reference to the value of its sales.

14. **Total production in the mining industry:** The value of production corresponds to the sum of the values of all goods and services that are actually produced within an establishment during the reference period, and become available for use outside that establishment, plus any products produced for own final use. The value of production at basic prices is calculated as follows:

$$
\begin{aligned}
&Gross\ output \\
&\quad = Value\ of\ sales\ of\ goods\ or\ services\ produced\ by\ the\ establishment \\
&\quad + Value\ of\ sale\ of\ all\ goods\ and\ services\ purchased\ for\ resale \\
&\quad - Purchases\ of\ goods\ and\ services\ for\ resale\ in\ the\ same\ condition\ as\ received \\
&\quad + Receipts\ for\ industrial\ work\ done\ or\ industrial\ services\ rendered\ to\ others \\
&\quad + Other\ revenues\ + Value\ of\ own\ account\ fixed\ assets \\
&\quad + Change\ in\ work\ in\ progress\ + Change\ in\ inventories\ of\ finished\ goods \\
&\quad + Change\ in\ inventories\ of\ goods\ purchased\ for\ resale
\end{aligned}
$$

15. **The share of output in the mining industry:** The derived indicator is defined as total output in the mining industry related to total output in all economic activities in the country. Table 6.2 highlights the share of output of the Mongolian mining industry.

$$Share\ of\ output\ in\ the\ mining\ industry\ = \frac{Output\ in\ the\ mining\ industry}{Output\ in\ all\ economic\ activities} * 100$$

Table 6.2: The share of output in the mining industry in Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Output in the mining industry	4 120.1	5 686.3
Output in the all economic activities	17 919.9	24 105.3
The share of output in the mining industry	***22.3***	***23.6***

16. **Export of the mining products:** Total exports include a country's direct exports of goods and re-export of foreign goods. The majority of sales earned in the mining industry for most countries are from export sales.

17. **Export as % of total sales in the mining industry:** The share of export in the mining industry is defined as export in the mining industry related to total sales in the mining industry in the country.

$$Export\ \ as\ \%\ of\ total\ sales\ in\ the\ mining\ industry\ = \frac{Export\ of\ the\ mining\ industry}{Sales\ \ of\ the\ mining\ industry} * 100$$

18. **Export the mining industry as % of total export:** The derived indicator is defined as exports of the mining industry related to total export for all economic activities in the country.

$$Export\ as\ \%\ of\ total\ export\ for\ all\ activities = \frac{Exports\ of\ the\ mining\ industry}{Total\ exports\ of\ all\ economic\ activities} * 100$$

Table 6.3: Export shares of the mining industry in Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Export in the mining industry	3 148.0	5 065.0
Export as % of total sales in the mining industry	***76.4***	***89.1***
Export all economic activities	4 554.3	6 923.3
Export as % of total Export	***69.1***	***73.2***

19. Table 6.3 presents the two export indicators. In 2011, a total of 5065.0 bln.tog, or 89.1% of sales revenue, was generated from exports, an increase from 76.4% in 2010. The share of exports of the mining industry to the total exports in the country Mongolia accounted for 69.1 % in 2010, increasing to 73.2 percent in 2011.

6.3.2 Employment

20. Measures of employment in the mining industry are alternative indicators of the industry's performance and contribution to the economy.

21. The share of employment may be relatively low, however mining activity create mining-related employment in other industries such as manufacturing and services. However, this is difficult to measure with any precision.

22. **Employment in the mining industry:** Employees in the mining industry are all those workers who hold the type of job defined as "paid employment jobs". Employment in other support activities can cover a wide range of industries from professional services to manufacturing activity. To do this accurately, care needs to be taken in survey design and also of the classification used to capture the activity. In a household survey, respondents may not be able to provide an accurate answer for their industry category.

23. **The share of direct employment in the mining industry:** The derived indicator is defined as total persons engaged in the mining industry related to total employment in all economic activities in the country.

$$Share\ of\ direct\ employment\ in\ the\ mining\ industry = \frac{Total\ persons\ engaged\ in\ the\ mining\ industry}{Total\ employment\ in\ all\ economic\ activities} * 100$$

Where: $Total\ persons\ engaged = Employed\ in\ the\ mining\ activities + Employed\ in\ other\ support\ activities$

24. Table 6.4 shows that, in 2010, the number of paid workers in the mining industry accounted for 3.3% of all employment in the country, with the share increasing to 4.3% in 2011.

Table 6.4: Direct employment supported in mining in Mongolia, thous. persons

Indicators/derived indicators	2010	2011
Employed in the mining activities	-	-
Employed in other support activities	-	-
Total persons engaged	34.1	45.1
Total employment	1 033.7	1 037.7
Direct employment as % of total employment	***3.3***	***4.3***

25. **Number of people that have been laid off from the mining industry:** Persons who had mining related jobs that were temporarily absent from their jobs with no formal job attachment and were currently available for work and seeking work. They should also be regarded as unemployed in accordance with the standard definition of unemployment. This means that a person has been laid off and is looking for another job.

6.3.3 Gross value added (GVA)

26. **Gross value added of the mining industry:** Gross value added (GVA) is defined as the value of production less the value of intermediate consumption. It is equivalent to Gross Domestic Product (GDP), which measures the extent of value

added across the economy as a whole. GVA is therefore the best measure of the contribution of an industry to the economy.

27. **The share of value added of the mining industry to the GDP:** The derived indicator is defined as GVA in the mining industry related to GDP.

$$Share\ of\ GVA\ of\ mining\ industry\ to\ the\ GDP\ = \frac{GVA\ in\ the\ mining\ industry}{GDP} * 100$$

28. As GDP includes tax less subsidies on products, there may be a small distortion for the proportion unless these taxes and subsidies could be correctly attributed to the industry. If this was not the case, a more consistent measure would be to use economy-wide GVA instead of GDP.

29. **GVA as % of output in the mining:** GVA as a share of output in the mining is gross value added of the mining industry divided by output in mining.

$$Share\ of\ GVA\ of\ mining\ to\ the\ output\ of\ mining = \frac{GVA\ of\ the\ mining\ industry}{Output\ of\ the\ mining\ industry} * 100$$

30. **GVA per employee in = mining:** GVA per employee in the mining is gross value added of the mining industry divided by employee in the mining.

$$GVA\ per\ employee\ of\ mining = \frac{GVA\ of\ the\ mining\ industry}{Total\ persons\ engaged\ in\ the\ mining\ industry}$$

31. **Gross National Income per capita:** Per capita growth rates in real national income or in real actual consumption generally provide a better measure of the changes in the average "welfare" of a country than changes in GDP volumes. GDP is a measure of production within a country but the inflows or outflows of income from the rest of the world can have a significant effect on both the level and growth rates in real national income per capita. GNI per capita is gross national income divided by mid-year population.

$$GNI\ per\ capita = \frac{GNI}{mid\ year\ population}$$

32. **National disposable income:** Primary incomes receivable by resident institutional units may be used in part to make transfers to non-resident units and resident units may receive transfers originating out of primary incomes from the rest of the world. Gross national disposable income measures the income available to the economy for final consumption and gross saving. By deducting the consumption of

fixed capital from gross national disposal income, net national disposable income is obtained. National disposable income is the sum of disposable income of all resident institutional units or sectors.

33. In Table 6.5 are the Mongolia estimates of GVA of the mining industry, utilizing data provided in SUT and IOT. We estimate that mining activity resulted in a significant GVA contribution of 19.3 percent during 2012.

Table 6.5 Gross value added of the mining to the country economy in Mongolia

Indicators/derived indicators	2010	2011
Value of gross sales turnover in mining, bln.tog	4 120.1	5 686.3
Gross value added in mining, at current prices, bln.tog	2 102.2	2 536.2
Gross value added in mining, at constant prices, bln.tog	736.9	791.0
GDP, at current prices, bln.tog	9 756.6	13 173.8
Employed in the mining activities, thous.persons	34.1	45.1
The share of value added of the mining industry in the GDP	***21.6***	***19.3***
GVA as % of output in mining	***51.0***	***44.6***
GNI per capita, thous.tog	***3266.1***	***3774.3***
GVA per employee, mln.tog	***64.6***	***56.2***
Annual change of gross value added of the mining industry , bln.tog	***-***	***434.0***

6.3.4. Expenditure

34. The overall economic impact of the mining activities will be a function of the level of expenditures by the mining industry on purchased goods and services to be used as inputs. This includes impacts via spending on wages and salaries of persons employed and expenditures on non-labour business inputs and capital investment.

35. **Total direct expenditure on wages and salaries in the mining industry:** This indicator aims to measure the level of compensation in the mining industry. Wages and salaries are an important component of value added in an economy. This should also include social contributions of employers.

36. **The share of expenditure on wages and salaries in the mining industry:** This derived indicator is defined as expenditure on wages and salaries in the mining industry related to expenditure on wages and salaries in all economic activities in the country.

$$Share\ of\ expenditure\ on\ wages\ and\ salaries\ in\ the\ mining\ industry = \frac{Expenditure\ on\ wages\ and\ salaries\ in\ the\ mining\ industry}{Expenditure\ on\ wages\ and\ salaries\ in\ all\ economic\ activities} * 100$$

37. Table 6.6 shows a total of 591.3 bln.tog was spent on wages and salaries by mining activities during 2011 compared to the 260.1 bln.tog were spent in 2010. In 2010, the share of expenditure on wages and salaries in the mining industry was 11.8% and almost 18.8% in 2011.

Table 6.6: Total direct expenditure on wages and salaries in mining in Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Expenditure on wages and salaries in mining	260.1	591.3
Expenditure on wages and salaries in the all economic activities	2 199.2	3 150.1
The share of expenditure on wages and salaries in the mining industry	***11.8***	***18.8***

38. **Intermediate consumption of the mining industry:** When considering the overall economic impact of the mining industry on the domestic economy a main component is the purchase of goods and services to be used as inputs to products These inputs include production materials, treatment and refining charges, professional and technical services, including education and training, total cost of electricity purchased, and water services.

39. **The share of expenditure on non-labour input in the mining industry:** This derived indicator is defined as expenditure on non-labour input in the mining industry expenditure on non-labour input to the totally economy.

$$Share\ of\ expenditure\ on\ non-labour\ input\ in\ the\ mining\ industry = \frac{Expenditure\ on\ non-labour\ input\ in\ the\ mining\ industry}{Expenditure\ on\ non-labour\ input\ for\ the\ total\ eonomy} * 100$$

Table 6.7: Total expenditure on non-labour input in mining for Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Expenditure on non-labour input in mining	1 896.8	2 899.1
Expenditure on non-labour input in the all economic activities	8 775.0	11 880.6
The share of expenditure on non-labour input in the mining industry	***21.6***	***24.4***

40. **Capital expenditure in the mining industry:** Capital expenditure include the purchase of lands and mining rights, expenditures on all buildings other infrastructure, machinery and equipment and construction of the mine itself such as mine shafts and underground work During the construction phase of a mine, companies are highly labour intensive. However, once the mine is in operation, the total number of workers required reduces.

41. **The share of capital expenditure in the mining industry to the total economy:** The derived indicator is defined as capital expenditure in the mining industry related to capital expenditure across all economic activity in the country.

$$Share\ of\ capital\ expenditure\ in\ the\ mining\ industry = \frac{Capital\ expenditure\ in\ the\ mining\ industry}{Capital\ expenditure\ in\ all\ economic\ activities} * 100$$

Table 6.8: Total capital expenditure in mining for Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Capital expenditure in mining	895.4	899.4
Capital expenditure in the all economic activities	3 881.8	7 106.0
The share of capital expenditure in the mining industry	***23.1***	***12.7***

42. The total amount spent by the main operating mines in Mongolia on capital goods in 2010 and 2011 is shown in Table 6.8

43. **The share of total expenditure of the mining industry:** The share of total expenditure in the mining industry is defined as total expenditure of the mining

industry as a proportion of total expenditure across all economic activity in the country.

$$Share\ of\ total\ expenditure\ in\ the\ mining\ industry = \frac{(E\ on\ W\&S + E\ on\ non\ labour\ input + E\ Capital)\ in\ the\ mining\ industry}{(E\ on\ W\&S + E\ on\ non\ labour\ input + E\ Capital)\ in\ all\ economic\ activities} * 100$$

44. Table 6.9 combines all the expenditure components profiled above for the mining industry. Total mining expenditure of 3052.3 bln.tog increasing to 4389.8 bln.tog in 2012.

Table 6.9 Total capital expenditure in mining, bln.tog

Indicators/derived indicators	2010	2011
Expenditure on wages and salaries in mining	260.1	591.3
Expenditure on non-labour input in mining	1 896.8	2 899.1
Capital expenditure in mining	895.4	899.4
Total expenditure in mining	3 052.3	4 389.8
Total expenditure in the all economic activities	14 856.0	22 136.7
The share of capital expenditure in the mining industry	***20.5***	***19.8***

6.3.5. Government Revenue

45. Government revenues from natural resources are the payments governments receive from enterprises.

46. In addition to its impact through expenditure, GVA and direct employment, the mining industry also contributes in the form of various payments to the Governments.

47. A template has been developed by the IMF to capture all possible government revenues from natural resources this will enable data to be gathered these data in a systematic manner, and to present in an analytically useful way, and ensure it is comparable across countries. In practice, for many countries it is likely that data for only a subset of these revenues will be collected.

48. Tax Revenue listed in table 6.10 cover the main taxes that would be payable by natural resource enterprises. These taxes are a subset of the main GFSM 2014 category Taxes (11). More specifically, taxes on income, profits and capital gains payable by corporations and other enterprises (1112), dividends (1412), and rent (1415) are the

principal revenue categories associated with revenues from natural resources. A short description of each subcategory is provided in **Annex2**, while a more detailed description of the revenue categories can be found in chapter 5 of the GFSM 2014.

Table 6.10: Template—Government Revenues from Natural Resources

***GFSM* Codes**	**Description***
11	**Taxes**
1112	Taxes on income, profits, and capital gains (payable by corporations and other enterprises)
	Taxes on income payable by natural resource enterprises
	Taxes on extraordinary profits payable by natural resource enterprises
112	Taxes on payroll and workforce
	Taxes on payroll and workforce payable by natural resource enterprises
113	Taxes on property
	Taxes on property payable by natural resource enterprises
114	Taxes on goods and services
1141	General taxes on goods and services (value added tax, sales tax, turnover tax)
	Value added taxes payable by natural resource enterprises
	Unrequited value added taxes payable by natural resource enterprises
1142	Excises
	Excise taxes payable by natural resource enterprises
1143	Profits of fiscal monopolies
	Profits of natural resource fiscal monopolies
1145	Taxes on use of goods and on permission to use goods or perform services
11452	Other taxes on use of goods and on permission to use goods or perform activities
	Business and professional licenses payable by natural resource enterprises
	Pollution taxes payable by natural resource enterprises
1146	Other taxes on goods and services
	Other taxes on goods and services payable by natural resource enterprises
115	Taxes on international trade and transactions
1151	Customs and other import duties (import taxes)
	Taxes on imports payable by natural resource enterprises
1152	Taxes on exports
	Taxes on exports of natural resources
1153	Profits of export or import monopolies
	Profits of natural resource export monopolies
116	Other taxes
1161	Other taxes payable solely by business
	Other taxes payable by natural resource enterprises
12	**Social contributions**
121	Social security contributions
1211	Social security employee contributions
	Employee contributions from natural resource enterprises
1212	Social security employer contributions
	Employer contributions from natural resource enterprises
122	Other social contributions
13	**Grants (not applicable)**
14	**Other revenue**
141	**Property income**
1412	Dividends
	Dividends from government owned natural resource enterprises

GFSM Codes	Description*
	Dividends from government participation in natural resource enterprises (equity)
1415	Rent
	Royalties payable by natural resource enterprises
	Bonuses payable by natural resource enterprises
142	*Production entitlements payable by natural resource enterprises*
	Compulsory social infrastructure payable by natural resource enterprises
	Other rent
	Sales of goods and services
1422	Administrative fees
143	*Administrative fees for government services supplied to natural resource enterprises*
	Fines, penalties, and forfeits
144	*Transfers not elsewhere classified*
145	*Voluntary social infrastructure payments payable by natural resource enterprises*
	Premiums, fees, and claims related to nonlife insurance and standardized guarantee schemes

* Terms in italics refer to categories exclusively associated with government revenues from natural resources. Source: *Government Finance Statistics Manual 2014*.

49. **The share of total direct payment of the mining industry in government revenue:** The share of total direct payment in the mining industry is defined as total direct payment the mining industry related to the government revenue.

$$Share\ of\ total\ direct\ payment\ of\ mining\ industry\ to\ the\ general\ government\ revenue = \frac{Total\ direct\ payment\ in\ the\ mining\ industry}{General\ government\ revenue} * 100$$

50. Table 6.11 shows the total combined direct exchequer contribution of mining for 2010 and 2011. It is estimated that the mining industry contributed a total of 1570.4 bln.tog or 35.1% to government revenue in tax and local authority payments during 2011.

Table 6.11: Total direct exchequer contribution of mining for Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Total tax payment	929.5	1 506.4
Social contribution	44.5	64.0
Total Direct Payment Contributions	974.0	1 570.4
General government revenue	3 122.5	4 468.2
The share of total direct payment in the mining industry	***31.2***	***35.1***

51. **The share of state receipts of the mining industry to the general government revenue:** The share of state receipts in the mining industry is defined as total receipts of the mining industry as a proportion of total government revenue.

$$Share\ of\ state\ receipts\ of\ mining\ industry\ to\ the\ general\ government\ revenue = \frac{Total\ receipts\ in\ the\ mining\ industry}{General\ government\ revenue} * 100$$

52. Table 6.12 integrates the above elements to identify the overall level of receipts from royalties, license fees and other payments by mining and prospecting license holders. A total of 250.1 bln.tog was paid to the Mongolian government during 2011.

Table 6.12: State receipts from mining industry for Mongolia, bln.tog

Indicators/derived indicators	2010	2011
Property income	99.3	158.4
Dividends	41.0	80.1
Rent and royalties	58.3	78.4
Sales of goods and services	5.9	6.7
Fines, penalties, and forfeits	30.6	53.0
Transfers not elsewhere classified		
Premiums, fees, and claims related to nonlife insurance and standardized guarantee schemes	15.1	31.9
Total Mining Receipts	150.9	250.1
The share of total receipts in the mining industry	***4.8***	***5.6***

6.4. Implications on External Sector Statistics

53. Mining is often related to foreign investment and usually implies ownership of land and other natural resources, and rights to use these assets through a lease or other permit over long periods. These activities are usually associated with a branch or quasi-corporation. The effect of the identification of branches, notional resident units for ownership of land and natural resources, and other quasi-corporations for preparatory operations prior to incorporation is that non-resident owners are shown as having a claim on the resident institutional unit, rather than as directly owning the various individual assets. Owners' claims on quasi-corporations that are resident in other economies are usually classified as direct investment. [7] Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an

[7] In the rare cases in which the proportion of equity in land or a joint venture is less than 10 percent, the claim is classified as other investment—other equity.

enterprise that is resident in another economy.[8]

54. Production sharing arrangements (PSA) may also take place in the mining industry. They are arrangements between a government (acting on behalf of the state as the owner of the mineral resources) and investors that govern exploration and production rights, and they usually imply a direct investment relationship between a resident operating company and its foreign owner(s).

55. In addition to the implications in direct investment, mining could affect other international accounts. Foreign investment in the mining industry can be in the form of portfolio investment when in debt or equity securities[9] or other investment, generating in turn investment income flows. Also, mining companies may have significant exports of goods and could seek external financing, engage in financial derivative transactions and invest their proceeds abroad.

56. Other cross-border transactions can also arise beyond the financial account in the current account, primary and secondary income accounts, and capital account, such as: international transport and other services, including manufacturing services on physical inputs own by others[10;] compensation of employees when resident mining companies hire workers that are non-resident; personal transfers and remittances when resident workers are long term migrants and send funds back to their countries of origin; rent on resource leases when the lessee is non-resident; acquisitions and disposals of non-produced, nonfinancial assets when sales of rights to use natural resources to non-residents, etc.

57. Below are details on some of these items that may require special attention by external sector statistics compilers.

Foreign Direct Investment in the mining industry

6.4.1. Treatment of quasi-corporations identified prior to incorporation and preparatory expenses

58. When a non-resident investor incurs in preparatory expenses, a resident quasi-corporation is identified prior to incorporation. Preliminary expenses including mining rights, license fees, site preparation, building permits, purchase taxes, local office expenses, and lawyers' fees, are incurred prior to establishing a legal entity. As a result of identifying a quasi-corporation, those preparatory expenses are recorded in the economy of the future operations as being resident-to-resident transactions

[8] Influence is achieved thought the ownership of equity that entitles voting power of 10 percent or more in the enterprise.
[9] Provided this investment does not give control or a significant degree of influence on the management and is not classified as reserves.
[10] For details on manufacturing services on physical inputs own by others see *BPM6* paragraphs 10.41 to 10.49.

that are funded by a direct investment inflow, rather than as sale of non-produced assets to non-residents, exports of legal services, and so on [11] (see Balance of Payments and International Investment Position Manual, Sixth Edition (*BPM6*), paragraph 4.47).

6.4.2. Treatment if the project is not successful and does not go into operation

59. If the project does not subsequently go into operation, withdrawals of funds resulting from the sale or disposal of the quasi-corporation's assets (e.g., the sale of inventories, fixed assets, or land or other natural resources) are recorded as a withdrawal from the equity (see *BPM6*, paragraph 11.26). Any remaining value of the direct investment is eliminated by an entry for other changes in the volume of assets or liabilities. This is, if exploration of natural resources proves unsuccessful (e.g., dry oil wells) and results in the shutdown of the quasi-corporation, a negative adjustment for the remaining value of the company should be recorded as a write-off by the two economies involved (see *BPM6*, paragraph 4.47).

6.4.3. Treatment of notional resident units for the ownership of natural resources

60. When land and other natural resources located in a territory are owned by a non-resident entity, a notional resident unit is identified for statistical purposes as being the owner of the land. A notional unit is also identified for a lease of land by a non-resident for long periods. This notional resident unit is a kind of quasi-corporation. The non-resident is treated as owning the notional resident unit (becoming a direct investor), rather than owning the land directly. This treatment is designed so that land and other natural resources are always owned by residents and therefore assets of the economy in whose territory they are located. Otherwise, the land would appear in another economy's national balance sheet. (see BPM6, paragraphs 4.34)

61. The operations of notional resident units include holding the asset, paying any associated expenses (such as insurance, repairs, and taxes), collecting rent for putting the natural resources at the disposal of another institutional unit, and any other transactions associated with those functions. If the nonresident owner uses the property, the notional resident unit generates rent in kind to its owner. The corresponding entry to the rent would be income payable in kind to the owner by the notional resident unit (direct investment income). The notional resident unit should also be treated as incurring expenses and taxes; payments by the nonresident

[11] Because of the limited scale of these activities, assembly of acceptable data for these enterprises is often feasible, despite the lack of incorporation.

owner to meet a loss arising from these costs therefore would be recorded as direct investment flows from the owner to the notional resident unit. Other transactions of the owner would not be attributed to the notional resident unit, for example, any borrowing or debt service [12](see *BPM6*, paragraph 4.36).

6.4.4. Identification of branches

62. Whereas quasi-corporations and notional resident units are identified, it is usually the case that ownership of land and other natural resources such as subsoil assets, and rights to use these assets through a lease or other permit over long periods are associated with a branch. A branch is usually identified when the ownership of land and other natural resources is associated with substantial operations. In such cases, a notional resident unit is not identified because the branch already exists as a resident owner (see BPM6, paragraph 4.37).

63. A branch is recognized when either a complete set of accounts, including a balance sheet, exists for the branch, or it is possible and meaningful, from both an economic and legal viewpoint, to compile these accounts if they were to be required[13,] and in addition, one or both of the following factors tend to be present for a branch: the branch undertakes or intends to undertake production on a significant scale that is based in a territory other than that of its head office for one year or more; and the branch is recognized as being subject to the income tax system, if any, of the economy in which it is located even if it may have a tax exempt status (see BPM6, paragraph 4.27). An example is a non-resident mining operator having a 10-year mining license for the natural resources of a territory. If the operator has a base in the territory, keeps separate records, and so on, then a resident branch is identified, and its accounts will show sales of minerals and other transactions.

6.4.5. Production sharing agreements

64. Occasionally there are production sharing arrangements (PSA) that govern exploration and production rights. PSAs are arrangements between a government (acting on behalf of the state as the owner of the mineral resources) and investors. These contracts are intended to provide a predictable legal and tax regime and are internationally recognized in law. While PSA models vary across economies, they usually include the following elements: (a) the investor or operator pays royalties to the government; (b) the investors receive production revenues to cover expenses; (c)

[12] As a result of the limited nature of notional resident units, making acceptable estimates for their operations is generally feasible when they are significant.
[13] The availability of separate records indicates that an actual unit exists and makes it practical to prepare statistics.

"profit production" is split between the government, the operator, and investors on the basis of a negotiated formula that takes into account the characteristics of the project; and (d) the operator and/or investors pay taxes on their portion of profits on production.

65. In some economies, the principal parties to the contract have limited statistical reporting obligations which may pose challenges for compilation. Implementation of the arrangements may be overseen by a government agency that manages the government's interests in the PSAs; but it, for statistical purposes, may not be the operating company. Further, in some economies, PSA information is confidential.

66. As a starting point, for determining the nature of cross border transactions and positions, the compiler should first identify the operating company, and then establish the existence of a direct investment relationship between the operating company and its foreign owner(s). In the case where the contracting parties to a PSA comprise a single foreign investor and the government, the former is the direct investor. However, when there are a number of foreign investors (as part of a consortium), determining the nature of the investment relationships is likely to be a challenge in the absence of full disclosure on the terms and conditions of PSAs.

67. Regarding the flows between the direct investor and the direct investment enterprise, identifying how the production sharing agreement is organized is a starting point for identifying potential transactions. Resident parties to the contract are the government, or agency acting on its behalf. They would obtain their share of the mineral revenue (or share of production), representing both their cost recovery and income on their investments. Royalties may also be paid to the government. These are resident-resident transactions. The non-resident direct investor would receive payments that represent a recovery of its capital investment (this would reduce direct investment liabilities in the reporting economy), and direct investment income, sometimes termed "cost oil" and "profit oil" respectively in PSAs.[14]

Implication on other items in international accounts.

6.4.6. Exports/imports of mining goods

68. The recording of export/import transactions of mining goods may pose compilation challenges when the price is not known at the time of the change in ownership. The contracts may establish a quotation period often months after the goods have changed hands. In such cases, market value at the time of change of ownership should be estimated. Market prices of the same or similar items when

[14] For more complex scenarios, see *BPM6 Compilation Guide*, Box 10.1

such prices exist will provide a good basis for estimation. Generally, market prices should be taken from the markets in which the same or similar goods are traded currently in sufficient numbers and in similar circumstances. If there is no appropriate market in which a particular good is currently traded, the valuation may be derived from the market prices of similar goods by making adjustments for quality and other differences. These estimates should be revised with the actual market value, when known. Market value is given by the contract price regardless of whether it is unknown at the time of change of ownership (see BPM6, paragraphs 3.71, 3.73).

69. In addition, in some cases actual exchange values may not represent market prices. Examples are transactions involving transfer pricing between affiliated enterprises. Transfer pricing may be motivated by income distribution or equity build ups or withdrawals. Replacing transfer prices with market-equivalent values is desirable, in principle, when the distortions are large and when availability of data (such as adjustments by customs or tax officials or from partner economies) makes it feasible to do so. Selection of the best market equivalent values to replace book values is an exercise calling for cautious and informed judgment. Compilers in each of the economies involved are encouraged to cooperate and exchange information in order to avoid asymmetrical recordings of bilateral data. In addition to the adjustment to the flow itself, there should be a corresponding offsetting entry (for example, if a direct investor is under-invoiced on goods provided by the direct investment enterprise, then the transfer pricing acts as a hidden dividend, so dividends should be increased by the difference between the market value of the goods and the prices actually charged; and if a direct investor is over-invoiced on goods provided by the direct investment enterprise, then the transfer pricing acts as a hidden investment, so direct investment equity flows should be increased by the difference between the market value of the goods and the prices actually charged) (see BPM6 paragraphs 3.76 and 11.101).

6.4.7. Foreign workers hired by mining companies

70. Mining companies may hire foreign workers, and foreign workers may incur in expenses in the local economy and may send the proceeds of their work to their countries of origin. The determination of the residency of the foreign workers is essential to properly capture the related cross-border transactions. Residence criteria for the workers is based on their principal dwelling rather than the territory of employment; being present for one year or more in a territory or intending to do so is sufficient to qualify as having a principal dwelling there (see BPM6, paragraph 4.117).

71. When foreign workers remain being residents of their home countries (present in the host country for less than one year), a cross border transaction between the non-resident employee and the resident employer arises. The total remuneration in cash or in kind as well as employer's social contributions is to be recorded in compensation of employees (primary income account);[15] social contributions made by the non-resident employee and the employer on behalf of the employee, and any taxes on income paid are to be recorded in other current transfers (secondary income account); and any expenses of the non-resident worker in the host country such as accommodation and local transport, are to be recorded in travel (services, current account) (see *BPM6* paragraphs 11.10, 11.17, 11.23). On the contrary, transfers of funds to their country of origin would not be regarded as current transfers, because they would not be cross-border transactions (non-resident-to-non-resident).

72. When foreign workers become residents of the host country (present for one year or more) their transactions in the host country are resident-to-resident transactions. Any transfer of funds to persons residing in their countries of origin would be a cross-border transaction, included as current transfers in the secondary income account. In some economies, current transfers made by employees to residents of another economy -worker's remittances- may be very significant.

6.4.8. Natural resource leases and associated rent

73. Cross-border transactions may also arise as a consequence of a resource lease. Resource lease is an agreement whereby the legal owner of a natural resource that has an infinite life makes it available to a lessee in return for a regular payment, which is recorded as rent. The resource continues to be recorded on the balance sheet of the lessor even though it is used by the lessee. Examples of rent include amounts payable for the use of land extracting mineral deposits and other subsoil assets. Usually, the entity using land or natural resources is a resident institutional unit. However, if the user is a non-resident then a cross-border transaction on rent arises (to be recorded in the primary income account, other primary income) (see *BPM6*, paragraph 5.60).

6.4.9. International transactions in land and natural resources (outright ownership) and contract, leases, or licenses: treatment in capital account.

74. International transactions in land and other natural resources do not usually arise because notional resident units are generally identified as the owners of these

[15] If an employer-employee relationship does not exist, the payment is not compensation of employees, it constitutes a purchase of services.

immovable assets. As a result, purchases and sales of these assets when there is outright ownership are generally resident-to-resident transactions.[16] In contrast to a change of ownership of the resource, the right to use a natural resource on a temporary basis is classified as a contract, lease, or license, if it amounts to an economic asset in its own right. Examples include purchases and sales of permissions to use natural resources that are not recorded as outright ownership of those resources. Transactions in these assets are recorded in the capital account as acquisitions and disposals of non-produced, nonfinancial assets, but holdings of these assets are not recorded in the international investment position because there is no counterpart liability (see *BPM6*, paragraphs 13.10 and 13.11).

6.5. Economy-Wide Impacts

75. This section examines the wider impacts of the direct activities measured in Section 6.3. These wider impacts take into account the indirect and induced, to estimate the overall impact of mining activity on the economy

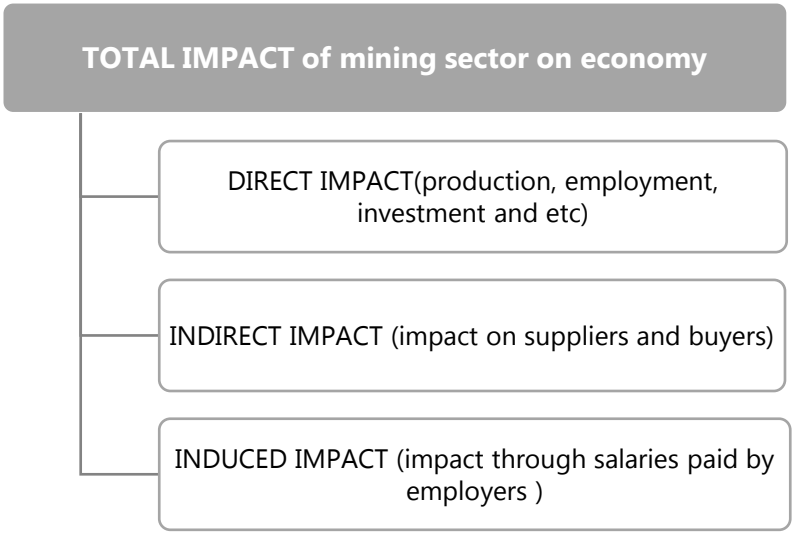
Direct impact– refers to the supply of primary mining products available in an economy.

Indirect impact– refers to the products from suppliers who provide inputs to the manufacturers of the mining products, and from the producers, using these manufactured product output, in an economy.

Induced impact – refers to the supply, secured by an increase in the income level of household enterprises, which is generated as a result of the direct and indirect impact.

[16] International transactions in land arise when there are acquisitions and disposals of land for enclaves of international organizations and foreign governments.

Figure 6.2: Categories of impacts on the economy



What are the options for economic modeling?

76. Economic models can be used to forecast variety impacts. The available models represent a continuum of sophistication and cost, so it is prudent to match the economic model to the problem.

77. Economic impact analysis using inter-industry models provides a method to evaluate the effects of a project or proposed policy change. Various possible methodologies could be used to estimate the indirect and induced impacts. Each methodology has its strengths and weaknesses, but all are potentially limited by the availability and quality of economic data related to the supply of, and demand for mining products.

Input-Output modelling (I-O).

78. Economic impact modelling in this section uses information in what are called Input-Output tables to predict how an increase in demand for the products of one industry will impact on other industries and therefore on the country's economy. The Input-Output accounts reflect the underlying industrial structure of the entire country economy. However, I-O models have significant limitations because they do not cover dynamic impacts over time.

79. The Input-Output approach was applied in arriving at the economy-wide impacts, which forms the basis for derivation of the national accounts for the economy in line with internationally agreed principles. The fundamental principle behind economic impact analysis in some goods and services generates a need for additional goods and services and by using this approach it is possible to track this cascading effect through the economy. Specifically, this section utilizes the supply and use and input-output

tables for the economy. The analysis is conducted through the development of multipliers for interested indicators that can be derived from these tables.

80. The main economic concept of demand impact analysis to be made by input-output modeling is to determine if demand elements in balance change exogenously, and what will be the impact on the economy. When the Leontief reverse matrix is multiplied by the final demand vector, the total production vector is the result. Therefore, in practice, it is called input-output multiplier analysis. A demand multiplier is considered in total production in the standard input-output modeling. There are 3 main forms for common multiplier:

- Output multiplier,
- Income multiplier,
- Labor multiplier.

81. Each method has strengths and weaknesses; however, they depend on the quality of, and access to, the source data.

82. **Multiplier:** A factor to be used in estimating the wider economic impacts of industry and economic activities. A multiplier considers the indirect and induced impacts caused by the industry. Indirect impacts relate to the additional economic activity supported in sub-supply of input to the industry. As these indirect impacts support employment and associated incomes, the re-spending of these incomes elsewhere in the economy gives rise to induced impacts, thereby supporting additional activity and employment. Multipliers are calculated using detailed industry data of input-output analysis of the relationships between economic industries.

83. There are 2 methods of multipliers to assess the economic impact:

- Type I multiplier,
- Type II multiplier.

84. A type I multiplier calculates the economy-wide impact to be expressed by the **sum of direct and indirect impacts.** It is expressed by the activity changes, which can occur in other industries when the demand of direct impact industry increases.

85. Type II multiplier is the expanded form of type I multiplier. It includes **direct, indirect and induced impacts.** Induced impacts are generated from the additional consumption, related to the additional employment income results from indirect impact. In other words, type II multiplier includes households, related to the input-output table.

86. Following multipliers will be applied to the analysis:

- **Output multipliers:** They are employed to measure the production of all industry, required for the demand of MNT 1 in an industry, and the intermediate expenses, to be provided by households.
- **Income multipliers:** They show how a change in the consumption costs impacts the income of the household enterprises and the labour supply. They describe how a change in the labour costs per gross production of an industry impacts on the household income.
- **Employment multipliers:** They explain how a change in the gross production impacts on the volume of labour supply.

87. The core indicators are structured as follows in table 6.13:

Table 6.13: Core indicators for the economy-wide impacts of the mining industry

Main indicator groups	Issues/derived indicators
Output	**1. Measurement of indirect and induced output impact**
	1.1. Industry output multiplier
	1.2. Indirect output impact
	1.3. Induced output impact
	1.4. Overall output impact
	1.5. The share of overall output in mining-related industry
Employment	**2. Measurement of indirect and induced employment impact**
	2.1. Industry employment multiplier
	2.2. Indirect employment impact
	2.3. Induced employment impact
	2.4. Overall employment impact
	2.5. The share of overall employment in mining-related industry
Income	**3. Measurement of indirect and induced income impact**
	3.1. Industry income multiplier
	3.2. Indirect income Impact
	3.3. Induced income Impact
	3.4. Overall income Impact
	3.5. The share of overall income in mining-related industry

88. Estimation of the statistics that measure the economy-wide impact of the mining industry shows the following:

Output impacts: The economic impact from mining expenditure can be shown in the following modeling.

$$Indirect\ output\ impact\ (C)_t = (A_t * B_t) - A_t$$

$$Induced\ output\ impact\ (E)_t = (A_t * D_t) - C_t - A_t$$

A_t: $Total\ expenditures\ in\ mining\ at\ t\ period$
B_t: $Sector\ output\ multiplier - Type\ I$
D_t: $Sector\ output\ multiplier - Type\ II$

$$\boldsymbol{Overall\ output\ impact_t} = \boldsymbol{Total\ expenditures\ in\ mining}(\boldsymbol{A_t}) + \boldsymbol{Indirect\ output\ impact}\ (\boldsymbol{C})_t + \boldsymbol{Induced\ output\ impact}\ (\boldsymbol{E})_t$$

89. **The share of overall output in the mining industry:** The share of overall output in the mining industry is defined as overall output in the mining activities related to total output in all economic activities in the country.

$$Share\ of\ overall\ output\ in\ the\ miningactivities = \frac{Overall\ output\ in\ the\ mining\ \ activities}{ales\ turnover\ in\ all\ economic\ activities} * 100$$

90. Table 6.14 shows 10 multiplier results expenditure of 1702.7 bln.tog is estimated to cause the indirect impact. As the demand of the mining industry increases, the input of the supply of other relevant industries increases.. The induced income impact, derived from the mining expenditure, is associated with the additional consumption, generated as a result of the indirect impact of the mining industry. It is estimated that the induced impact amounts to 1209.3 bln.tog. The total output impact on the economy from direct, indirect and induced impact results is 5964.3 billion tugrugs, which is 33.3 percent of the output in the national economy.

Table 6.14: Impacts of the mining Output in Mongolia (bln.tog), 2010

Derived indicators	Mining industry -TOTAL	Mining of coal and crude petroleum	Mining of metal ores	Other mining and quarrying	Mining support service activities
Direct Impact					
Total Mining Expenditure	3052.3	415.6	786.8	69.6	1780.3
Indirect Multiplier Impact					
Industry Output Multiplier - Type I		*1.27*	*1.25*	*1.33*	*1.77*
Indirect Output Impact	1702.7	112.2	196.7	23.0	1370.8
Induced Multiplier Impact					
Industry Output Multiplier - Type II		*1.52*	*1.64*	*2.06*	*2.19*
Induced Output Impact	1209.3	103.9	306.8	50.8	747.7
Overall Output Impact: Direct + Indirect + Induced Output Impact	**5964.3**	**631.8**	**1290.3**	**143.4**	**3898.8**
The share of overall output in the mining activities	***33.3***	***3.5***	***7.2***	***0.8***	***21.8***

91. **Employment impact:** Employment impact on the economy from mining activities can be shown in the following modeling.

$$Indirect\ employment\ impact\ (C)_t = (A_t * B_t) - A_t$$

$$Induced\ employment\ impact\ (E)_t = (A_t * D_t) - C_t - A_t$$

A_t: $Number\ of\ persons\ employed\ in\ mining\ at\ t\ period$
B_t: $Sector\ employment\ multiplier - Type\ I$
D_t: $Sector\ employment\ multiplier - Type\ II$

$$\boldsymbol{Overall\ employment\ impact_t} = \boldsymbol{Employment\ in\ mining}\ (\boldsymbol{A_t}) + \boldsymbol{Indirect\ employment\ impact}\ (\boldsymbol{C})_t + \boldsymbol{Induced\ employment\ impact}\ (\boldsymbol{E})_t$$

92. **The share of overall employment in the mining activities:** The share of overall employment in the mining activities is defined as overall employment in the mining activities related to total employment in all economic activities in the country.

$$Share\ of\ overall\ employment\ in\ the\ mining\ activities = \frac{Overall\ employment\ in\ the\ mining\ activities}{otal\ employment\ in\ all\ economic\ activities} * 100$$

93. Table 6.15 shows the results from the economic impact analysis of the employment in the mining activities reveals that in 2010, there were 34.1 thousand direct employees and the indirect impact of the employment was 74.7 thousand in the industry relating to the mining activities. The induced impact of employment was 68.7 thousand employments. The overall impact of the employment in the mining industry on the economy was 177.5 thousand. The share of overall employment in the mining activities in the total employment is 17.2 per cent in 2010.

Table 6.15: Impacts of the Mining Employment in Mongolia (thous.person), 2010

Derived indicators	Mining industry –TOTAL				
		Mining of coal and crude petroleum	Mining of metal ores	Other mining and quarrying	Mining support service activities
Direct Impact					
Number of Persons Employed in the mining	34.1	9.5	10.4	8.8	5.4
Indirect Multiplier Impact					
Industry Employment Multiplier - Type I		*2.61*	*2.96*	*1.2*	*7.9*
Indirect Employment Impact	74.7	15.3	20.4	1.8	37.3
Induced Multiplier Impact					
Industry Employment Multiplier - Type II		*3.96*	*5.79*	*1.57*	*12.2*
Induced Employment Impact	68.7	12.8	29.4	3.3	23.2
Overall Employment Impact: Direct + Indirect + Induced Employment Impact	**177.5**	**37.6**	**60.2**	**13.8**	**65.9**
The share of overall employment in the mining activities	***17.2***	***3.6***	***5.8***	***1.4***	***6.4***

94. **Income impact:** The final component of analysis of multiplier impacts of mining relates to the income multiplier impacts arising from the wages and salaries earned by the employed in the mining. Income impact on the economy from mining activities can be shown in the following modeling.

$$Indirect\ income\ impact\ (C)_t = (A_t * B_t) - A_t$$

$$Induced\ income\ impact\ (E)_t = (A_t * D_t) - C_t - A_t$$

A_t: $Expenditure\ on\ wages\ and\ salaries\ in\ mining\ at\ t\ period$
B_t: $Sector\ income\ multiplier - Type\ I$

$$D_t: Sector\ income\ multiplier - Type\ II$$

$$\boldsymbol{Overall\ income\ impact_t} = \boldsymbol{Expentidure\ on\ wages\ and\ salaries\ in\ mining}\ (\boldsymbol{A_t}) + \boldsymbol{Indirect\ income\ impact}\ (\boldsymbol{C})_t + \boldsymbol{Induced\ income\ impact}\ (\boldsymbol{E})_t$$

95. **The share of overall income of the mining industry:** The share of overall income in the mining activities is defined overall income in the mining activities related to expenditure on wages and salaries in all economic activities in the country.

$$Share\ of\ overall\ income\ in\ the\ mining\ activities = \frac{Overall\ income\ in\ the\ mining\ activities}{Expenditure\ on\ wages\ and\ salaries\ in\ all\ economic\ activities} * 100$$

96. Table 6.16 show the wage revenue of MNT 626.8 billion was generated through the direct, indirect and induced impact of the mining industry in 2010.

Table 6.16: Impacts of the mining income in Mongolia (bln.tog), 2010

Derived indicators	Mining industry -TOTAL				
		Mining of coal and crude petroleum	Mining of metal ores	Other mining and quarrying	Mining support service activities
Direct Impact					
Expenditure on Wages & Salaries in the mining	260.1	49.4	142.8	18.3	49.6
Indirect Multiplier Impact					
Industry Income Multiplier - Type I		*1.8034*	*1.4272*	*1.234*	*3.22991*
Indirect Income Impact	215.7	39.7	61.0	4.3	110.7
Induced Multiplier Impact					
Industry Income Multiplier - Type II		*2.3758*	*1.8802*	*1.6257*	*4.2551*
Induced Income Impact	151.0	28.3	64.7	7.2	50.9
Overall Income Impact: Direct + Indirect + Induced income Impact	**626.8**	**117.4**	**268.5**	**29.7**	**211.2**
The share of overall income of the mining industry	**19.9**	**3.7**	**8.5**	**0.9**	**6.8**

6.6. Trends in the mining boom

97. This section shows that the mining boom involves a comparison of two scenarios. These are how national economies develop with the mining boom and without mining boom. Differences between the economies with mining and without mining scenarios are interpreted as the effects of the mining boom.

98. **Effects of the mining boom on GDP:** Growth is calculated by dividing the change in value added by the value added of the previous.

$$GDP\ growth\ in\ the\ mining\ industry\ at\ t\ period = \frac{Value\ added\ in\ the\ mining\ industry\ at\ t\ period}{Value\ added\ in\ the\ mining\ industry\ at\ t-1\ period} * 100$$

Figure 6.3: Effects of the Mining boom on GDP growth in Mongolia (trend, through the year)

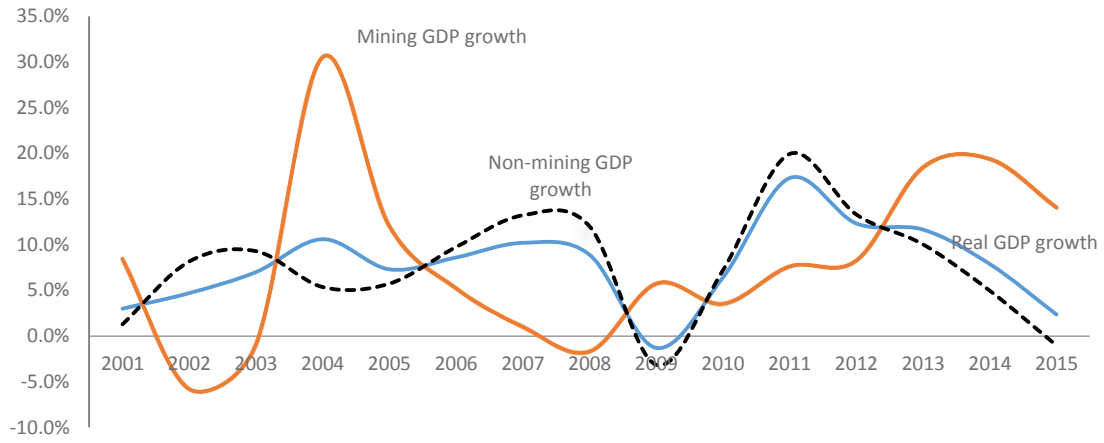
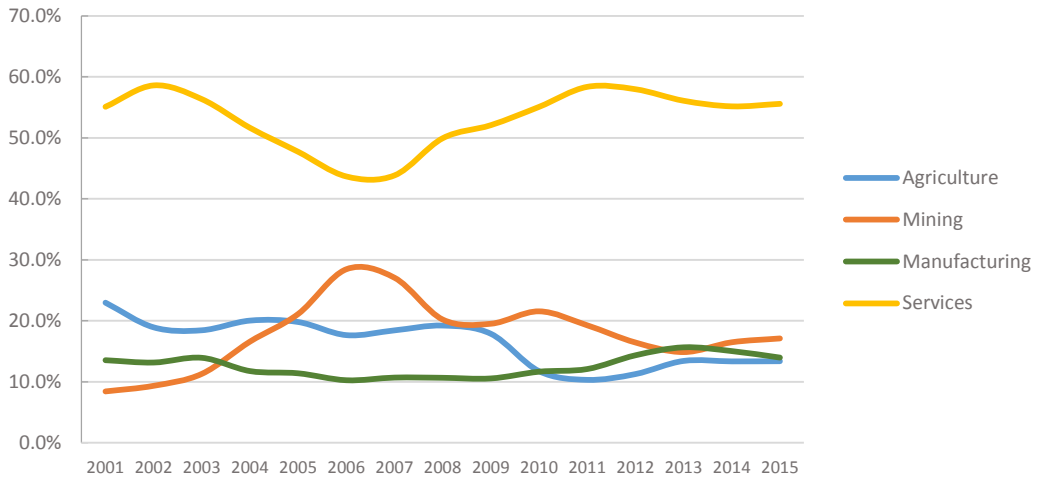


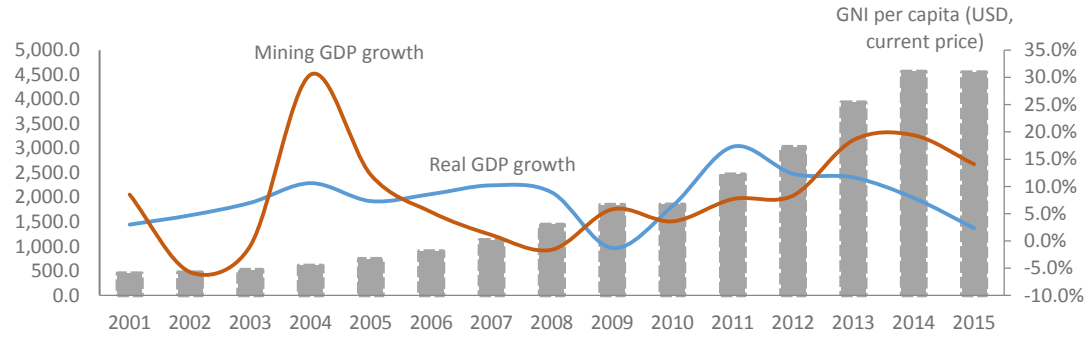
Figure 6.4: Effects of the Mining boom on sectorial shares of GDP in Mongolia (trend, through the year)



99. **Effects of the mining boom on income:** The effect of the mining boom on overall living standards can be gauged by the difference in real household gross national income per capita. GNI per capita growth is calculated by dividing the change of GNI per capita at t period by GNI per capita at t-1 period in the economy.

$$GNI\ per\ capita\ growth\ in\ the\ mining\ industry\ at\ t\ period = \frac{GNI\ between\ t\ an\ t-1}{GNI\ in\ economy\ at\ t-1\ period} * 100$$

Figure 6.5: Effects of the Mining boom on income in Mongolia (trend, through the year)



100. The share of income impact in the mining activities is defined as j category income related to total income in all economic activities in the country.

$$Share\ of\ income\ in\ the\ j\ category\ at\ t\ period = \frac{Income\ in\ the\ j\ category\ at\ t\ period}{Total\ income\ in\ all\ economic\ activities\ at\ t\ period} * 100$$

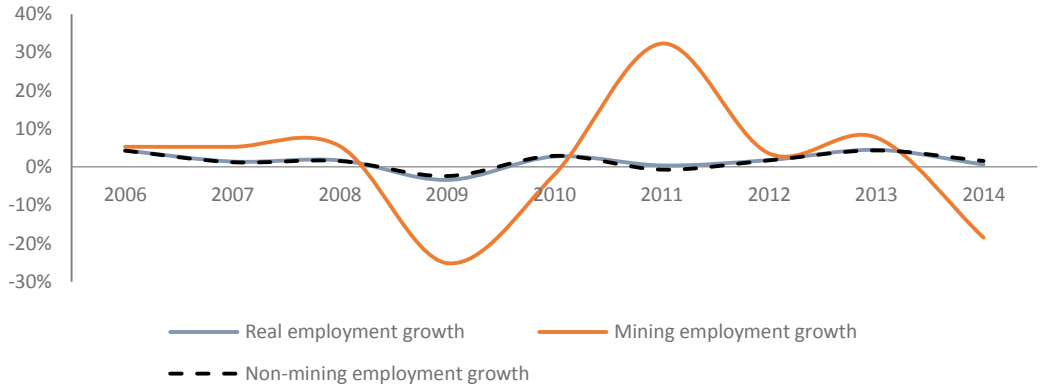
Where: j-direct category, indirect category, induced category and non-mining category

Figure 6.6: Effects of the mining boom on income in Mongolia

101. **Effects of the mining boom on employment growth:** The stronger activity arising from the mining boom results in higher employment. Employment growth is calculated by the ratio of the change in employment at t period and employment at t-1 period in the mining industry.

$$Employment\ growth\ in\ the\ mining\ industry\ at\ t\ period = \frac{Employment\ in\ the\ mining\ industry\ between\ t\ and\ t-1\ t\ period}{Employment\ in\ the\ mining\ industry\ at\ t-1\ period} * 100$$

Figure 6.7: Effects of the Mining boom on employment growth in Mongolia (trend, through the year)

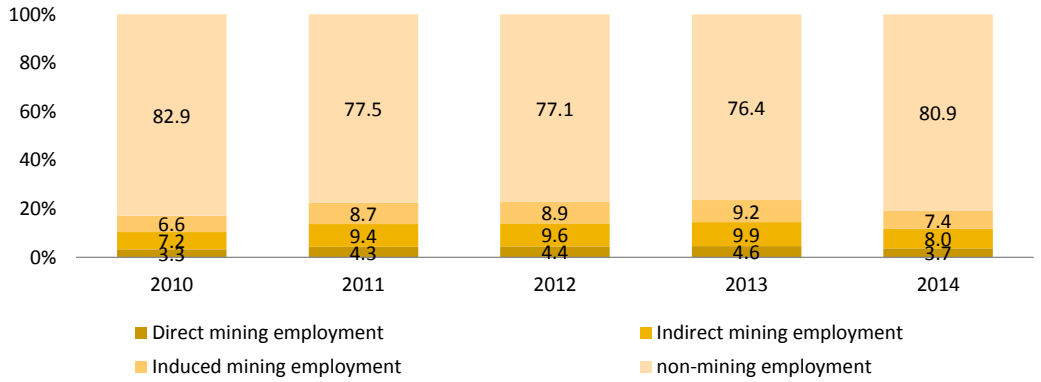


102. The share of j categories employment impact in the mining activities is defined as j employment related to total employment in all economic activities in the country.

$$Share\ of\ employment\ in\ the\ j\ category\ at\ t\ period = \frac{Employment\ in\ the\ j\ category\ at\ t\ period}{Total\ employment\ in\ all\ economic\ activities\ at\ t\ period} * 100$$

Where: j-direct category, indirect category, induced category and non-mining category

Figure 6.8: Effects of the mining boom on employment

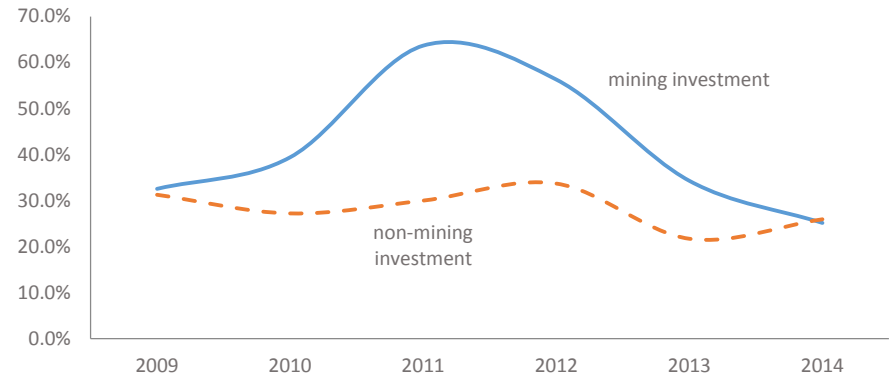


103. **Effects of the mining boom on investment:** Investment without the mining boom is lower than that with the mining boom.

104. The share of investment to value added is calculated by the ratio of investment at t period and value added at t period in mining industry.

$$Share\ of\ investment\ in\ the\ mining\ industry\ at\ t\ period = \frac{Investment\ in\ the\ mining\ industry\ at\ t\ period}{Value\ added\ in\ the\ mining\ industry\ at\ t\ period} * 100$$

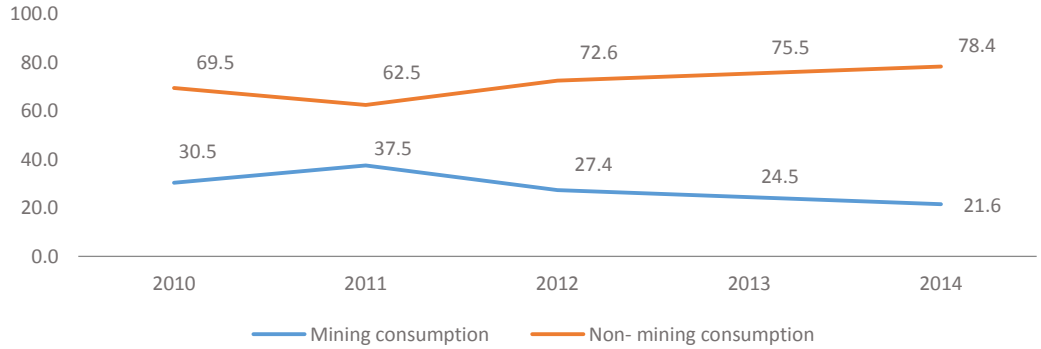
Figure 6.9: Effects of the Mining boom on investment, percent of trend GVA



105. **Effects of the mining boom on consumption:** The share of consumption to total consumption is calculated by the ratio of consumption in the mining at t period and consumption at t period in all economic activities in the country.

$$Share\ of\ consumption\ in\ the\ mining\ industry\ at\ t\ period = \frac{Consumption\ in\ the\ mining\ industry\ at\ t\ period}{Consumption\ in\ all\ economic\ activities\ at\ t\ period} * 100$$

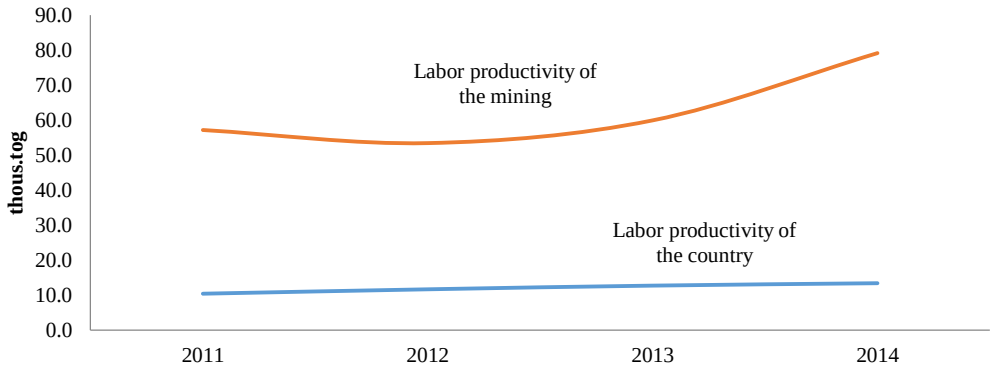
Figure 6.10: Effects of the mining boom on consumption



106. **Effects of the mining boom on Labor productivity:** The labor productivity is defined and calculated by the ratio of value added and annual average of employees in the mining industry.

$$Labor\ productivity\ in\ the\ mining\ industry\ at\ t\ period = \frac{Value\ added\ in\ the\ mining\ industry\ at\ t\ period}{Employment\ in\ in\ the\ mining\ industry\ at\ t\ period} * 100$$

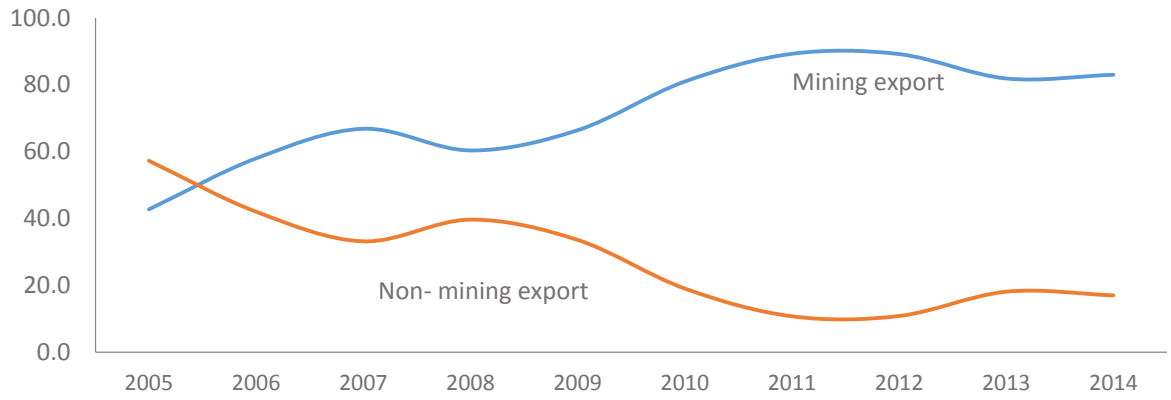
Figure 6.11: Labor productivity of mining industry in Mongolia (thous.tog/employees)



107. **Trade industry:** The share of export to total export is calculated by the ratio of export in the mining at t period and export at t period in all economic activities in the country.

$$Share\ of\ export\ in\ the\ mining\ industry\ at\ t\ period = \frac{Export\ in\ the\ mining\ industry\ at\ t\ period}{Export\ in\ all\ economic\ activities\ at\ t\ period} * 100$$

Figure 6.12: Export growth with and without mining (%) in Mongolia



6.7. Description of framework and IMF guidelines

6.7.1. Case study example from Mongolia

108. This section shows case study example from Mongolia that sample survey had conducted for determining the effect of the "Oyu Tolgoi" LLC activities on economy in its impact area, where one of the copper mines play a major role in the mining industry.

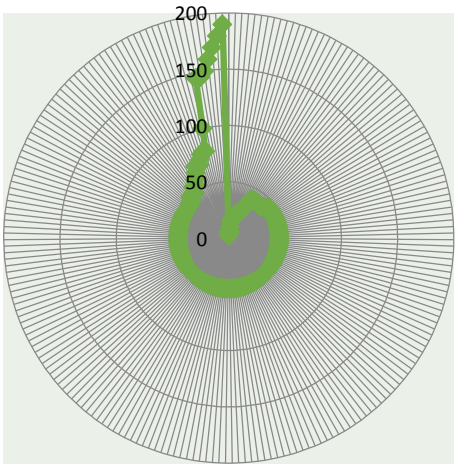
6.7.2. Brief introduction

109. Khanbogd soum is the main mining region. Since 2002 there were 22 registered mining fields in Khanbogd soum, from which 3 have special permission of exploiting (mine) and the others have special permissions for exploration. The owner of the 3 special permissions for exploitation is the “Oyu Tolgoi” LLC.

110. The “Oyu Tolgoi” LLC, one of largest mining companies in Mongolia with stable activities. The “Oyu Tolgoi” LLC is the world biggest mine with unused copper and gold.

111. The nearest household lives in 3 km far from the mining site and the farthest lives about 200 km. The figure below shows the distance from the mining site to all the households in Khanbogd soum. However, 92.2 percent of total households are Khanbogd soum is located close to the mining activities by the “Oyu Tolgoi” LLC.

Figure 6.13 Distance from the mining site to the households in Khanbogd soum, 2015



112. Mining activities provide employment, earnings and income to the economy of the country at national, regional and local level. It pays taxes, deductions and

payments from operational income. This part includes the economic benefits from mining sector to the local employment, tax revenue, payments and deductions.

6.7.3. Approach the developing survey for the mining area

113. Survey covered whole Khanbogd soum of Omnogovi province. The survey was organized by following 3 target groups:

1) Household sampling survey (by questionnaire)
2) Survey from administrative units (by forms)
3) Survey from Oyu Tolgoi LLC (by form)

114. The Mongolian National Statistics office made the household sampling, considering the representativeness of the soum and financial resources. According to the population and household database of Mongolia as of September 2015 the households of Khanbogd soum, Omnogovi province was 1713, which was the data sampling frame. Five strata by the economic activities of the household heads included herder, government officer, household businesses, employee in mining and others were created.

115. The collected indicators to determine economic impacts are as follows:

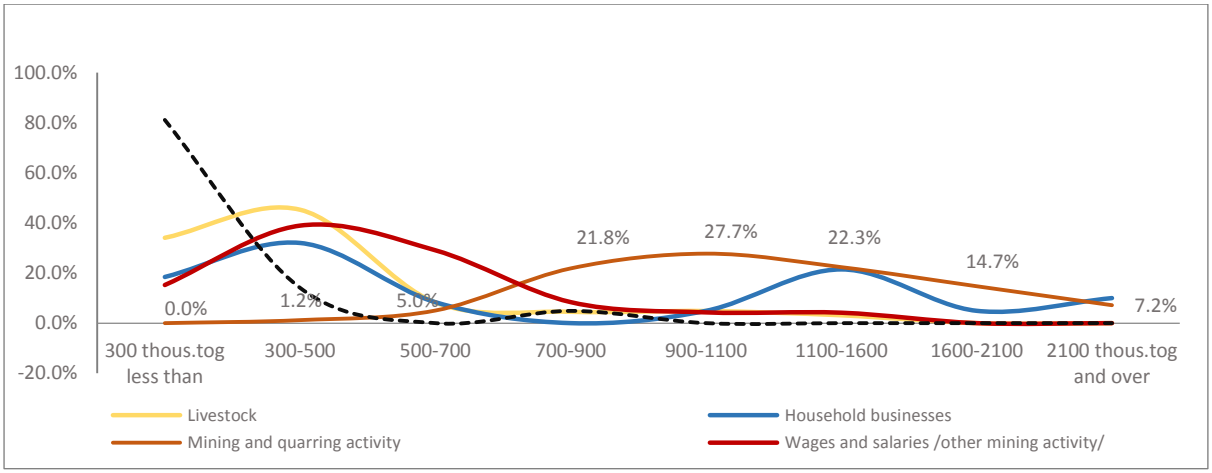
- Income of mining workers,
- Average wage of mining,
- Revenue to the budget from mining,
- Donations and supports from mining.

6.7.4. Impacts of the mining activities on economy of the Khanbogd soum

116. The sources of primary income of the households in Khanbogd soum were concerned: 30.2% of total households have mining activities, 24.8% livestock activities, 19.4% of wages and salaries from industries other than mining, 13.9 percent household businesses, 8.7 percent pension and allowances and 3.1 percent others. It shows that mining sector is a major psource of household income.

117. Figure 6.14 below shows that the average income of the households from mining sector is relatively high compares to other sources.

Figure 6.14: Household grouping, by monetary income group, share to total, by income primary source, thous.MNT, 2015

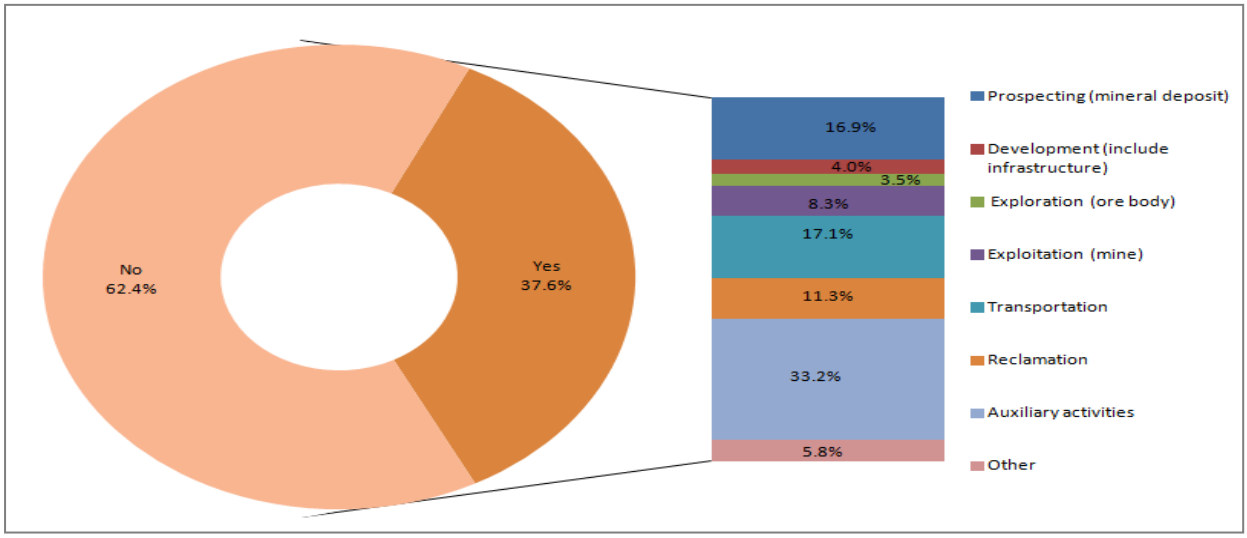


118. For 2015, average monetary income per rural household was 704.5 thousand MNT in national level, but it is 757.8 thousand MNT in Khanbogd soum. Average wages and salaries of the workers in Khanbogd soum was 881.7 thousand MNT in mining and 547.0 thousand MNT in sectors other than mining.

Impact of the mining activities on employment

119. Mining had 37.6% of total employees of 815 people in Khanbogd soum. With 33.2% of the total mining employees participating in auxiliary activities, 17.1% in transportation activities, 16.9% in prospecting and 11.3% waste cleaning and environment remediation works.

Figure 6.15: Employed in the mining activities by mining procedure, 2015



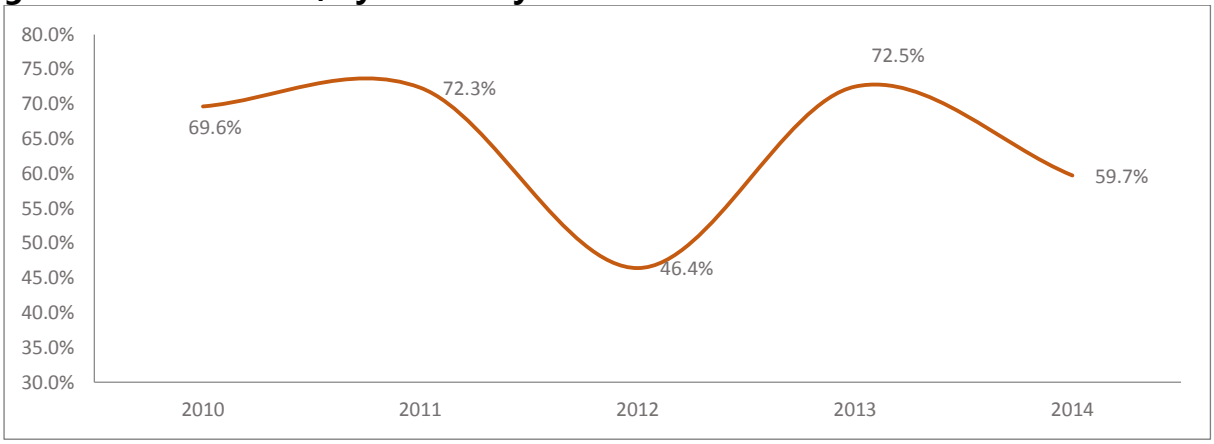
Impact of the mining activities on budget

120. The impacts of local revenue from mining sector to the soum economic conditions were calculated. The following types of taxes, payments and other income is accumulated to the local budget revenue. In 2014 59.7% of local budget revenue was paid by mining sector.

Table 17: Taxes, payments and fees paid by mining industry to the local budget, million MNT, selected year

No.	Indicators	2010	2011	2012	2013	2014
	TOTAL	**2 130.4**	**15 358.9**	**22 913.8**	**57 367.1**	**43 598.0**
1	Taxes	101.2	144.0	259.9	5 822.3	8 362.7
1.1	Real estate tax	84.4	117.1	191.4	5 764.3	8 302.5
1.2	Tax on automobile and self-moving vehicles	16.8	26.9	68.5	57.9	60.2
2	Payments	2 020.8	9 183.4	5 116.2	24 386.1	11 325.5
2.1	Land payment	333.7	1 414.9	1 778.0	1 760.4	1 804.6
2.2	Water payment	13.7	22.5	91.4	15 415.6	9 520.9
2.3	Exploitation of mineral resources (royalty fees)	226.4	1 406.6	3 246.8	1 670.6	-
2.4	Foreign specialists and workers accommodation payment	1 447.0	6 339.3	-	5 539.5	-
3	Others	8.5	6 031.5	17 537.7	27 158.8	23 909.8
3.1	Fines	-	-	1 873.8	19.0	23.9
3.2	50 percent of environment protection expenses transferred to special account	6.9	193.4	172.3	397.0	109.7
3.3	Others	1.6	5 838.1	15 491.6	26 742.8	23 776.2

Figure 16: The share of total revenue of the mining activities to the local government revenue, by selected year



Chapter 7.

Impacts on society

7.1. Introduction

1. Mining is known to have different stages of activity such as exploration, pre-development work, development, operations, expansion, temporary slowdown or shutdown, decommissioning and reclamation. Each stage may have different impacts on society (Haley et al, 2011). The societal impacts of mining can be measured mainly through social indicators.

2. Social indicators are defined as statistical measures that describe social trends and conditions impacting on human well-being (Wikiprogress.org 2016). Generally, social indicators perform one or more of three functions:

- Providing information for decision-making,
- Monitoring and evaluating policies,
- Searching for a common good and deciding how to reach it.

3. The social indicators in relation to mining sector can broadly be classified into eight groups, and are discussed in the following sections:

- Demographic characteristics of mining workers,
- Measuring employment in mining,
- Nature of employment in mining,
- Trend analysis in the demand of employees in mines and other related industries,
- Mining and safety,
- Mining and health,
- Mining, work environment and working conditions,
- Mining resettlement issues.

7.2. Demographic characteristics of mining workers

4. **Age:** The recording of age and mean average age of workers is an important statistic. In a nation-wide survey of mine workers in the USA, information was collected on age as one of the descriptive variables (Jensen etal, 2007). A study from the USA on coal mine workers indicated that the age range of the workers was from 17 to 19 years. The paper highlighted the relationship between age and days lost following an injury. Furthermore, the data indicated an increased risk of overexertion

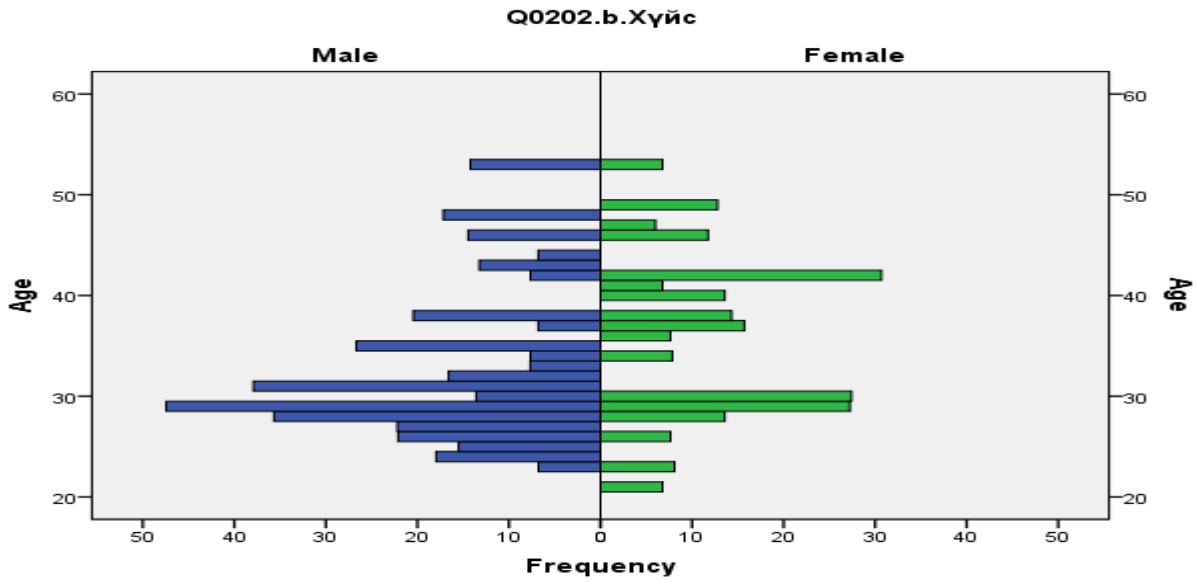
injuries as age increases (Margolis, 2010).

5. **Sex or gender:** The literature available from a number of countries shows that the gender disparity exist in the employment of mines (Abrahamson etal., 2014, Nayak etal 2005, Lahri Dutt 2011). In view of these studies, it is suggested that while collecting the data of mine workers according to various social indicators, attempt should also be made to collect the information of mine workers according to their age and gender.

7.2.1. Number employed by age and sex:

6. The number of persons of a specified age group and sex employed in the mining sector can be specified in groups, for example <30, 30-44, >45. This information can be obtained through surveys. Figure 7.1 presents mining data from Mongolia in 2015. Figure 7.1 shows 62.7% are male, 37.3% are female. The majority of the workers are male around 30 years old.

Figure 7.1: Mining on employment by age and sex in Mongolia



Source: Survey on impact of mining sector to economic, social and environmental status of Khanbogdsoum, Omnogovi province, 2015

7.2.2. Education

7. The level of education is another element to consider regarding the impact of mining on society. This is not only directly in the mining industry but also more broadly as governments obtain revenues that can be invested into education. A

possible grouping of education levels are shown in in figure 7.2. This information could be captured from surveys. By education level: 79.6 percent of the mining workers from Khanbogdsoum have lower than secondary education, which shows that they mostly engaged in auxiliary activities.

Figure 7.2: Distribution of employment, by level of education in the Mining industry

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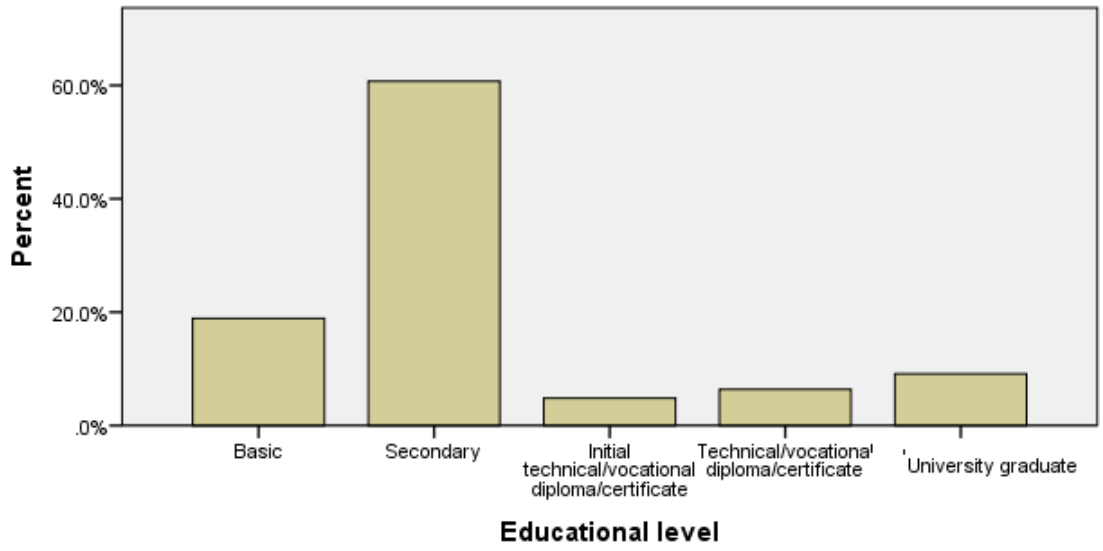


Source: Survey on impact of mining sector to economic, social and environmental status of Khanbogdsoum, Omnogovi province, 2015

8. **Occupation:** The mining industry employs a wide range of occupations, obtaining data on occupations is necessary for policy-makers if they were to address particular skill shortages. The international classification: The International Labour Organisation has the International Standard Classification of occupation as a standard to use.

9. **Income:** Income for the purpose of the analysis in this chapter consists of remuneration received in cash or equivalent. This includes bonuses, allowances, overtimes and payments towards leave period. The following indicators are proposed to measure the income. This does not include other transfers, such as payments from the government.

Figure 7.3: Primary sources for household income, by baghs, 2015

Income source	Share to total number of households
Total households	**100.0**
Livestock	24.8
Household businesses	13.9
Mining industry	30.2
Wages and salaries (other than mining sector)	19.4
Pensions, allowances	8.7
Others	3.1

Source: Survey on impact of mining sector to economic, social and environmental status of Khanbogdsoum, Omnogovi province, 2015

10. **Total compensation of employees of the mining industry, by sex:** This is the aggregate of salary and wages received by all the employees of the mining sector.

11. **Monthly average wages and salaries of employees of the mining industry by residency:** This is the total compensation received by employees split into residency status, either domestic or foreign workers.

12. Total compensation received by the foreign employees is important to measure, especially if they comprise a large portion of the workforce. Foreign workers can send remittance overseas, which can impact estimate of national income.

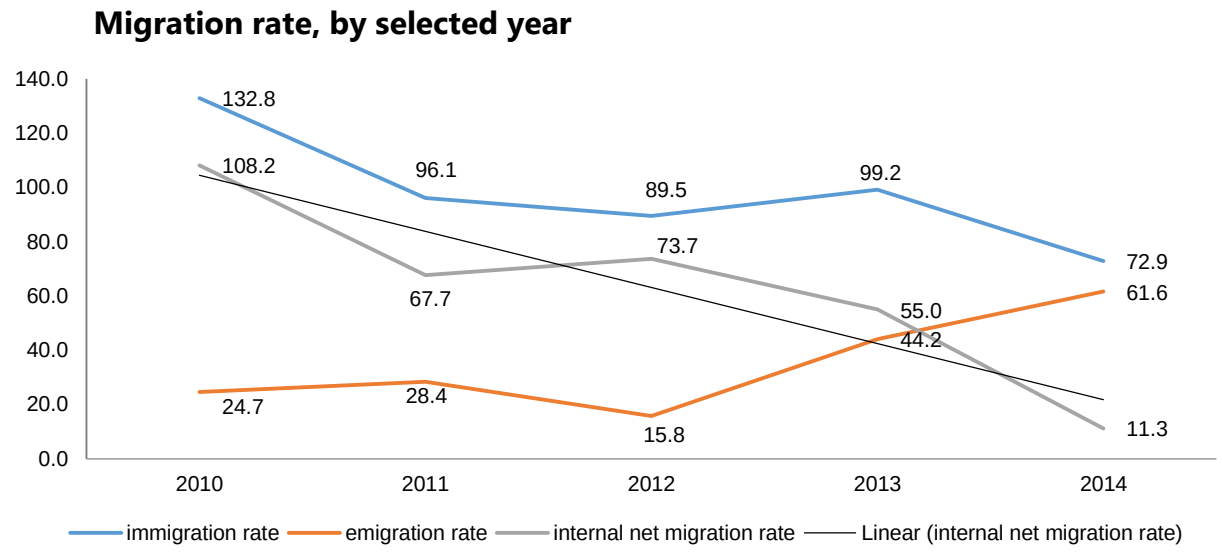
7.3. Measuring employment in mining sector

13. Reliable estimates of the labour force engaged in mining are important for policy and planning purposes. The following indicators are proposed.

14. **Number of employees by sex:** The standard definitions used by the International Labour Organisation should be used. Most countries that conduct a labour force survey may have this information. However, industry specification may be difficult if it is a household survey.

15. The appropriate definition for residency needs to be considered. This is important because of how the scope is defined in the labour force survey sourced from households. The ILO recommendations should be used for the purpose of conducting a labour force survey.

Figure 7.4: Impact of mining on migration in Mongolia



Source: Survey on impact of mining sector to economic, social and environmental status of Khanbogdsoum, Omnogovi province, 2015

7.4. Trend analysis in the demand for employees in mining and other related sectors

16. Business surveys can be used to estimate labour demand of employees in mining and to compare to other industries. This will provide an indication of the impact on the employment change in other industries, if there are substantial shifts or shocks in the industry. Similar growth for the demand for mining employees compared to other sectors will indicate that there is minimal effect on the supply of labour in other sectors due to changes in the demand from mining. In case of no parallel trend, the change in the employment of other sectors due to changes in the employment of mining sector can be expected.

7.5. Mining and safety

17. Safety for mining employees means an injury and illness-free workplace. A US study (Morgolis, 2010) used the Mine Safety and Health Administration's (MSHA) database on accidents, injury, and illness from the years 2003 through 2007 to examine how age, and experience affects injury severity. The results of the data indicated that there was a relationship between age (capturing experience in mining) and days lost following an injury. Furthermore, the data also indicated an increased risk of overexertion injuries as age increases.

18. Safety measures can be calculated in two ways, either by injury rate or by average illness period.

19. **Injury rate by age group:** This is the number of persons injured by the number of persons working in mining. It can be calculated separately for each age group and sex.

20. **Injury rate by mining activity:** This is the number of persons injured due to mining activity relative to the number of persons working in mining.

21. **Injury period by age:** This refers to the number of calendar days a person remained absent from the work due to mining related injuries by the total number of working days at the mine. It can be calculated separately for each age group and sex. This can also be calculated by mining activity.

7.6. Mining and Health

22. Health issues related to mining are important requirements for policy makers. There are a number of indicators that could be developed.

23. **Morbidity rate:** This is the number of persons falling sick attributable to mining activity by the number of person working in the mines. In certain instances, mining related disease will be difficult to assess. That is, a mining employee may contract a disease but the causality may not necessarily be attributable to mining activity. Another aspect to consider is the latency period for a disease, as it may be a number of years before it may be diagnosed and the individual may have left the mining workforce.

24. **Average illness period:** This refers to the total number of days employees have fallen sick divided by the number of employees. This will indicate in general the extent of the health problems in mining workers. Higher average illness period will indicate the severity of health problems. However, there may be difficulty in obtaining the data.

25. **Life Expectancy of mining workers:** This is an indicator of overall health experiences of the mining workers. This will potentially require matching of data from different sources. Alternatively, specific research may be available, although this is generally a snapshot and not capture changes over time.

26. **Health insurance coverage of mining workers:** This refers to the number of mining workers who are covered by a health insurance scheme. This is the indication of social measures adopted by the Mine owners.

7.7. Mining, work environment and working conditions

27. Estimates for working conditions and how they may change over time are difficult to capture quantitatively. In general, it is usually qualitative information. Job turnover is one proxy measure that could be measured.

28. **Job turnover rate:** This is an indirect measure of working conditions and the work environment. If working conditions or the work environment is not adequate, it can be expected that the workers will leave the job. However, levels of poverty can also impact on this. This can be given by the number of workers leaving the job divided by the total number of employees engaged in mining activity.

7.8. Mining and resettlement issues

29. The problem of mining induced displacement and resettlement (MIDR) is global, occurring in all continents. Countries with particularly large-scale MIDR include: India, China, Ghana, Mali, Zimbabwe, Indonesia and Papua New Guinea. At a national level, mining has led to the displacement of more than 1.5 million people over the last fifty years. This is less than 0.5% of the population spread over a very long time. While this indicates little impact at the national level, it can be severe for a particular region, such as the Jharkland region in India.

30. The largest portion of the displacement is caused by open-pit mining, associated with the extraction of gold, copper, iron, lignite, and diamonds (Terminski, 2012). The loss of livelihood is also likely to be associated with displacement due to Mining and relevant compensations and resettlement issues (Lillywhite and Kemp, 2015). A number of indicators could be used for:

- Loss of livelihood,
- Resettled number of persons, and
- Compensation paid.

31. This data will be difficult to collect in a timely manner psot resettlements, from a survey. Administrative data is one option that could be used here.

32. Annex 2 provides definitions and priories for agencies to estimate the impact of mining on society.

Chapter 8.

Measuring the impact of the mining industry on the environment

8.1. Introduction

1. The extractive nature of mining operations creates a variety of impacts on the environment before, during and after mining operations. The extent and nature of the impacts can range from minimal to significant depending on a range of factors associated with each mine. These factors include: the characteristic of the ore body; the type of technology and extraction methods used in mining and the on-site processing of minerals; and the sensitivity of the local environment. The environmental impacts of mining, although significant, are generally confined to local areas. Apart from direct physical impacts of extractive activities, contamination of air, land and water may also result. However, mining in isolation may not be the main land use that upsets ecological systems, as environmental effects are cumulative in nature and other past activities or events may have contributed to these effects.

2. The impact of the mining industry on the environment has been a concern for many years. Governments and businesses have responded with a number of initiatives and regulations to protect and manage the environmental effects of mining activities. To do this effectively, governments need relevant statistics that measure the impact of mining on the environment.

3. There has been much literature on the impact of mining on the environment, but minimal work that systematically measures this impact and the changes over time. The System of Environment and Economic Accounts provides the basic framework to address this shortcoming. This handbook provides guidance and methodologies for National Statistical Offices (NSOs) to develop appropriate statistics and standards to address this.

4. This chapter discusses the main environmental impacts of mineral mining, such as wastes and the rate of resource use. The chapter also links these impacts to the statistics required for measurement.

5. Many NSOs currently produce a raft of environmental statistics including a suite of environmental accounts. Box 8.1 outlines some of the environmental statistics available in Kazakhstan.

BOX 8.1 : Environmental Statistics in Kazakhstan

Kazakhstan produces a suite of statistics on the environment across a number of agencies, that measure:

- Hazardous waste,
- Environmental protection and sustainable development,
- Emissions of greenhouse gases by sector,
- Air pollution index (API) of 19 cities in Kazakhstan.
- Report on the costs of environmental protection, which includes the following indicators:
    - Costs by type of economic activity,
    - Fee for regulatory emissions (discharges) of pollutants by type of economic activity,
    - Fee for excess emissions (discharges) of pollutants by type of economic activity
    - Funds (lawsuits, fines) recovered for damages by type of economic activity,
    - Fee for the use of natural resources by type of economic activity,
    - Special payments of subsurface users by type of economic activity.

6. Impacts on the environment can occur from range of activity. While there are many indicators and statistics to draw upon, they may not necessarily address the impact of mining. This handbook draws upon some of these indicators and provides practical guidelines for NSOs to establish appropriate data sets to measure the impact of mining on the environment.

7. Much of this chapter draws upon the *System of Environmental-Economic Accounting 2012 - Central Framework (SEEA2012)*. The SEEA2012 provides the underlying accounts framework to measure the impact of mining on the environment. Another source of material is the *Framework for the Development of Environment Statistics (FDES) 2013*. FDES is a useful guide to the indicators that might be used in measuring mining's impact.

8.2. Residuals

8. Some of the significant direct impacts of mining predominantly occur via the residuals 'produced' by the industry. The SEEA2012 defines residuals to be the "flows of solid, liquid and gaseous materials, and energy that are discarded, discharged or emitted by establishments and households through processes of production,

consumption or accumulation" (SEEA 2012 3.73). Residuals can be grouped depending on analytical need, the physical nature or purpose of the flow. (SEEA 2012 3.83). The most widely accepted groupings that relate directly to mining are solid waste, wastewater, emissions, and natural resource residuals. The SEEA 2012 has not defined a single classification of residuals as the various groups overlap.

9. There are a number of residuals that are unique to mining. These residuals occur during the many phases of the mine life, from exploration through to closure and beyond. Some of these residuals may not be evident until long after the mine has closed. There is general awareness of residuals such as those from disasters, such as oil spills, however there are many others. For example, dust from production from open cut mines, overburden and tailing.

8.3. Selected mining activities and their impact

8.3.1. Mineral exploration

10. The impact of mineral exploration will depend on the scale of exploration and what equipment is used in the exploration phase. Initial exploration may involve the use of satellites and aerial photography, with the latter impacting through noise and proximity to wildlife areas when conducted at a low altitude. Activities at ground level often require the use of bore holes, excavation pits and transect lines. The use of support equipment also leaves an impact on the environment. Exploration vehicles require access tracks, and even helipads, if left un-rehabilitated, can have medium to long-term effects.

Main indicators

11. There are very few direct indicators that measure the impact of mineral exploration. Land and eco-system accounts are potential measurement tools to provide estimates of the impact of exploration. However, given the short term nature of this activity (compared to a mine in operation) any impact may be difficult to capture. While an accounts based process could be linked with rehabilitation expenditure and environmental management, the impact of exploration may not be significant compared with broader mining operations.

12. One alternative could be to use mineral and petroleum exploration expenditure, as a measure of overall activity. If this data were available by region then the impacts on the environment might be identifiable. It is worth noting that exploration expenditure is capitalised in the System of National Accounts and contributes to Gross Domestic Product.

8.3.2 Mining operation

13. Environmental impacts may also occur through mine establishment, ore extraction, mineral concentration and associated transport and infrastructure.

14. Inherent to mining and mineral processing operations is the generation of waste. These are mostly in the form of waste rocks, including surface waste rocks, rocks between ore bodies or layers and other unwanted material. This form of waste contains low or nil concentrations of the material desired and is often relatively toxic. Normally, waste rocks are stockpiled or dumped adjacent to or near the excavation area, to be used later as backfill during reclamation.

15. Mineral processing produces wastes in grain sizes of fine sand, silt and clay fractions. Referred to as mine tailings, this type of waste contains significant concentrations of minerals that are not amenable to recovery at the time of initial mining. Tailings are usually disposed of in specially lined tailings dams, which are normally capped and revegetated to prevent the release of environmentally harmful materials. Other wastes from mining may be in the form of water and air pollution. The majority of air emissions associated with the mining industry includes dust, oxides of nitrogen, sulphur dioxide and carbon monoxide. Some of these come from mining vehicles and on-site plant machinery. Water quality may be affected by:

- *Acid mine drainage* - when large quantities of excavated rock containing sulphide minerals interact with water and oxygen to create sulphuric acid.
- *Heavy metal contamination and leaching* - heavy metals occur naturally in many ores, and are often released in the mineral extraction process. Metals (i.e. arsenic, cobalt, copper, cadmium, lead, silver and zinc) contained in an excavated or exposed rock may be leached out and carried downstream by flowing water.
- *Processing chemical pollution* - spilling, leaking or leaching of chemical agents (i.e. cyanide, sulphuric acid) from the mine site into nearby water bodies.
- *Erosion and sedimentation* - erosion of cleared land surface and dumped waste material resulting in sediment loadings into the adjacent water bodies, particularly during rainfall.

16. Environmental impacts resulting from mining are not limited to current mining operations. Mining residues and scars at old mining sites may also impact on local environments. The legacy of abandoned, un-rehabilitated mine sites has required comprehensive remediation efforts paid for with taxpayers' funds.

17. With the increasing extraction of unconventional gas resources, such as coal seam gas and shale gas there have been growing concerns over the environmental

impact. The environmental impacts from these forms of extraction are not fully understood. Besides competing concerns of water and land usage, there are concerns over damage to both surface and underground water supplies. While indicators could be used, there needs to be accurate high quality data for decision makers. The accurate measurement of residuals is an important part of this process.

Main indicators

18. There are numerous indicators to consider for mine operations, with the measurement of residuals and the use of environmental inputs being the most significant. The indicators should cover all the groups of residuals, providing as much detail as possible.

19. Other indicators to consider are environmental ratios, such as air emissions per unit of value added. SEEA 2012 provides the following ratios:

- Productivity and intensity indicators
- Decoupling indicators
- Polluter pay indicators

20. Environment protection expenditure on rehabilitation and residuals should also be captured. Having this data will enable NSOs to produce both monetary and physical accounts in these areas. Coupling these with other accounts, such as water, land and eco-systems will provide rich detail for analysing the impact of mining on the environment. Building upon this, indicators on environment management activity by mining businesses can be developed capturing not only expenditure, but whether businesses have environment management plans, environmental protection income, or eco-efficiency savings.

8.3.3. Rate of mineral resource use

21. Minerals, oil and gas are finite and non-renewable. Their consumption today poses a threat of scarcity to future generations. For the mining industry to be sustainable it would need to maintain a rate of resource use which is reasonable, that is, its consumption of resources does not go beyond a level which can ensure the availability of resources for the future of the industry and the people. This rate of resource use depends on a variety of factors including the rate of use of existing known resources, the rate at which new resources are discovered, and the rate of recycling of existing materials. If discoveries or recycling do not keep pace with the rate of use, depletion will result.

Main indicators

22. The main indicator here is the rate of depletion. SEEA 2012 (p. 146) defines depletion "in physical terms,[as] the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the extraction of the natural resource by economic units occurring at a level greater than that of regeneration." SEEA then states that for non-renewable resources "depletion is equal to the quantity of resource extracted." The reasoning behind this is that the regeneration of these resources is considerable in human time-scales.

23. The System of National Accounts (SNA) can provide a balance sheet approach to measuring changes in the stock of assets, however, it incorporates increases via discoveries that need to be separated out. Developing asset accounts for subsoil assets in conjunction with the SNA balance sheet approach will provide greater detail analysis. For more detail on these approaches see the 2008 SNA and SEEA 2012.

8.3.4. Use of energy and water by the mining industry

24. The mining industry is not a major user of energy compared to other industries, like manufacturing and electricity. The mining industry is not a high user of water, although most water consumed is sourced from the environment.

Main indicators

25. The main indicators to measure energy and water use here relate to intensity indicators such as the amount of energy per unit of value added. However, this may be difficult to measure as many mining corporations will potentially produce their energy on own account or extract it free from the environment in the case of water usage.

26. In this case an economy-wide set of water and energy accounts will enable analysis of the supply and use of these products. By compiling these alongside the SNA supply and use tables an integrated estimate of intermediate usage is formed between the environment and the economy.

8.3.5. Environmental management

27. In order to mitigate the adverse impacts from mining activities mentioned above, the mining industry and government undertake environmental management measures. These measures are aimed at the prevention, reduction or elimination of pollution or any degradation of the environment. They include waste management

and protection of biodiversity, landscape, air and climate. Protection mechanisms can be backed legislation from the government.

28. Environmental management involves the use of mechanisms in the development, operation and subsequent rehabilitation of mine sites. These mechanisms can be supported by regulation and legislation. In some countries the mining industry has introduced its own code for self-regulation.

Main indicators

29. The main indicators are the same as those above on environmental management activity and protection expenditure.

8.3.6. Restoration

30. The amount of 'rehabilitation' to an area disturbed by mining can range from restoration, where an area is brought to as near as possible to pre-mining condition, to re-contouring and revegetating to a state that is non-polluting and compatible with environmental regeneration and community expectations (Hancock 1993). Re-contouring can involve construction of pit walls and waste dumps, covering of reactive materials, dismantling of buildings/plant, revegetation, and ongoing environmental quality monitoring.

Main indicators

31. The main indicator here is the amount of expenditure spent on rehabilitation. This can be both government and industry expenditure Another useful indicator is the proportion of businesses who undertake rehabilitation activity. However, the appropriate use of standards is required in reporting rehabilitation activity to be of any analytical benefit.

32. The development of eco-system accounts would be of great benefit, especially if they are timely. Then assessments pre- and post-mine operations of the impact of the mine and rehabilitation can occur.

8.3.7. Oil and gas disasters

33. The environmental impact from an oil or gas disaster is discussed separately due to the scale of the impact. While the disasters can potentially be captured from the measurement of residuals, it is also the immediacy of the occurrence rather than at a constant rate over time that needs consideration. Monetary measures such as disaster recovery expenditure and government fines are available as indicators over

the short term. However, without developed eco-system account it may prove difficult to measure the longer term impact from the damage to the environment.

8.4. Environmental accounts and the mining industry

34. The SEEA 2012 recommends developing a suite of environmental accounts. The development of set of accounts would be valuable, although the level of detail for a country will be a determining factor in the usefulness of measuring the impact of mining on the environment. Hence, industry detail is priority, and if this is not available, then a satellite account approach may be more viable.

35. That is, environmental accounts could be developed in such a way to focus on the mining industry and its supply and use framework for energy, land, water, environmental protection expenditure, and other asset accounts.

36. The other important aspect of environmental accounts relates to their frequency. The SEEA 2012 recommends annual tables for its accounts, which is a similar practice for the supply and use tables in the SNA.

8.5. Data collection

37. Environmental statistics can be compiled from a variety of sources, including surveys, administrative data and satellite imagery. The important aspect for this handbook is to link these data sources with mining activity. While much of this linking could be down via analytical data sets such as environmental accounts, it is business surveys where environmental questions are asked that can also be a valuable instrument for data collection.

38. The FDES outlines succinctly the sources of environment statistics, and includes the following:

- Statistical surveys (e.g., censuses or sample surveys of population, housing, agriculture, enterprises, households, employment, and different aspects of environment management);
- Administrative records of government and non-government agencies in charge of natural resources as well as other ministries and authorities;
- Remote sensing and thematic mapping (e.g., satellite imaging and mapping of land use and land cover, water bodies or forest cover);
- Monitoring systems (e.g., field-monitoring stations for water quality, air pollution or climate);
- Scientific research;
- Special projects undertaken to fulfil domestic or international demand.

39. FDES 2013 provides a detailed discussion on these data sources on pages 25 to 32.

Chapter 9.

Priority statistics for economies based on natural resources

1. This chapter highlights those indicators that NSOs should prioritise for users. This is based on discussion among the Steering Committee and from consultation with key policy and decision makers. The discussion in previous chapters provides some of the rationale for choosing the priority list. The indicators listed here are essentially a summary. For more details see the chapter on standard indicators.

2. **Economy**

- Total production of mining products, by value and quantity
- Share of value added of the mining industry to Gross Value Added
- Total exports and imports
- Total exports and imports of the mining products
- Export and import prices of mining products and economy-wide aggregates (average prices for the period by product)
- Terms of trade index (ratio of export price index to import price index)
- Intermediate consumption of the mining industry
- Total income of the mining industry, including gross operating surplus.
- Mining inventories, by value and quantity.
- Measurement of mining fixed capital investment
- Measurement of foreign investment (both direct and portfolio)
- Measurement of government finances, including measuring of taxes and revenues from mining
- Measurement of mining impact on national income, including balance of payments incomes associated with mining and measures of real gross domestic income and real net national disposable income
- Number of multinational enterprises in the mining industry
- Number of mining companies with FDI, percentage of FDI
- Main indicators for informal mining (total output, intermediate consumption, value added, taxes paid).

3. Society

- Number of mining industry employees
- Number of foreign employees in the mining industry,
- Number of employees by type of occupation

- Total compensation of mining employees
- Number of mining related deaths
- Number of accidents at mining operations
- Number of internal migrants, by region
- Number of international migrants, by region
- Household income and expenditure, by region
- Population, by sex, age group and region
- Number of households, by region

4. Environment

- Measurement of environmental inputs into mining, both market and non-market, incorporating measurement in terms of value.
- Measurement of residuals and overburden from mining
- Measurement of degradation to land (including agricultural land) and ecosystems from mining activity and any subsequent rectification activity. This can also include water systems and oceans
- Land cover of mining
- Asset accounts for natural resource, by resource types
- Depletion of natural resources, by resource types
- Cost of environmental protection
- Environmental protection expenditure
- Natural resource management
- Environmental taxes.

5. Priorities for NSOs will ultimately depend on the resources available to them. The priorities listed in this chapter are guidelines for where they might direct those resources.

Chapter 10.

Remaining issues

1. Some of the issues that the manual is yet to consider are:

- Difficult conceptual areas, that are part of the research agenda for the System of National Accounts and the System of Environmental-Economic Accounting
- Difficult measurement issues, especially in relation to measuring the impacts from mining on society and the environment,
- Whether to expand the scope to other areas where natural resources are intertwined such as Agriculture, Tourism, Forestry and Fishing, and
- Implementation issues.

2. A dissemination strategy is potentially required although most NSOs are publishing these statistics in other frameworks, such as the national accounts and the environmental accounts. These will be covered under the IMF standards, such as enhanced General Data Dissemination Service (e-GDDS), Special Data Dissemination Service (SDDS), and SDDS+. However, the key focus should be about what users want and how they would receive the data. The issue to be determined is whether agencies would be willing to invest in compendiums that bring the disparate suite of statistics together or leave the status quo with data available in a range of publications. With most statistics available online, the cost of producing them is greatly reduced, especially if they are published elsewhere. Broad themes of mining statistics could be produced to cover the topics under consideration or provide links to other data publications.

3. An important aspect of this work will be the analytical commentary that places the data in context. This will enable users to understand and assess the impact of mining. On this basis NSOs must be acutely aware of what the user needs are, and whether their focus is on the economy, society or the environment.

4. At this stage the manual is not addressing green growth and green jobs, leaving this to other groups, such as the London Group to progress.

5. Finally the manual has not explicitly considered the Sustainable Development Goals, although the recommendations and guidelines in this handbook should not be inconsistent with these.

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Annex 1.

THE STATISTICAL INDICATORS TO MEASURE THE CONTRIBUTION OF THE MINING INDUSTRY TO THE ECONOMY

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
1. Measurement of mining production in terms of quantity and value	1	Total production of mining products, by value	1	The value of production corresponds to the sum of the values of all goods and services that are actually produced within an establishment during the reference period, and become available for use outside that establishment, plus any products produced for own final use. Source: (International Recommendations for Industry statistics 2008, 4.186)	The value of production at basic prices is calculated as follows: Gross output = Value of shipments/turnover/sales of goods or services produced by the establishment + Value of sale/turnover/shipments of all goods and services purchased for resale in the same condition as received - Purchases of goods and services for resale in the same condition as received + Receipts for industrial work done or industrial services rendered to others + Other revenues + Value of own-account fixed assets + Change in work-in-progress + Change in inventories of finished goods + Change in inventories of goods purchased for resale in the same condition as received. Source: (International Recommendations for Industry Statistics 2008, 4.186).
	2	Total production of mining products, by quantity and by commodity and level of processing and contents	1	The production is understood to be a physical process, carried out under the responsibility, control and management of an institutional unit, in which labour and assets are used to transform inputs of goods and services into outputs of other goods and services. Source: (SNA-2008, 1.40)	All products produced as outputs must be such that they can be sold on markets or at least be capable of being provided by one unit to another, with or without charge. The SNA includes within the production boundary all production actually destined for the market, whether for sale or barter.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
2. Measurement of prices of mineral commodities and the impact of mineral prices on the terms of trade, as well as mining-induced terms of trade impacts on the rest of the economy	3	Export and import unit price of mining products	1	The export and import unit price of mining products tells the price for per unit, such as per kilogram, per ton, etc., of what homogenous mining products to exported and imported. It expresses you the cost per measurement unit of a mining product.	The export and import unit price in particular group of mining products is the total value of mining products divided by total volume of the products.
	4	Export and import price index of mining products	2	An export price index (XPI) measures the rate of change in the prices of mining products sold by residents of that country to, and used by, foreign buyers. An import price index (MPI) measures the rate of change in the prices of mining products purchased by residents of that country from, and supplied by, foreign sellers. Source: (Export and Import Price Index Manual 2009, IMF, Page: xiii).	The two most commonly used index formulae are the Laspeyres and Paasche indices. The Laspeyres price index can be defined as the change in value of a basket of products whose composition is kept fixed as it was in the reference period 0. The Paasche index differs from the Laspeyres index in two respects. It uses a harmonic mean instead of an arithmetic average and the fixed period volumes or prices are those of the current period t. Source: (SNA-2008, 15.17, 15.18). The modified Laspeyres price index is used to estimate foreign trade index.
	5	Overall export and import price index	2	The higher-level indices up to and including the overall XMPIs are often calculated as young indices: that is, as weighted averages of the elementary price indices using weights derived from traded value shares in some earlier weight reference period. Source: (Export and Import Price Index Manual 2009, IMF, 1.309).	The required weight in calculation process is computed for share of each mining product, which was in base year total in export and import and define basket of foreign trade mining products. The exported and imported total value (cost) of mining products equals with quantity is multiplying by its unit price. The modified Laspeyres price index is used to estimate foreign trade index. $Vnt = P_{nt} * Q_{nt}$ V_{nt} – value (cost) n – product type

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					t – current period P_{nt} – price of product type n in current period Q_{nt} – quantity of product type n in current period To compute price indexes for overall and group according to share of each mining commodities in the total exports and imports as considered as index weight. Share of each commodity in total export and import is calculated on comparison between value of each commodity and value of export and import in base year. $W_{no} = \frac{P_{no} \times q_{no}}{\sum p_{no} \times q_{no}}$
	6	Terms of trade index (ratio of export price index to import price index)	2	The indicator is obtained by dividing an export unit value index by corresponding import unit value index. To estimate terms of trade index which shows foreign trade character based on comparison between export prices overall index and import price overall index.	A terms of trade index is calculated for a country as the ratio of its XPI to its MPI—a simple enough calculation. Source: (Export and Import Price Index Manual 2009, IMF, 1.322).
3. Measurement of intermediate consumption in the mining industry, including energy inputs	7	Intermediate consumption of the mining industry	1	Intermediate consumption consists of the value of the goods and services consumed as inputs by a process of mining production, excluding fixed assets whose consumption is recorded as consumption of fixed capital. Of which, the cost of energy consists of value of the electricity and thermal energy consumed in the production process. Source: (SNA-2008, 6.213)	It must be measured at purchasers' prices, i.e. the prices the purchaser actually pays for it. It also, can be calculate as sum of the value for goods and services consumed for production process of mining products. It does not include expenditures by mining enterprises on valuables consisting of works of art, precious metals and stones and articles of jewellery fashioned out of them. It also does not include costs incurred by the gradual using up of fixed assets owned by the mining enterprise.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					However, intermediate consumption does include the rentals paid on the use of fixed assets, whether equipment or buildings, that are leased from other institutional units under an operating lease, and also fees, commissions, royalties, etc., payable under licensing arrangements. The intermediate consumption not including labour costs, capital costs and taxes on the production itself such as license fees, etc.
	8	Cost of energy in the mining industry	3	Cost of the electricity in mining industry covers the total energy used for production activity of the mining industry at the particular period. It includes the purchased, generated, and sold electricity. Source: (International Recommendation on Industry Statistics-2008)	Sum of the value of electricity consumed for all production activity.
	9	Consumption of the water in mining industry, by volume	3	Consumption of the water in mining industry covers the volume of water used for production activity of the industry at the particular period. It could not cover the drinking water.	Sum of the volume of water consumed for all production activity.
	10	Share of the consumption of water, surface water and ground water in mining industry to total consumption of water	3	Consumption of the water covers the volume of water used for production activity of the mining industry at the particular period. It could not cover the drinking water. Surface water includes water in artificial reservoirs, lakes, rivers and streams, snow, ice and glaciers. Source: (FDES-2013, 3.131)	Sum of the volume of water consumed for all production activity.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				Ground water comprises water that collects in porous layers of underground formations known as aquifers. Source: (SEEA-CF, 5.481)	
	11	Share of the consumption of reused water to total consumption of water in mining industry	3	Reused water is wastewater supplied to a user for further use with or without prior treatment, excluding the reuse (or recycling) of water within mining industry. Source: (SEEA-CF, 3.207)	Share of the consumption of reused water to total consumption of water in mining industry is volume of reused water divided by total consumption of water in mining industry.
	12	Consumption of fuel in mining industry, by volume	3	Consumption of the fuel in mining industry covers the volume of fuel used for production activity of the industry at the particular period.	Sum of the volume of fuel consumed for all production activity.
	13	Cost of the management or consultant service in mining industry with foreign investment	3	Cost of the management or consultant service refers to all expenses in relation to management or consultant service in mining industry with foreign investment.	Total cost of management or consultant service basis cost of management and management or consultant service.
	14	Consumption of chemical products in the mining industry, by types of chemical product	3	Consumption of the chemical products in mining industry covers the volume of chemical products used for production activity of the industry at the particular period.	Sum of the volume of chemical products consumed for all production activity in particular type.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
4. Measurement of mining gross operating surplus	15	Total income of the mining industry	1	Mining gross operating surplus is the difference between total income and expenditure or income before tax of the mining activity at the current period.	
	16	Total expenditure of the mining industry	1		
5. Measurement of mining inventories	17	Inventories	2	Inventories are produced assets that consist of goods and services, which came into existence in the current period or in an earlier period, and that are held for sale, use in production or other use at a later date. Materials and supplies consist of all products that an enterprise holds in inventory with the intention of using them as intermediate inputs into production. Source: (SNA 2008, 10.131). Work-in-progress consists of output produced by an enterprise that is not yet sufficiently processed to be in a state in which it is normally supplied to other institutional units. Source: (SNA 2008, 10.134). Finished goods consist of goods produced as outputs that their producer does not intend to process further before supplying them to other institutional units. Source: (SNA 2008, 10.141). Goods for resale are goods acquired by enterprises,	The information on inventories is required principally to measure the value of changes in inventories. Changes in inventories consist in the difference (positive or negative) between the value of inventories at the end and their value at the beginning of the reference period. They may also be measured by the value of entries into inventories less the value of withdrawals and of any recurrent losses of goods held in inventories. Source: (International Recommendations for Industry Statistics 2008, 4.167).

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				such as wholesalers or retailers, for the purpose of reselling them to their customers. Source: (SNA 2008, 10.145).	
6. Measurement of mining fixed capital investment	18	Fixed assets, by type	2	Fixed assets are tangible or intangible assets used repeatedly or continuously in processes of production for more than one year as follows. Dwellings are buildings, or designated parts of buildings, that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are also included, as are public monuments identified primarily as dwellings. Source: (SNA 2008, 10.68). Other buildings and structures comprise non-residential buildings, other structures and land improvements. Source: (SNA 2008, 10.73). Machinery and equipment covers transport equipment, machinery for information, communication and telecommunications (ICT) equipment, and other	Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain specified expenditure on services that adds to the value of non-produced assets. Source: (SNA 2008, 10.32). The data item includes the value of all durable goods expected to have a productive life of more than one year and intended for use in the production process by the establishment (land, buildings, machinery, equipment and vehicles). Source: (International Recommendations for Industry Statistics 2008, 4.200). Fixed assets acquired from others should be valued at purchasers' prices, which should cover all costs directly connected with the acquisition and installation of the items for use. These costs of ownership transfer comprise the cost of purchase of the fixed assets on the market including taxes and fees paid to government, transport, delivery and installation charges, direct preliminary outlays, for example, for site clearance and the fees of architects, designers and engineers, and all legal costs. Indirect outlays for purposes of financing the acquisition of the fixed assets, for example, flotation costs in respect of security issues such as underwriters' commissions and

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				machinery and equipment. Source: (SNA 2008, 10.82).	registration charges, service charges in respect of loans, and expenses of special advertising campaigns are excluded. Such expenses are treated as intermediate consumption. For countries using the value added tax system, the deductible value added tax should be excluded. Source: (International Recommendations for Industry Statistics 2008, 4.202). Fixed assets acquired through barter are valued at their estimated basic prices plus any taxes payable and costs of ownership transfer. In principle, fixed assets produced on own account should also be valued in this manner. However, as this may be impracticable, particularly in the case of the construction of structures and other works and alterations, it may frequently be necessary to resort to valuing such own-account assets production at explicit cost, including any imputations that may be required in respect of the employed own-account labour. Source: (International Recommendations for Industry Statistics 2008, 4.203). Fixed assets produced by one establishment of a multi-establishment enterprise for the use of another establishment of the same enterprise should be valued by the receiving establishment as though purchased from outside the enterprise. Source: (International Recommendations for Industry Statistics 2008, 4.204). Disposal of fixed assets should be valued at the actual amounts realized rather than at book values. It should be

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					noted that only disposal should be deducted, and not decreases in inventories of fixed assets owing to other causes. Source: (International Recommendations for Industry Statistics 2008, 4.205).
	19	Military weapons	3	Weapons systems include vehicles and other equipment such as warships, submarines, military aircraft, tanks, missile carriers and launchers, etc.	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				Source: (SNA 2008, 10.87).	
	20	Cultivated biological resources	3	Cultivated biological resources cover animal resources yielding repeat products and tree, crop and plant resources yielding repeat products whose natural growth and regeneration is under the direct control, responsibility and management of an institutional unit. Source: (SNA 2008, 10.88).	
	21	Costs of ownership transfer on non-produced assets	3	Purchasing a fixed asset is often a complicated procedure that may involve using lawyers to establish legal title to the asset, engineers to certify that it is in satisfactory working order and so on. There may also be taxes to be paid occasioned by the change of ownership of the item. Further, in the case of highly complex machinery there may be significant costs associated with delivery and installation that were not included in the purchase price. Source: (SNA 2008, 10.48).	
	22	Research and development	3	Research and development consists of the value of expenditures on creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications. This does not extend to including human capital as assets within the SNA. Source: (SNA 2008, 10.103).	Research and experimental development (R&D) on own account consists of the value of expenditures on creative work undertaken on a systematic basis in order to devise new applications. By convention, output of own-account R&D production by enterprises is valued at the sum of costs, including the cost of unsuccessful R&D. Source: (International Recommendations for Industry Statistics 2008, 4.220). The sum-of-costs approach for R&D undertaken on own

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					account by enterprises is illustrated by the following identity: Output of own-account R&D = material and service costs (intermediate consumption) + Compensation of employees paid to R&D personnel + Other taxes less subsidies on production + Depreciation of capital goods used in R&D + A net return to fixed capital Source: (International Recommendations for Industry Statistics 2008, 4.221).
	23	Mineral exploration and evaluation	3	Mineral exploration and evaluation consists of the value of expenditures on exploration for petroleum and natural gas and for non-petroleum deposits and subsequent evaluation of the discoveries made. Source: (SNA 2008, 10.106).	
	24	Computer software and databases	3	Computer software consists of computer programs, program descriptions and supporting materials for both systems and applications software. Databases consist of files of data organized in such a way as to permit resource-effective access and use of the data. Source: (SNA 2008, 10.110, 112).	The formula used to calculate output is similar to that for R&D. Source: (International Recommendations for Industry Statistics 2008, 4.224). The creation of a database will generally have to be estimated by a sum-of-costs approach. Source: (International Recommendations for Industry Statistics 2008, 4.225).
	25	Entertainment, literary or artistic	3	Entertainment, literary and artistic originals consist of the original films, sound recordings, manuscripts, tapes,	Such works are frequently developed on own account which may be estimated by a sum-of-costs approach.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		originals		models, etc., on which drama performances, radio and television programming, musical performances, sporting events, literary and artistic output, etc., are recorded or embodied. Source: (SNA 2008, 10.115).	Source: (International Recommendations for Industry Statistics 2008, 4.226).
	26	Other intellectual property products	3	Other intellectual property products include any such products that constitute fixed assets but are not captured as research and development, mineral exploration and evaluation, computer software and databases or entertainment, literary and artistic originals. Source: (SNA 2008, 10.117).	
7. Measurement of financial investment (including foreign investment, both direct and portfolio) and associated incomes, including retained earnings	27	Financial investment	2	The financial account records transactions that involve financial assets and liabilities and that take place between residents and non-residents. Source: Balance of Payments and International Investment Position, chapter 8.	It may be of interest to show balances for components of the financial account. For example, analysts may be interested in net flows for each functional category—such as net direct investment derived as net acquisition of direct investment assets less net incurrence of direct investment liabilities.
	28	Foreign direct investment	2	Foreign direct investment (FDI) is defined as the establishment of a lasting interest in and significant degree of influence over the operations of an enterprise in one economy by an investor in another economy. Source: Measuring International Investment by Multinational Enterprises, 4th edition, OECD, page 5, FDI Statistics, International Monetary Fund, 2003 page 23,	There are three main components to FDI statistics: 1) financial flows, which capture debt and equity investments between related parties in a specific period; 2) income, which represents the return on equity and debt investment to the direct investor in a specific period; and 3) positions, which are the value of the accumulated direct investment at a specific point in time—it is also referred to as the stock of FDI.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				152, 154.	
	29	Other investment	2	Other investment is a residual category that includes positions and transactions other than those included in direct investment, portfolio investment, financial derivatives and employee stock options and reserve assets. Source: SNA 2008 26.94, Balance of Payments and International Investment Position Manual 6th edition 6.61	Other investment includes the remainder of the following financial instruments: a. other equity; b. currency and deposits; c. loans (including use of IMF credit and loans from the IMF); d. non-life insurance technical reserves, life insurance and annuities entitlements, pension entitlements and provisions for calls under standardized guarantees; e. trade credit and advances; f. other accounts receivable/payable; and g. SDR allocations (SDR holdings are included in reserve assets).
	30	Cash flow	2	Cash flow is the money that comes in and goes out of a mining company. It is the generation of income and the payment of expenses. Cash inflows result from either the generation of revenue through the selling of goods and services, money borrowed, or money earned through investments. Source: http://study.com/academy/lesson/what-is-cash-flow-definition-calculation-example.html	Free cash flow (FCF) measures how much cash you generate after taking into account capital expenditures for such things buildings, equipment, and machinery. The formula is: FCF = Operating Cash Flow - Capital Expenditures Operating cash flow (OCF) is the measure of your company's ability to generate positive cash flow from its core business activities. Here's the formula: OCF = Earnings before Interest and Taxes + Depreciation

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					+ Amortization - Taxes
8. Measurement of impact of mining on trade statistics, including coherency with production statistics	31	Total sales of the domestic trade sector	2	Sales revenue is the total amount of the sales and services in the reporting time. Source: UNSD, 2008, "International recommendation of Internal Trade Statistics".	Trade sector entities shall be the sum of net sales.
	32	Total sales of the mining products at the domestic market, by types of minerals	1	Amount of sales of mining products sold in the domestic market, by type of minerals.	
	33	Total exports and imports	1	Export: A function of international trade where by goods produced in one country are shipped to another country for future sale or trade. Import: A goods or service brought into one country from another. Source: International Merchandise Trade Statistics, Concepts and Definitions 2010.	Total export: including in the country's direct exports of goods and re-export of foreign goods. Total import: including in the direct import of foreign goods and re-import of the country's goods
	34	Total exports and imports of the mining products	1	Export: Mining products produced in one country are shipped to another country for sale or trade. Import: Mining product brought into one country from another.	Total export and import of the mining products.
9. Measurement of mineral exploration,	35	Total output of mineral explorations, by	1		

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
discoveries and sub-soil reserves		types of mineral, by physical quantity			
	36	Number of discoveries, by mineral resources in physical quantity	1		
	37	Soil resource, by physical quantity	1		
10. Measurement of the impact of mining on government budget including measuring of taxes on mining	38	Corporation income tax	1	Taxes on the income of corporations consist of corporate income taxes, corporate profits taxes, corporate surtaxes, etc. Source: Glossary of Statistical Terms of OECD page 776, SNA 2008 8.58 b [OECD 1210].	Such taxes are usually assessed on the total incomes of corporations from all sources and not simply profits generated by production (GFSM2001, 1112; OECD, 1210)
	39	Value added tax, repayment of VAT	1	Value-added taxes (VAT) (11411) are taxes on goods or services collected in stages by enterprises but that are ultimately charged in full to the final purchasers. Source: SNA 2008 7.89, 6.55-6.62, GFSM2001 11411.	
	40	Royalty	1	"Royalties" is the term often used to describe either the regular payments made by the lessees of subsoil assets to the owners of the assets (these payments are treated as rents in the System of National Accounts (SNA)) or the payments made by units using processes or producing products covered by patents (these are	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				treated as purchases of services produced by the owners of the patents in the SNA). Source: SNA 2008 7.110, 7.160	
	41	Fee for exploration and mining special permit of the mineral resources	1		
	42	Other royalty	1		
	43	Cumulative royalty	2	A term that most commonly refers to a single company having to pay patent license fees/royalties to numerous companies in the same or a similar field. Source: Technology and IP law Glossary	
	44	Exports duties	2	Export duties consist of general or specific taxes on goods or services that become payable when the goods leave the economic territory or when the services are delivered to non-residents; profits of export monopolies and taxes resulting from multiple exchange rates are excluded. Source: OEDC-Glossary https://stats.oecd.org/glossary/detail.asp?ID=910, Glossary of Statistical Terms page 280.	The contributions to percent change in a real aggregate, such as real GDP, provide a measure of the composition of growth in the aggregate that is not affected by the non-additivity of its components. This property makes contributions to percent change a valuable tool for economic analysis. The contribution to percent change (C% Δi,t) in an aggregate in period t that is attributable to the quantity change in component i is defined by the formula aggregate.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
	45	Contributions and donations to the local government and individuals from the mining enterprises	2	Employers' social contributions are social contributions payable by employers to social security funds or other employment-related social insurance schemes to secure social benefits for their employees. Source: A Guide to the National Income and Product Accounts of the United States Page 28, Balance of Payments and International Investment Position Manual 6th edition 11.22	The contributions to percent change in a real aggregate, such as real GDP, provide a measure of the composition of growth in the aggregate that is not affected by the non-additivity of its components. This property makes contributions to percent change a valuable tool for economic analysis. The contribution to percent change (C% Δi,t) in an aggregate in period t that is attributable to the quantity change in component i is defined by the formula aggregate.
11. Measurement of productivity in the mining industry	46	Total productivity of mining industry	1	Productivity expresses the relationship between the output of goods and services (real output) and the various inputs required for production. Productivity is commonly defined as a ratio between the output volume and the volume of inputs. In other words, it measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output. Source: Measuring Productivity, OECD manual, 2001, page 12, http://statsmauritius.govmu.org/English/Documents/product.pdf, http://www.oecd.org/std/productivity-stats/40526851.pdf	Ratio between the output volume and the volume of inputs
	47	Total factor productivity of mining industry	1	A measure that takes account of the contributions of both labour and capital to growth in output is multifactor productivity (MFP), which is sometimes referred to as total factor productivity (TFP). The advantage of using MFP as the measure of productivity	multifactor productivity index= output index/ input index

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				is that it includes effects not included in the labour and capital inputs. Source: SNA 2008- 16.64, http://statsmauritius.govmu.org/English/Documents/product.pdf	
	48	Labour productivity of mining industry	1	Labour productivity is a revealing indicator of several economic indicators as it offers a dynamic measure of economic growth, competitiveness, and living standards within an economy. It is the measure of labour productivity (and all that this measure takes into account) which helps explain the principal economic foundations that are necessary for both economic growth and social development. Source: Labour Productivity Indicators, OECD, 2008, page from 5.	Labour productivity is equal to the ratio between a volume measure of output (gross domestic product or gross value added) and a measure of input use (the total number of hours worked or total employment). Labour productivity = volume measure of output / measure of input use
	49	Fixed capital productivity of mining industry	1	Measures of capital productivity, calculated by dividing the volume of output by an index of capital services provided, suffer from similar drawbacks since they do not capture the effects of the amount of labour employed and the efficiency and composition of the capital inputs. Source:SNA-200819.63, http://statsmauritius.govmu.org/English/Documents/product.pdf	The capital productivity index shows the rate of change in output per unit of capital. Capital Productivity Index= Output index/ capital input index* 100
	50	Main raw material productivity of	1	The indicators "energy productivity" and "raw material	Raw material productivity is derived from the ratio between gross domestic product and abiotic material

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		mining industry		productivity" are used for measurement purposes. Source: Environment-Economic Accounting (EEA), Federal Statistical Office German, Jan 2010, page from 2	used.
	51	Energy productivity of mining industry	1	International Energy Agency, Key World Energy Statistics 2014 (Paris: IEA, 2014) defines energy productivity as the volume of services or products that can be generated per unit of energy. It is not the same as energy efficiency, which measures the inverse, i.e., how much energy is needed to produce a given level of output. Source: A new approach to measuring the Energy Productivity of an Economy, Chi Yuan Liang, Research Fellow The Institute of Economics, Academia Sinia, International Energy Agency, Key World Energy Statistics 2014 (Paris: IEA, 2014)	Energy Productivity, which is defined as the ratio of output divided by energy consumption, is a useful indicator for understanding the energy efficiency of an industry or an economy. The GDP from the National Income Accounts/ The Energy Consumption from the Energy Balance Table
12. Measurement of construction activity associated with the mining industry	52	Construction, capital repairs and maintenances associated with the mining industry, by type.	2	Construction work includes the activities of building of houses, bridges, banks as engineering construction and creating of fixed capital, expansion, repairs, restoration. Residential building is a building should be regarded as residential building when more than half of the floor area is used for dwelling purposes. Non-residential building is a building is regarded as a non-residential building when the minor part of the building (i.e. less than half of its gross floor area) is used for dwelling purposes.	International Recommendations for Construction Statistics, UN, 1997 and Bulletin of Housing and Building Statistics for Europe and North America, UNECE, Geneva, 2000

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				Civil engineering construction includes all construction work not classified under building construction, that is, construction of railways, roads, bridges, highways, airports, water and sewage, dams and irrigation, etc.	
	53	Capitalized repairs and maintenances, by type	2	Repairs and maintenance covers all construction work not included under new construction. Such repairs may be broken down into capital repairs and current repairs and maintenance.	International Recommendations for Construction Statistics, UN, 1997
13. Measurement of impact of mining on transportation	54	Freight turnover of the mining products, by type and mln.ton km	3	**Freight turnover** is estimated by multiplying the total amount of the weight of transported cargo by the shipping distance. **Railway**: Unit of measurement of goods transport which represents the transport of one tonne of goods over a distance of one kilometre. Source: Glossary for Transport Statistics (UNECE) AV-20 **Road**: Unit of measurement of goods transport which represents the transport of one tonne by road over one kilometre. Source: Glossary for Transport Statistics (UNECE) B.V-22 **Water**: Unit of measurement of goods transport which represents the transport of one tonne by inland	The distance to be covered is the distance actually travelled on the considered network. To avoid double counting each country should count only the km performed on its territory. If it is not available, then the distance charged or estimated should be taken into account. The distance to be taken into consideration is the distance actually run.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				waterways over one kilometre Source: Glossary for Transport Statistics (UNECE) C.V-21	The distance taken into account is the distance performed in the reporting country.
	55	Carried freight of the mining products, by ton	3	Amount of mining products that are carried by railway, road, or water vehicles. Source: Glossary for Transport Statistics (UNECE) A.V-16 Source: Glossary for Transport Statistics (UNECE) B.V-18 Source: Glossary for Transport Statistics (UNECE) C.V-17	Total volume of mining products that are carried by railway, road, or water vehicles. This includes all packaging and equipment, such as containers, swap-bodies or pallets as well as road goods vehicles carried by railway, road, or water.
14. Measurement of other economic activity to support the mining industry, including role of input-output analysis	56	Total supply, by products and economic activities	2	The amount of a product available for use within the economy must have been supplied either by domestic production or by imports. The same amount of the product entering an economy in an accounting period must be used for intermediate consumption, final consumption, capital formation (including changes in inventories) or exports. Source: SNA-2008, 14.4.	Output + imports = intermediate consumption + final consumption + capital formation + exports Total supply by product = Total use by product
	57	Total use, by products and economic activities	2	A use table can be viewed as a rectangular table with four quadrants, two in the upper part and two in the lower part. The upper left quadrant consists of a sub-matrix showing the use of different products by different	Total use by product=Intermediate consumption by product and by industry+Final uses by product and by category

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				groups of producing units. In other words, this quadrant contains intermediate consumption, disaggregated by product in the rows and by industries in the columns. The upper right quadrant consists of a sub-matrix showing the use of different products by final consumers, a sub-matrix for exports and a sub-matrix showing the use of different products for capital formation. Together these three submatrices show final demand. The lower left quadrant contains information on value added disaggregated to show the elements of the generation of income account, that is compensation of employees, gross operating surplus or gross mixed income and taxes less subsidies on production. Source: SNA-2008, 14.84.	
		'IOT analysis. In which:			
	58	o Production multiplier, by economic activities	3	An output multiplier for a sector j is defined as the total value of production in all sectors of the economy that is necessary at all stages of production in order to produce one unit of product j for final demand. Source: Eurostat Manual of Supply, Use and Input-Output Tables 15.1.7	As we are assuming constant returns to scale, the effect on the economy is seen by multiplying (I-A)〗^(-1) by a final demand vector that has unity in the sector we are concerned with and zero elsewhere, i.e. the vector of value multipliers is defined as 〖i^' (I-A)〗^(-1). This is just the column sum of the Leontief inverse. Here (i) is the unit vector and a prime indicates the transpose
	59	o Income multiplier, by economic	3	Income multipliers attempt to identify the impacts of final demand changes on income received by households (labour supply). The static input-output models are used to calculate the direct and indirect	Z = B(I-A)(-1) Direct and indirect requirements for wages B = vector of input coefficients for wages

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		activities		requirements for wages which are incorporated in one unit of output for final demand. Source: Eurostat Manual of Supply, Use and Input-Output Tables 15.1.7	I = unit matrix A = matrix of input coefficients for intermediates Z = vector with results for direct and indirect requirements for wages
	60	o Labour multiplier, by economic activities	3	When employment multipliers are calculated, the major difference to the calculation of the wage content of products is that this time physical labour input coefficients are used instead of monetary labour input coefficients. Source: Eurostat Manual of Supply, Use and Input-Output Tables 15.1.7	Z = E(I - A)(-1) Direct and indirect requirements for labour E = matrix of input coefficients for labour (1.000 persons per millions of DEM of output) Z = matrix with results for direct and indirect requirements for labour (persons)
	61	o Backward and forward linkages, by economic activities	3	Impact models can measure the effect an industry's production has on other industries in the economy in two ways. If an industry increases its production, there will be increased demand on the industries that produce the intermediate inputs. Models that measure impacts based on this type of relationship are called backward-linkage models. If an industry increases its production, there will also be an increased supply of output for other industries to use in their production. Models that measure impacts based on this type of relationship are called forward-linkage models. Source: Eurostat Manual of Supply, Use and Input-Output Tables 15.1.7	
15. Measurement	62	The impacts of			

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
of 'down-stream' economic impacts of mining, including the manufacturing of mineral products		the mining to the other economic industries' productions, especially:			
	63	o Total production of the electricity, gas, steam and air conditioning supply	3	Total production of the electricity, gas, steam and air conditioning supply	The total amount of electricity, thermal energy and water supply sector.
	64	o Total production of the water supply; sewerage, waste management and remediation activities	3	Total production of the water supply, sewerage, waste management and remediation.	The total amount of water supply, sewerage, waste management and remediation sector.
	65	o Total production of the wholesale and retail trade; repair of motor vehicles and motorcycles	3	Total production of the wholesale and retail trade; repair of motor vehicles and motorcycles.	The total amount of wholesale and retail trade; repair of motor vehicles and motorcycles sector.
	66	o Total production of the transportation	3		

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		and storage			
	67	o Total imports of the heavy machinery, mechanism and equipment	3	Total imports of the heavy machinery, mechanism and equipment.	The total value of imported heavy machinery, mechanism and equipment.
16. Measurement of infrastructure to support mining activity	68	Fixed telephone lines per 100 inhabitants	2	Fixed telephone lines refer to telephone lines that connect a subscriber's terminal equipment to the public switched telephone network (PSTN) and that have a dedicated port on a telephone exchange. Source: Core ICT indicators 2010, Partnership on measuring ICT for development, ITU, page 12, indicator A1	Fixed telephone lines per 100 inhabitants are calculated by dividing the number of fixed telephone lines by the total population and then multiplying by 100.
	69	Proportion of households with a radio	2	A radio is defined as a device capable of receiving broadcast radio signals, using common frequencies, such as FM, AM, LW and SW. A radio may be a stand-alone device, or it may be integrated with another device, such as an alarm clock, an audio player, a mobile telephone or a computer. Source: Manual for Measuring ICT Access and Use by Household and Individuals, 2014 edition, ITU, page 45, indicator HH1	The proportion of households with a radio is expressed as a percentage and is calculated by dividing the number of in-scope households with a radio by the total number of in-scope households, and then multiplying the result by 100.
	70	Proportion of households with a television	2	A television (TV) is a device capable of receiving broadcast television signals, using popular access means such as over-the-air, cable and satellite. A television set is typically a stand-alone device, but it	The proportion of households with a TV is expressed as a percentage and is calculated by dividing the number of in-scope households with a TV by the total number of in-

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				may also be integrated with another device, such as a computer or a mobile telephone. Source: Manual for Measuring ICT Access and Use by Household and Individuals, 2014 edition, ITU, page 46, indicator HH2	scope households, and then multiplying the result by 100.
	71	Proportion of individuals using a mobile cellular telephone	2	A mobile (cellular) telephone refers to a portable telephone subscribing to a public mobile telephone service using cellular technology, which provides access to the PSTN. This includes analogue and digital cellular systems and technologies such as IMT-2000 (3G) and IMT-Advanced. Users of both post-paid subscriptions and prepaid accounts are included. Source: Manual for Measuring ICT Access and Use by Household and Individuals, 2014 edition, ITU, page 60, indicator HH10.	The proportion of individuals using a mobile telephone is expressed as a percentage and is calculated by dividing the total number of in-scope individuals using a mobile telephone by the total number of in-scope individuals, and then multiplying the result by 100.
	72	Proportion of businesses using computer	2	A computer refers to a desktop computer, a laptop (portable) computer or a tablet (or similar handheld computer). It does not include equipment with some embedded computing abilities, such as smart TV sets, and devices with telephony as their primary function, such as smartphones. Source: Core ICT indicators 2010, Partnership on measuring ICT for development, ITU, page 36, indicator B1.	The proportion of businesses using computers is calculated by dividing the number of in-scope businesses using computers during the reference period by the total number of in-scope businesses. The result is then multiplied by 100 to be expressed as a percentage.
	73	Proportion of households with	2	The Internet is a worldwide public computer network. It provides access to a number of communication services	The proportion of households with Internet is expressed as a percentage and is calculated by dividing the number

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		Internet		including the World Wide Web and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only via a computer – it may also be by mobile telephone, tablet, PDA, games machine, digital TV etc.). Access can be via a fixed or mobile network. Source: Manual for Measuring ICT Access and Use by Household and Individuals, 2014 edition, ITU, page 53, indicator HH6.	of in-scope households with Internet by the total number of in-scope households, and then multiplying the result by 100.
	74	Proportion of businesses using the Internet	2	The Internet is a worldwide public computer network. It provides access to a number of communication services including the World Wide Web and carries e-mail, news, entertainment and data files. Source: Core ICT indicators 2010, Partnership on measuring ICT for development, ITU, page 37, indicator B2.	The proportion of businesses using the Internet is calculated by dividing the number of in-scope businesses using the Internet by the total number of in-scope businesses. The result is then multiplied by 100 to be expressed as a percentage.
	75	Energy and public services	1	Public service includes electricity supplied and services rendered to municipalities or divisions or agencies of State or Federal governments under special contracts, agreements, or service classifications applicable only to public authorities. Source: ISIC divisions: 33, 36-39, 45-96 and 99, excluding ISIC 8422.	
	76	Petrol and gas tubes	1		

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
	77	Electric adjustment assets	1		
	78	Allocation and transmission system	1	An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers or is delivered to other electric systems. Source:http://www.eia.gov/tools/glossary/index.cfm?id=T	
	79	Water supply purification	1	Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. The goal is to produce water fit for a specific purpose. Most water is disinfected for human consumption (drinking water), but water purification may also be designed for a variety of other purposes, including fulfilling the requirements of medical, pharmacological, chemical and industrial applications. Source:https://en.wikipedia.org/wiki/Water_purification	
17. Measurement of mining impact on national income, including balance of payments incomes	80	Value added of mining sector, by volume change	1	When gross domestic product (GDP) is derived by summing final domestic expenditures and exports and subtracting imports, or by subtracting intermediate consumption from output and adding taxes less subsidies on products, volume measures of GDP can be obtained provided that the volumes being aggregated	The gross value added of an establishment, enterprise, industry or sector is measured by the amount by which the value of the outputs produced by that establishment, enterprise, industry or sector exceeds the value of the intermediate inputs consumed. This may be written as: where the Q's refer to outputs, P's their basic prices, q's to

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
associated with mining and measures of real gross domestic income and real net national disposable income				are additive, (that is, are based on the Laspeyres formula). Source: (SNA 2008, 15.132-138).	intermediate inputs and p's their purchasers' prices. Value added in year t at prices of year t is given by: while value added in year t at the prices of the base year, 0, is given by: This measure of value added is generally described as being obtained by "double deflation" as it can be obtained by deflating the current value of output by an appropriate (Paasche-type) price index and by similarly deflating the current value of intermediate consumption. Source: (SNA 2008, 15.134).
	81	Annual change of value added of mining sector	1	Annual changes refer to annual changes in levels expressed over the previous year. Annual growth rates are annual rates of change expressed over the previous year. Source: "Glossary of statistical terms" OECD 2007	Annual change=Xt-Xt-1; Percent change=Xt/Xt-1*100; X-value added of mining sector; t- current year; t-1-previous year
	82	The share of value added of mining sector to the GDP	1		The share of value added of mining sector is value added of mining sector divided by GDP.
	83	GNI	1	Primary incomes generated in the production activity of resident producer units are distributed mostly to other resident institutional units; however, part of them may go to non-resident units. Symmetrically, some primary incomes generated in the rest of the world may come from resident units. This leads to the definition and measurement of gross national income (GNI).	GNI is equal to GDP less primary incomes payable to non-resident units plus primary incomes receivable from non-resident units. In other words, GNI is equal to GDP less taxes less subsidies on production and imports, compensation of employees and property income payable to the rest of the world plus the corresponding items receivable from the rest of the world.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				Source: (SNA 2008, 2.143).	Source: (SNA 2008, 2.143).
	84	Annual change of GNI	1	Annual changes refer to annual changes in levels expressed over the previous year. Annual growth rates are annual rates of change expressed over the previous year. Source: Glossary of statistical terms" OECD 2007	Annual change=Xt-Xt-1; Percent change=Xt/Xt-1*100; X-GNI; t-current year; t-1-previous year
	85	GNI per capita	1	Per capita growth rates in real national income or in real actual consumption generally provide a better measure of the changes in the average "welfare" of a country's population than the changes in GDP volumes. GDP is a measure of production within a country but the inflows or outflows of income from or to the rest of the world can have a significant effect on both the level and growth rates in real national income per capita. Source: (SNA 2008, 19.14).	GNI per capita is gross national income divided by midyear population.
	86	RNND /NDI/	1	Primary incomes receivable by resident institutional units may be used in part to make transfers to non-resident units and resident units may receive transfers originating out of primary incomes in the rest of the world. Gross national disposable income measures the income available to the total economy for final consumption and gross saving. By deducting the consumption of fixed capital from gross national disposal income, net national disposable income is obtained. National disposable income is the sum of disposable income of all resident institutional units or	Gross national disposable income is equal to GNI less current transfers (other than taxes, less subsidies, on production and imports) payable to non-resident units, plus the corresponding transfers receivable by resident units from the rest of the world. Source: (SNA 2008, 2.145).

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				sectors. Source: (SNA 2008, 2.145).	
18. Measurement of national wealth	87	Natural resource (oil, coal, natural gas, minerals etc.)	1	Natural resources are natural assets (raw materials) occurring in nature that can be used for economic production or consumption. Natural resources cover mineral and energy resources, soil, water and biological resources. Source: 'Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997, page 51, SNA 2008 10.15, SEEA-CF 2.101, 5.18, https://stats.oecd.org/glossary/detail.asp?ID=1740.	Natural resources are a sub-set of environmental assets. Natural resources include all natural biological resources (including timber and aquatic resources), mineral and energy resources, soil resources and water resources. All cultivated biological resources and land are excluded from scope.
	88	Produced assets (machinery and equipment, buildings and urban land)	1	Produced assets are non-financial assets that have come into existence as outputs from processes that fall within the production boundary of the SNA. Source: SNA 2008- 10.9a, 10.10, A3.51	
	89	Human resource (number of employees)	1	The resource that resides in the knowledge, skills, and motivation of people.	
19. Measurement of impact of mining on regional economies (including regional prices and	90	Consumer price index, by goods and regions	2	Consumer price indices (CPIs) are index numbers that measure changes in the prices of goods and services purchased or otherwise acquired by households, which households use directly, or indirectly, to satisfy their own needs and wants. Source: (Consumer price index manual: Theory and	$P^(t/0)=(\sum_i p_i^t \ q_i^b)/(\sum_i p_i^0 \ a \ i^b)$ p_i^t = price for i^{th} item (or product) at time t. p_i^0 = price for ith product (or item) at time 0, the price reference period (or base period) qib = quantity of ith item purchased during the weight (or basket) reference period. Source: (Practical guide for

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
regional housing markets)				practice 2004, 1.3)	producing consumer price index 2009, 10.4)
	91	Housing price index, by regions	3	The housing price index (HPI) shows the changes of residential properties purchased by households (flats, detached houses, terraced houses, etc.) both newly-built and existing ones, independently of their final use and independently of their previous owners. Source: (http://ec.europa.eu/eurostat/statistics-explained/index.php/Housing_price_statistics_-_house_price_index)	Four main methods have been suggested in the literature to control for changes in the amounts of the property characteristics: stratification or mix adjustment, repeat sales methods, hedonic regression methods, and the use of property assessment information. Stratification of transactions according to some of the price determining characteristics is a straightforward and computational simple way to adjust for changes in the quality mix of the samples in different time periods. By defining a number of reasonably homogeneous strata or cells, the average selling price within each cell can be used as a (proxy to a) constant quality price for that type of property. Regular index number theory can then be applied to aggregate up the average prices by cell into an overall index. Such stratification methods are also known as mix adjustment methods. The repeat sales method addresses the quality mix problem by comparing properties that have sold more than once over the sample period. Restricting the comparison to units that have sold repeatedly ensures that the price relatives compare like with like, provided that the quality of the houses remained unchanged. The standard repeat sales method is based on a regression model where the repeat sales data pertaining to all periods are pooled. Hedonic regression methods can in principle adjust for such quality changes in addition to changes in the quality mix of the samples. These methods utilize information on the relevant property characteristics

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					to estimate quality adjusted price indices using regression techniques, though it may prove difficult to sufficiently control for location. Many countries tax real estate property and are likely to have an official property valuation office that provides periodic appraisals of all taxable real estate properties. Assessment-based methods combine selling prices with appraisals to compute price relatives (sale price appraisal ratios) and control for quality mix changes. Source: (Handbook on Residential property prices indices (RPPIs), 2013, 3.20, 3.21, 3.22, 3.23, 3.24)
20.General measurement issues, including dealing with multinational enterprises, dealing with confidentiality issues, correction of 'off year' reporting, ensuring coherence of information from different sources and consistency thereof, by developing a	92	Number of multinational enterprises at the mining industry	3	Number of multinational enterprises in mining sector that is an organization that owns or controls production of goods or services in one or more countries other than their home country.	Total number of multinational enterprises in mining sector.
	93	Number of mining companies with FDI, percentage of FDI	3	Number of mining companies with FDI that are registered in Business Register. A foreign direct investment (FDI) is an investment made by a company or entity based in one country, into a company or entity based in another country.	Total number of mining companies with FDI.
	94	Main indicators of the artisanal mining (total output, intermediate consumption, value added, total tax paid,	3	A citizen who is not a member of any partnership but explores mineral resources through artisanal mining. Of them total output, intermediate consumption, value added, total tax paid, contributions to the local government, number of employees, land damage, remediation.	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
coordinated approach to large mining projects, measuring informal mining activity)		contributions to the local government, number of employees, land damage, remediation)			
21. Measurement of the procurement of nationally produced goods and services	95	Total procurement of nationally produced goods and services of the mining enterprises	2		

THE STATISTICAL INDICATORS TO MEASURE THE IMPACT OF THE MINING INDUSTRY ON THE SOCIAL SECTOR

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
1. LABOR FORCE					
1.1. Measuring employment in the mining industry	96	Number of employees at the mining sector	1	Employees are all those workers who hold the type of job defined as "paid employment jobs" in mining industry. Paid employment jobs are those jobs where the incumbents hold explicit (written or oral) or implicit employment contracts which give them a basic remuneration which is not directly dependent upon the revenue of the unit for which they work (this unit can be a corporation, a non-profit institution, a government unit or a household). Some or all of the tools, capital equipment, information systems and/or premises used by the incumbents may be owned by others, and the incumbents may work under direct supervision of, or according to strict guidelines set by the owner(s) or persons in the owners' employment. Persons in "paid employment jobs" are typically remunerated by wages and salaries, but, may be paid by commission from sales, by piece-rates, bonuses or in-kind payments such as food, housing or training. Source: International Labour Organization (ILO) Resolutions Concerning International Classification of Status in Employment Adopted by the 15th International Conference of Labour Statisticians,	(a1) "at work": persons who during the reference period performed some work for wage or salary, in cash or in kind; (a2) "with a job but not at work": persons who, having already worked in their present job, were temporarily not at work during the reference period and had a formal attachment to their job. This formal job attachment should be determined in the light of national circumstances, according to one or more of the following criteria: (i) the continued receipt of wage or salary; (ii) an assurance of return to work following the end of the contingency, or an agreement as to the date of return; (iii) the elapsed duration of absence from the job which, wherever relevant, may be that duration for which workers can receive compensation benefits without obligations to accept other jobs;

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				January 1993, para. 6.	
	97	Number of foreign employees at the mining sector, by nationality	1	A person who migrates or who has migrated from one country to another with a view to being employed in mining industry other than on his own account. Source: ILO	
	98	Number of engineering and technical staffs	1	Physical and engineering science technicians perform technical tasks to aid in research on and the practical application of concepts, principles and operational methods particular to physical sciences including such areas as engineering, technical drawing or economic efficiency of production processes. Source: International Standard Classification of Occupation ISCO-08, International Labour Office, Geneva, 2012, page 170	Tasks performed usually include: undertaking and carrying out technical work related to chemistry, physics, geology, meteorology, astronomy, engineering, or technical drawing; setting up, operating, and maintaining laboratory instruments and equipment, monitoring experiments, making observations, and calculating and recording results; preparing materials for experimentation; conducting tests of systems; collecting and testing samples; recording observations and analysing data; preparing, revising and interpreting technical drawings, wiring diagrams, circuit board assembly diagrams, or layout drawings.
1.2. Measuring the demographic characteristics of the mining labour	99	Mining labour, by working age	2	For statistical purposes, the working age population comprises all persons above a specified minimum age threshold for which an inquiry on mining activity is made. Source: https://www.ilo.org/ilostat/faces/home/statisticaldata/conceptsdefinitions?_afrLoop=4284023318850814#%40%3F_afrLoop%3D4284023318850814%26_adf.ctrl-	For purposes of international comparability, the working age population is commonly defined as persons aged 15 years and older, but this varies from country to country. In addition to using a minimum age threshold, certain countries also apply a maximum age limit. Adoption of a specified upper age limit means that all persons above that age limit are excluded from the count of the working age

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				state%3D303iff4lm_4	population. Most countries, however, do not use a maximum age limit. Data by age are provided according to 5-year: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74 and 75+. Whenever this data was not available, 10-year age bands are used: 15-24, 25-34, 35-44, 45-54, 55-64 and 65+.
	100	Mining labour, by sex	2		
	101	Mining labour, by level of education	2		
	102	Mining labour, by occupation	2	Information on occupation provides a description of the set of tasks and duties which are carried out by, or can be assigned to, one person. Persons are classified by occupations through their relationship to a present job, for employed persons, or a past job, for persons who are unemployed. Topics disaggregated by occupation are provided according to the latest version of the International Standard Classification of Occupations (ISCO) available for that year. Data may have been regrouped from the national occupational classification, which may not be strictly compatible with ISCO. Source: https://www.ilo.org/ilostat/faces/home/statisticaldata/c	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				onceptsdefinitions?_afrLoop=4284023318850814#%40%3F_afrLoop%3D4284023318850814%26_adf.ctrl-state%3D303iff4lm_4	
1.3. Measuring of the impact of the supply of labour on other parts of the economy due to changes in the demand for labour from the mining industry.	103	Employment elasticity of mining industry	1	The employment elasticity is defined as the average percentage point change in employment for a given employed population group associated with a 1 percentage point change in output over a selected period.	
2. INCOME					
2.1. Measuring mining wages and salaries, total and averages; 2.2. Measuring the distribution of mining incomes, including gender distributions.	104	Total compensation of employees of the mining industry	1	The concept "Compensation employees" which is defined as: The total remuneration, in cash or in kind, payable by enterprise to an employee in return for work done by the latter during the accounting period. Source: SNA 2008	The aggregate of compensation received by all the employees of the mining sector. Compensation of employees has two main components: 1. Wages and salaries payable in cash or in kind, 2. the value of the social contributions payable by employers.
	105	Monthly average wages and salaries of employees of the mining industry, by sex and type of occupations	2	Wages and salaries include the values of any social contributions, income taxes, etc.., payable by the employee even if they are actually withheld by the employer for administrative convenience or other reasons and paid directly to social insurance schemes, tax authorities, etc.,.., on behalf of the employee. Wage and salaries payable to employees in cash regular intervals including: Direct wages and salaries,	The monthly average wage and salaries employees of the mining sector is calculated by weighted wage and salaries of employees of the mining sector dividing by it by the total number of employees of the mining sector.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				remuneration for time not worked, bonuses and gratuities, food, drink, fuel and other payment in cash. It can be disaggregation by sex and type of occupations. Source: SNA 2008, ILO resolution 1973	
	106	Real wage index of the employees of the mining industry	2	Real wages are goods and services which can be purchased with wages or are provided as wages, must be distinguished from the broader concept of real income and the complex concept of level of living to which they are related. Source: ILO resolution 1954	The real wage index is calculated by dividing the nominal wage index by the consumer price index.
	107	Labour cost of the employees of the mining industry	2	The statistics of labour cost comprises remuneration for work performed, payment in respect of time paid for but not worked, bonuses and gratuities, the cost of food, drink and other payment in kind, cost of workers' housing borne by employer, employers' social security expenditures, cost to the employer for vocational training, welfare services and miscellaneous items, such as transport of workers, work clothes and equipment, together with taxes regarded as labour cost. Source: ILO, Resolution concerning statistics of labour cost, adopted by the 11th International Conference of Labour Statisticians, Geneva, 1966	The aggregate of labour cost received by all the employees of the mining sector.
3. HEALTH AND PRODUCTIVITY					
3.1. Measuring workers conditions	108	Occupational safety of the	1	The protection of workers' lives and physical well-being by eliminating or controlling risks in the working	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
and industrial relations in the mining industry		mining employees (safety workwear and facilities etc.)		environment or the system of work within which workers operate. Source: http://www.ilo.org/thesaurus/default.asp	
3.3. Measuring the impact of mining on workers' health and the health of the community generally	109	Life expectancy at birth, by sex and regions	1	Life expectancy at birth is defined as how long, on average, a newborn can expect to live, if current death rates do not change. However, the actual age-specific death rate of any particular birth cohort cannot be known in advance. If rates are falling, actual life spans will be higher than life expectancy calculated using current death rates. Life expectancy at birth is one of the most frequently used health status indicators. Gains in life expectancy at birth can be attributed to a number of factors, including rising living standards, improved lifestyle and better education, as well as greater access to quality health services. This indicator is presented as a total and per gender and regions and is measured in years. Source: https://data.oecd.org/healthstat/life-expectancy-at-birth.htm	According to statistics, it suggests that the mortality rate at the time of a child's birth, might remain the same during his/her lifetime.
	110	Number of mining related deaths, by sex, age group, level of education and occupations	1	Number of died employees die to mining activities.	
	11	Crude death rate,	1	The crude death rate is the number of deaths occurring among the population of a given geographical area	The total number of people who died during the period compared with the annual average number of

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
	1	by regions		during a given year, per 1,000 mid-year total population of the given geographical area during the same year. Source: https://stats.oecd.org/glossary/detail.asp?ID=491	the population and multiplied by 1000.
	11 2	The sex ratio at death, by regions	1	The number of death males per 100 death females and estimated as a ratio of males to females.	Death population of man compared to the death population of women and multiplied by 100.
	11 3	Number of inpatients, by classification of disease, by regions	3	The number of people suffering from the disease. Source: Inpatient morbidity recorded statements Health Report-503 (MHS)	
	11 4	Number of prevalence and deaths of malignant neoplasms, by regions	3	International Classification of Diseases (ICD) according to classification M800-M969 Report morbidity listed in the clinic HC-502, Report of inpatient morbidity registered Health Report-503 (MHS)	
	11 5	Diseases of the mining employees, by type of diseases	3		
4. MEASURING THE IMPACT OF MINING ON SOCIAL ISSUES					
4.1. Measuring internal and international	11 6	Number of internal migrant	1	A migrant is a person who has changed his usual place of residence from one migration-defining area to another (or who moved some specified minimum	With respect to a given area, the sum of in-migration and out-migration, or of in-migrants and out-migrants, is turnover.

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
migration flows associated with mining (including remittances);				distance) at least once during the migration interval. An in-migrant is thus a person who enters a migration-defining area by crossing its boundary from some point outside the area, but within the same country. Source: Methods of measuring internal migration, Manual 6, UN.	Number of migrant = Number of emigrant + Number of immigrant
	117	Number of international migrant	1	The definition of the word can be ''international migrant'' is defined as any person who changes his or her country of usual residence. Country of usual residence: The country in which a person lives, that is to say, the country in which he or she has a place to live where he or she normally spends the daily period of rest. Temporary travel abroad for purposes of recreation, holiday, visits to friends and relatives, business, medical treatment or religious pilgrimage does not change a person's country of usual residence. Source: (Recommendations on Statistics International Migration 1998, 4.186)	Short-term migrant: A person who moves to a country other than that of his or her usual residence for a period of at least 3 months but less than a year (12 months) except in cases where the movement to that country is for purposes of recreation, holiday, visits to friends and relatives, business, medical treatment or religious pilgrimage. For purposes of international migration statistics, the country of usual residence of short-term migrants is considered to be the country of destination during the period they spend in it. Long-term migrant: A person who moves to a country other than that of his or her usual residence for a period of at least a year (12 months), so that the country of destination effectively becomes his or her new country of usual residence. From the perspective of the country of departure the person will be a long-term emigrant and from that of the country of arrival the person will be a long-term immigrant. (Recommendations on Statistics International Migration 1998, 4.186). Source: (Methods of measuring internal migration,

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					Manual 6, UN).
	118	Workers' remittances	2	Workers' remittances are current transfers made by employees to residents of another economy. Source:https://www.imf.org/external/pubs/ft/bop/2007/pdf/bpm6.pdf, 12.22	Total workers' remittances are the sum of personal remittances and social benefits.
4.2. Measuring the impact of mining on poverty;	119	Household income and expenditure, by regions	1	Household income is a measure of the combined incomes of all people sharing a particular household or place of residence. It includes every form of income, e.g., salaries and wages, retirement income, near cash government transfers like food stamps, and investment gains. Household expenditure is included the amount paid for lodging, food consumed within the home, utilities paid and other expenses. Source: World bank	The total income (expenditure) of a household is defined by the sum of the household's monetary income (expenditure) and the value of consumed commodities from own farming and received from others free of charge.
	120	Poverty headcount index, by regions	2	The poverty headcount index is the share of the population whose consumption /expenditure/ is below the poverty line. This is a most widely used poverty index, that is comparably easy to interpret and understand, while other two more indices poverty gap and severity of poverty are used in order to get more comprehensive pictures of poverty. Source: World bank	By far the most widely-used measure is the headcount index, which simply measures the proportion of the population that is counted as poor, often denoted by P0. Formally, $P0 = \frac{Np}{N}$ where Np is the number of poor and N is the total population (or sample).
4.3. Measuring social impacts of	121	Number of population	1	The total number of persons inhabiting a country, city, or any district or area.	$Pt = P0 + B - D + In - Out$

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
population dislocation associated with mining activity;				Source: Population Handbook, USA, Handbook for Population and Housing Census, UN, Principles and Recommendations for Population and Housing Census, UN, Principles and Recommendations for Vital Statistics, UN	B - the live births that occurred during the time, D - deaths that occurred during the time , In - in-migration during the time interval, Out - out-migration during the time interval, P0 - population number beginning of the year
	122	Number of households	1	The household is the group of people who live together in one house, with a joint budget and jointly provide their food and other basic needs. Members of the household should be family members or relatives; there can be some members in the household with no relation to the other members. Source: Handbook for Population and Housing Census, UN, Principles and Recommendations for Population and Housing Census, UN	
4.4 Measuring the impact of mining on education and training.	123	Number of students in higher educational institutions, by level of education and sex	2	Higher education institutions are universities, colleges and technical schools. Characteristics of University are research, training and production or research and training based, colleges are education and research based, technical schools are academic or vocational training based.	Total number of students studying in higher education institutions of that year.
	124	Graduates of domestic universities, institutes and college, by professional areas	2	Number of person who has received a degree or diploma on completing a course of study, as in a domestic universities and colleges.	The number of students who have graduated with that profession.

THE STATISTICAL INDICATORS TO MEASURE THE IMPACT OF THE MINING INDUSTRY ON THE ENVIRONMENT

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
1. Measurement of the direct and indirect demand from the mining industry for environmental inputs, both market and non-market, incorporating measurement in terms of value	125	Mineral resource, by mineral types	1	In the context of this classification, mineral resources mean all inorganic or organic substances in the earth that may be exploited, wholly or partly, for the benefit of mankind. Water resources are not a subject of this classification. Source: United Nations Framework Classification for Fossil Energy and Mineral Resources, page 3,15, SNA-2008 17.340	
	126	Soil resource	1	Soil resources are a fundamental part of the environment. They provide the physical base to support the production and cycling of biological resources, provide the foundation for buildings and infrastructure, are the source of nutrients and water for agriculture and forestry systems, provide a habitat for diverse organisms, play an essential role in carbon sequestration, and fulfil a complex buffering role against environmental variability (ranging from dampening diurnal and seasonal change in temperature and water supply to the storage and binding of a range of chemical and biological agents).	A first stage of accounting for soil resources is to measure the area of different soil types within a country. In order to focus on soil resources that are available as a biological system the scope of this account should be restricted to land used for agriculture and forestry and also volumes of soil extracted to be used as a biological system. (Table 5.7.1 Physical Asset Account for Area of Soil Resource /Hectares/ SEEA-CF)

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				Source: SEEA-CF 5.318-5.342	
	127	Water resource	2	Water resources consist of surface and groundwater resources used for extraction to the extent that their scarcity leads to the enforcement of ownership or use rights, market valuation and some measure of economic control. Water resources consist of fresh and brackish water in inland water bodies including groundwater and soil water. Source: SEEA-CF 5.471-5.498, SNA-2008 10.184	
	128	Energy resource (oil, natural gas, coal, peat, uranium)	1	Mineral and energy resources are defined as known deposits of oil resources, natural gas resources, coal & peat resources, non-metallic minerals and metallic minerals. 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. Source: SEEA-CF 5.173, SNA-2008 10.179	
2. Measurement of emissions (air and water) and waste products from the mining industry;	129	Emissions from the mining activities	1	Emissions are substances released to the environment by mining industry as a result of production, consumption and accumulation processes. Source: SEEA-CF 3.88, 3.89	Generally, emissions are analysed by type of receiving environment, (i.e. emissions to air, emissions to water bodies, emissions to soil) and by type of substance.
	130	• Emissions to water	1	Emissions to water are substances released to water resources by mining industry as a result of production, consumption and accumulation processes. Source: SEEA-CF 3.92, 3.257	Water emission accounts record the quantity of substances added to water by mining industry during an accounting period. The quantities are expressed in terms of mass (kilograms or tonnes, depending on the substance under consideration). Water emission

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					accounts cover: (a) substances added to wastewater and collected in the sewerage system; (b) substances added to wastewater discharged directly to water bodies; and (c) substances from non-point sources, for example, emissions and releases from urban runoff and emissions from agriculture.
	131	• Emissions to air	1	Emissions to air are gaseous and particulate substances released to the atmosphere by mining industry as a result of production, consumption and accumulation processes. Source: SEEA-CF 3.91, 3.233	
	132	• Emissions to soil	1	Emissions to soil are substances released to the soil by mining industry as a result of production, consumption and accumulation processes. Source: SEEA-CF 3.95	
	133	Solid waste	1	Solid waste covers discarded materials that are no longer required by the owner or user. Solid waste includes materials that are in a solid or liquid state but excludes wastewater and small particulate matter released into the atmosphere. Source: SEEA-CF 3.84, 3.85	
3. Measurement of damage to land (including agricultural land) and ecosystems from mining activity and any	134	Land area of mining exploration and production	1	Land is a unique environmental asset that delineates the space in which economic activities and environmental processes take place and within which environmental assets and economic assets are located. Source: SEEA-CF 5.239, 5.241	A particular feature of statistics on land use and land cover is the means by which data are collected. Broadly, two methods are used – field surveys and satellite images. Field surveys are important as they can provide a high level of specificity regarding the land cover and, in particular, the land use in a particular area. Satellite images are important as they

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
subsequent rectification activity					enable a broader assessment of all areas in a country and, over time, more detailed resolutions of the images are permitting new forms of analysis. (SEEA-CF 5.244)
	135	Land area, water, soil and biodiversity with remediation	1	Protection and remediation of soil, groundwater and surface water refers to measures and activities aimed at the prevention of pollutant infiltration, cleaning up of soils and water bodies and the protection of soil from erosion and other physical degradation as well as from increased salinity. Monitoring, control of soil and groundwater pollution is included. Protection of biodiversity and landscape refers to measures and activities aimed at the protection and rehabilitation of fauna and flora species, ecosystems and habitats as well as the protection and rehabilitation of natural and semi-natural landscapes. The separation between 'biodiversity' and 'landscape' protection may not always be practical. For example, maintaining or establishing certain landscape types, biotopes, eco-zones and related issues (hedgerows, lines of trees to re-establish 'natural corridors') have a clear link to biodiversity preservation. Source: SEEA-CF Annex 1, CEA, I. Environmental Protection	
	136	Land area, water, soil and biodiversity	1	All actions that making land in previous shape, recovering by soil, thickening soil, planting, caring are the environmental restoration actions.	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
		without remediation			
	137	Land degradation	1	Degradation considers changes in the capacity of environmental assets to deliver a broad range of contributions – known as ecosystem services (e.g. air filtration services from forests) and the extent to which this capacity may be reduced through the action of economic units, including households. In this sense, since depletion relates to one type of ecosystem service, it can be considered as a specific form of degradation. Source: SEEA-CF 5.90, 5.91	The measurement of degradation is complicated because the capacity of environmental assets to deliver ecosystem services is not solely attributable to individual assets, and because individual assets may deliver a number of different ecosystem services. Further, while individual environmental assets, such as water and soil resources, may have been degraded over time, separating the extent of degradation of the individual asset from the broader degradation of the related ecosystem may not be straightforward.
	138	Soil damage	1	Soil erosion is the wearing away of the land surface by physical forces such as rainfall, flowing water, wind, ice, temperature change, gravity or other natural or anthropogenic agents that abrade, detach and remove soil or geological material from one point on the earth's surface to be deposited elsewhere. (European Commission) Source: European Commission, http://esdac.jrc.ec.europa.eu/esbn/Plenary_esbn_2007/Workshop/ESBN_SoilErosion.pdf , http://eusoils.jrc.ec.europa.eu/projects/scape/uploads/108/Benyamini.pdf	The trend to use models in erosion evaluation is attractive. As a result, potential soil erosion rates are typically modelled from empirical and functional relationships driven by factors related to soil properties, climate, and landscape position. These models do not yet represent the actual soil erosion losses and only provide estimations of potential erosion under specified climatic conditions. Without repeated field-based measurements, there is currently no way to determine accurate erosion losses. Soil erosion can occur in two stages: 1) detachment of soil particles by raindrop impact, splash or flowing water; and 2) transport of the detached particles by splash or by the flowing water. Therefore, soil erosion is a physical process requiring

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
					energy, and its control requires certain measures to dissipate this energy. (Soil Conservation And Protection for Europe)
4. Measurement of the environmental impact of economic activity 'downstream' from the mining industry;	139	Fee on usage of road from the mining companies	1		
	140	Environmental damages (water, animal, plant etc.) from the transportation, consignment and discharge of the mining products	1		
	141	Cost of environmental protection	1	Environmental protection expenditure refers to all operating and capital expenditure in relation to compliance or in anticipation of environmental regulations/conventions in country. This includes expenditure for preventing, reducing and rehabilitation of environmental degradation or preserving the environment. Source: Environmental protection expenditure survey of Malaysia, 2013	Total cost of environmental protection basis cost of management and environmental monitoring.
	142	Natural resource management	1	Resource management includes all actions and activities that are aimed at preserving and maintaining the stock of natural resources and hence safeguarding	

Measurement issues	№	Appropriate indicators	Priority (high-1; medium-2; low-3)	Definition of indicator	Calculation method
				against depletion. This includes actions and activities aiming at reducing the withdrawals of natural resources (recovery, reuse, recycling, substitution of natural resources) as well as restoring natural resource stocks (increases/ recharges of natural resource stocks). Source: SEEA-CF- II.Resource management, 10.	

Annex 2.

GOVERNMENT REVENUES FROM NATURAL RESOURCES

The *Government Finance Statistics Manual 2014* (*GFSM 2014*) provides national authorities and data users with a conceptual framework suitable for analyzing and evaluating fiscal policy, especially the performance of the general government sector and the broader public sector. Specifically, the *GFSM 2014* describes a specialized macroeconomic statistical system that covers all flows (revenue, expense, financing, and other economic flows) and stock positions (in nonfinancial assets, financial assets, and liabilities) associated with government units. The information to be collected from natural resource enterprises is broad and the government and other parties may be interested not just in data on revenues from natural resources, but also in data on assets, expenses, and other economic flows associated with natural resources. However, for the purposes of the natural resource revenues template described in Chapter 6, this annex describes the tax and non-tax revenue classifications to be used in compiling data on the revenue streams that accrue to government from mining activities.

It is worth noting that in the government balance sheet the *GFSM 2001* category subsoil assets is replaced in the *GFSM 2014* by mineral and energy resources. To be an economic asset, a resource must also be able to supply economic benefits given the technology, scientific knowledge, economic infrastructure, available resources, and relative prices existing at a given time or expected in the foreseeable future. Thus, a known deposit of minerals is an economic asset only if it is already commercially exploitable or is expected to become commercially exploitable in the foreseeable future.

In the GFS system, 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. Ownership rights to the mineral and energy resources are usually separable from those to the land itself. The deposits may be located on or below the earth's surface, including deposits under the sea, but they must be economically exploitable. Mineral and energy resources are known reserves of oil, natural gas, coal, metallic ores (including ferrous, nonferrous, and precious metal ores), and nonmetallic mineral reserves (including stone quarries, clay and sand pits, chemical and fertilizer mineral deposits, and deposits of salt, quartz, gypsum, natural gem stones, asphalt, bitumen, and peat). The tax and non-tax revenue classifications outlined below may therefore be applied to the revenue streams that accrue to government from mining activities

1. **Taxes on extraordinary profits payable by natural resource enterprises:** These are specific taxes applied to natural resource enterprises. These are taxes generally classified as profit taxes, for example, resource rent taxes, which are often imposed on profits earned above a defined rate of return allowed by the government for the corporation to earn. These taxes could be imposed pre- or post-corporate income tax. These taxes differ from royalties as they take into account the profit of the mining/energy operation, whereas a royalty is generally imposed on the production level irrespective of profitability. The taxes on profits are levied on revenue less allowable deductions. The amounts recorded under this line item are part of the *GFSM 2014* category Taxes on income, profits, and capital gains payable by corporations and other enterprises (1112).

2. **Taxes on payroll and workforce payable by natural resource enterprises:** These are taxes paid by natural resource enterprises either as a proportion of payroll size or as a fixed amount per person, and are not earmarked for social security schemes. If governments are able to identify general corporate income taxes paid by natural resource enterprises, they should be able to determine the same for payroll based taxes. The amounts recorded under this line item are part of the *GFSM 2014* category Taxes on payroll and workforce (112).

3. **Taxes on property payable by natural resource enterprises:** These are taxes payable on the use, ownership, or transfer of wealth. The taxes may be levied at regular intervals, one time only, or on a change of ownership. The amounts recorded under this line item are part of the *GFSM 2014* category Taxes on property (113).

4. **Value-added taxes payable by natural resource enterprises:** In many countries, businesses are subject to VAT. A value-added tax is a tax on goods and services collected in stages by enterprises, but which is ultimately charged in full to the final purchaser. Enterprises usually collect the VAT from purchasers on their sales, and deduct the VAT paid on their purchases. The amounts recorded under this line item are part of the *GFSM 2014* category Value-added taxes (11411).

5. **Unrequited value-added taxes (VAT) payable by natural resource enterprises:** In the majority of cases, enterprises are able to claim input tax credits as the enterprises' purchases are for intermediate and not for final consumption. In some countries, natural resource enterprises do not have input tax credits available to reclaim any value-added taxes paid, and therefore receive no refunds. Hence, a category is required for unrequited value-added taxes paid by these enterprises.

The amounts recorded under this line item are part of the *GFSM 2014* category Value-added taxes (11411).

6. **Excise taxes payable by natural resource enterprises:** Excises are taxes levied on particular products (e.g., hydrocarbon oils, tobacco goods, sugar), or on a limited range of products, that are not classifiable under general taxes on goods and services (1141); profits of fiscal monopolies (1143); customs and other import duties (1151); or taxes on exports (1152). The amounts recorded under this line item are part of the *GFSM 2014* category Excises (1142).

7. **Profits of natural resource fiscal monopolies: This item covers that part of the profits of fiscal monopolies that is transferred to the government.** Fiscal monopolies are public corporations or quasi-corporations that exercise the taxing power of government by the use of monopoly powers over the production or distribution of a particular kind of good or service. The monopolies are created to raise government revenue that could otherwise be gathered through taxes on private sector production or distribution of the commodities concerned. Typical commodities subject to fiscal monopolies are tobacco products, petroleum products, salt, etc. The amounts recorded under this line item are part of the *GFSM 2014* category Profits of fiscal monopolies (1143). Depending on the specific circumstances of a given country, the profits transferred to the government by a public corporation would be classified as dividends (when no monopoly exists) or as profits of fiscal monopolies (when a monopoly exists).

8. **Fiscal monopolies are distinguished from public enterprises such as rail transport, electricity, and post offices.** These latter may enjoy a monopoly but normally exist primarily to promote or advance the interests of public economic or social policy, rather than to raise revenue for government. Transfers to government from such public enterprises are treated as dividends (1412) or withdrawals of income from quasi-corporations (1413). Profit transfers from export and import monopolies are similar to fiscal monopoly profits but have their own category (see below).

9. **While in principle only the excess of the monopoly profits over "normal" profits should be treated as taxes, it is difficult to estimate this amount.** Thus, in practice, the value of the taxes should be taken to be equal to the amount of the profits actually transferred to government. The taxes are recorded when the transfer takes place rather than when profits are earned.

10. **Business and professional licenses payable by natural resource enterprises:** These are payments where no specific service is attached or, in general, the amount of the fee is significantly disproportionate to the service provided. Possible examples are license fees, rental fees, and entry fees. Some licenses might be for exploration or extraction. The amounts recorded under this line item are part of the *GFSM 2014* category Other taxes on use of goods and on permission to use goods or perform activities (11452). If there is a specific service attached to the fee and the payment is proportionate to the service, it should be recorded as a sale of a service under the subcategory Administrative fees for government services supplied to natural resource enterprises (1422).

11. **Pollution taxes payable by natural resource enterprises:** These are taxes levied on the emission or discharge of noxious gases, liquids, or other harmful substances. Amounts payable to government for the collection and disposal of waste or noxious substances are excluded from this category, as they constitute sales of goods and services. The amounts recorded under this line item are part of the *GFSM 2014* category Other taxes on use of goods and on permission to use goods or perform activities (11452).

12. **Other taxes on goods and services payable by natural resource enterprises:** This item includes taxes on the extraction of mineral fossil fuels, and other exhaustible resources from deposits owned privately or by another government. Taxes on the extraction of exhaustible resources usually are a fixed amount per unit of quantity or weight, but can be a percentage of value. Payments for the extraction of exhaustible resources from deposits owned by the government unit receiving the payment are recorded under rent. The amounts recorded under this line item are part of the *GFSM 2014* category other taxes on goods and services (1146).

13. **Taxes on imports payable by natural resource enterprises:** This items covers revenue from all levies collected on goods because they are entering the country or services because they are delivered by nonresidents to residents paid by natural resource enterprises. The amounts recorded under this line item are part of the *GFSM 2014* category Customs and other import duties (1151).

14. **Taxes on exports of natural resources:** This category includes all levies on resource commodities transported out of the country. The amounts recorded under this line item are part of the *GFSM 2014* category Taxes on exports (1152).

15. **Profits of natural resource export monopolies:** Governments may establish enterprises with the exclusive right to export natural resource products to

nonresidents to raise revenue that could be gathered through taxes on exports. When such monopolies exist, the profits remitted to governments by the monopolistic enterprise or marketing board are considered to be taxes. Such profits are recorded as tax revenue when transferred to the government and do not include the retained reserves of the enterprises or marketing boards. The amounts recorded under this line item are part of the *GFSM 2014* category Profits of export or import monopolies (1153).

16. **Profits received from export enterprises or marketing boards that do not represent monopoly profits are recorded as property income (dividends).** Profits transferred to the government from public enterprises or marketing boards dealing in commodities domestically, outside of international trade are recorded under property income (dividends, 1412) or profits of fiscal monopolies (code 1143). For further information, refer to paragraphs 5.63-5.68 of the *GFSM 2014*.

17. **Other taxes payable by natural resource enterprises:** This item covers revenue from taxes levied predominantly on a base or bases other not elsewhere classified under the preceding tax headings payable by natural resource enterprises. Also included is revenue from unidentified taxes and interest and penalties collected for late payment or non-payment of taxes but not identifiable by tax category. Stamp taxes that do not fall exclusively or predominantly on a single class of transactions would be included here. The amounts recorded under this line item are part of the *GFSM 2014* category other taxes paid solely by business (1161).

18. **Social contributions:** Social contributions (12) are actual or imputed receipts either from employers on behalf of their employees or from employers, self-employed, or unemployed persons on their own behalf that secure entitlements to social benefits for the contributors, their dependents, or their survivors. The contributions may be compulsory or voluntary. Social security contributions are compulsory social contributions to social security schemes.

19. **Employee contributions from natural resource enterprises:** These contributions are payable directly by employees or deducted from employees' wages and salaries and other compensation and transferred by employers on their behalf. The amounts recorded under this line item are part of the *GFSM 2014* category Social security employee contributions (1211).

20. **Employer contributions from natural resource enterprises:** These contributions are payable directly by employers engaged in natural resource activities on behalf

of their employees. The amounts recorded under this line item are part of the *GFSM 2014* category Social security employer contributions (1212).

21. **Other revenue:** Other revenue (14) includes property income, interest, sales of goods and services, and miscellaneous other types of revenue.[17] For natural resource-based revenues, this will predominantly be property income. Property income earned by governments from natural resource products includes mainly rent and dividends.

22. **Dividends:** Dividends refer to payments to general government units, in their capacity as shareholders in and/or owners of an enterprise, for example, as a result of placing equity funds at the disposal of the enterprise. Equity funds do not entitle shareholders to a fixed or predetermined income. Dividends are recorded either on the date they go ex-dividend, or if the enterprise is 100 percent owned by government the date the dividends are payable or, if no prior declaration occurs, on the date the payments are made.

23. **General government units may receive dividends from private or public enterprises.** Distributions of profits by public enterprises may take place irregularly and may not be explicitly labeled as dividends. Dividends include all distributions of profits by enterprises to their shareholders or owners (except withdrawals of equity). Dividends from natural resource enterprises are likely to take two forms: dividends from public resource enterprises, and dividends from government participation in natural resource enterprises (equity).

24. **When payments are received from public enterprises (e.g., oil companies), it can be difficult to decide whether they are dividends or withdrawals of equity.** An enterprise may, however, smooth the dividends it pays from one period to the next so that in some periods it pays more in dividends than it earns from its productive activities. Withdrawals of equity may take the form of distribution of proceeds from accumulated retained earnings and reserves for the consumption of fixed capital.

25. **A complication may arise when a government requests payment from a public enterprise. In many cases, the government requests the enterprise to pay a dividend that is set by the government.** According to the *GFSM 2014*, this is not revenue if the payments are not made from current income. These payments are a

[17] Interest earned by governments from the investment of funds originally generated from natural resources is not included in the template because they are not considered to constitute direct government revenues from natural resources. Revenues earned by entities such as sovereign wealth funds are not considered to be government revenues from natural resources.

financial transaction that should be classified as a withdrawal of equity. According to the *2008 SNA*:

It is important to distinguish between the return of the equity investment by the corporation to its owner and the payment of income in the form of dividends. Only regular distributions from the entrepreneurial income are recorded as property income either as dividends or withdrawals of income from quasi-corporations. Large and irregular payments, based on accumulated reserves or sale of assets are recorded as a withdrawal of equity (*2008 SNA* 22.136).

26. **Dividends from government owned natural resource enterprises:** These are dividend payments by public enterprises declared by the board of directors or other managers of the enterprise of their own volition that are paid to general government. General government will in most instances have 100 percent equity in the public enterprise. The amounts recorded under this line item are part of the *GFSM 2014* category Dividends (1412).

27. **Dividends from government participation in natural resource enterprises (equity):** These are dividend payments, as described above, from natural resource enterprises where the government has an equity position. In some cases, the government may receive dividend payments in kind. These should be valued at the market price for the goods in kind at the time of the transaction. The amounts recorded under this line item are part of the *GFSM 2014* category Dividends (1412). Note that for in-kind transactions to be recorded under this item, the amount should be set by the enterprise of its own volition and not mandated by the government. If the amount of in-kind payment is predetermined or fixed, it should be recorded under the subcategory production entitlements payable by natural resource enterprises under the *GFSM 2014* category Rent (royalties, 1415).

28. **Rent is the property income received from certain leases of subsoil assets and other naturally-occurring assets**. The ownership of subsoil assets is dependent on how property rights are defined by law. General government units may grant leases that permit other units to extract deposits over a specified period of time in return for a payment or series of payments. These payments are often described as "royalties," but they are rents that accrue to owners of the assets in return for putting the assets at the disposal of other units for specified periods of time.[18] The rents may take the form of periodic payments of fixed amounts or, more usually,

[18] The *GFSM 2014* states that when owners of a natural resource put the resource at the disposal of another institutional unit, and this other unit can use the resource to extinction, the transaction be treated as a sale of the resource asset.

will be derived according to the quantity, volume, or value of the asset extracted. Enterprises engaged in exploration may make payments to general government units in exchange for the right to undertake test drilling or otherwise investigate the existence and location of subsoil assets. Such payments are also treated as rents even though no extraction may take place. Rents are the sum of royalties, bonuses, production entitlements, and compulsory social infrastructure payments; and, in most cases, rent from natural resources will be equal to the total rent revenues received by government. The amounts recorded under this line item are part of the *GFSM 2014* category Rent (1415).

29. **The *2008 SNA* recommends that payments by an extractor to the owner of the mineral resources corresponding to a share of the resource rent be shown as property income, even if they are described as taxes and treated as such in the government's accounts.** It also recommends that when the legal owner of a mineral reserve contracts with another unit to undertake extraction, on pragmatic grounds the resource may continue to be shown on the balance sheet of the legal owner, with payments by the extractor to the owner treated as property income (rent). The proper recording of rent presents practical challenges because payments to governments described as rent or royalties often include a mix of payments. Some may effectively be rent and others may be taxes or fees. The latter should be classified in the corresponding sub-category and not under rent. A further complicating factor for the proper recording of rent is that in some cases payments to government not described as rent or royalties (e.g. taxes, fees) should actually be classified as rent. The key to determine whether a given payment is rent is whether the payment is made to the government as owner of the natural resource.

30. **The nonfinancial enterprises exploring and exploiting natural resources may be public enterprises.** These enterprises will reflect in their financial statements the flows and stocks associated with their operations. These flows may include flows to and from government units, which would not be consolidated when compiling GFS for the general government sector, but would be subject to consolidation when compiling GFS for the public sector (or nonfinancial public sector). A classification issue may arise concerning payments to government by a public enterprise for the right to explore a natural resource. These payments are treated by government as revenue (rent, 1415), and by the enterprise as an operating expense (rent, 2814). The distribution of profits (residual between all operating revenues and operating expenses) by the enterprise to government as owner of the enterprise is treated as dividends by both entities (1412 and 2811, respectively).

31. **Royalties payable by natural resource enterprises: Royalties are rents earned by the government (as owner of the subsoil asset) based on the production or extraction levels of a commodity.** The royalties will usually be derived according to the quantity, volume, or value of the asset extracted. For example, the royalty will be levied as a dollar amount per ton (or equivalent) or as a percentage of the value of the resource extracted. The amounts recorded under this line item are part of the *GFSM 2014* category Rent (1415). If the general government does not own the subsoil assets but similar taxes are levied, then these payments should be recorded under Other taxes on goods and services (1146).

32. **Bonuses payable by natural resource enterprises:** These are payments to general government units that are related to awards, grants, or transfer of extraction rights. These payments are sometimes called signature, discovery, or production bonuses. In the case of signature payments, these do not have to be linked to either the discovery or extraction of resources. Payments can also be tied to the achievement of certain production levels or targets. Bonus payments can also be for the discovery of additional mineral reserves or deposits. Payments can be in the form of periodic payments or a fixed amount. Bonuses are payments made to the government because it is the owner of the subsoil asset and has given a corporation the right to extract the resource. The amounts recorded under this line item are part of the *GFSM 2014* category Rent (1415).

33. **Production entitlements payable by natural resource enterprises:** Production entitlements are the volumes of output the general government is entitled to receive as mandated in any agreement or license. These mandated volumes can be paid in cash or in kind, and can be net of any other royalty payments. For in-kind payments, these should be valued at market price (or cost of extraction). The amounts recorded under this line item are part of the *GFSM 2014* category Rent (1415).

34. **If a public enterprise receives production entitlements from private enterprises, the revenue from production entitlements should be attributed to the general government.** Production entitlements are generally stipulated in Production Sharing Contracts or Production Sharing Agreements. These contracts can be with either the general government or a government-owned corporation. In either case, the revenue from production entitlements should be attributed to the general government. Any production entitlement that is received by a public enterprise should be rerouted to be shown as being received by the general government unit. The rerouting is done to properly record the underlying

economic event that it is the government as owner of the resource that is the true recipient of the production entitlements, which it then chooses to transfer to a public enterprise. Otherwise, the market value of the production entitlements would not be reflected in the government accounts, which would only show the revenues eventually transferred by the public enterprise to the government.

35. **Compulsory social infrastructure payments payable by natural resource enterprises:** These are payments where natural resource enterprises are required to provide social infrastructure as part of their contractual arrangements to exploit the resource. Payments can either be cash or in-kind (completed infrastructure). The value of the payment should in principle be equal to the value of the infrastructure. The amounts recorded under this line item are part of the *GFSM 2014* category Rent (1415).

36. **For social infrastructure payments, the timing of the recording of the payment should be as the work on the infrastructure is being performed.** If this is not feasible, the recording of the transaction may occur on completion of the infrastructure project, or when ownership is handed to the government. The compulsory nature of the infrastructure payments means that they are not grants, because grants are non-compulsory transfers.

37. **Other rent.** This item covers any payment to the government as owner of the resource not included in the previous four sub-categories of rent.

38. **Administrative fees for services supplied to natural resource enterprises:** This item includes fees for compulsory licenses and other administrative fees that are considered a sale of services by government. Most are applicable to all sectors and industries of an economy. There may be specific licenses that apply only to resource extraction. Typical examples are licenses for specialized equipment operation or licenses linked to qualifications to operate a mine. For these fees to be considered a sale of a service, the general government unit must exercise some regulatory function—for example, checking the competence or qualifications of the person concerned, checking the efficient and safe functioning of equipment in question, or carrying out some other form of control that it would otherwise not be obliged to do. The amounts recorded under this line item are part of the *GFSM 2014* category Administrative fees (1422).

39. **Voluntary social infrastructure payments payable by natural resource enterprises:** This category includes gifts and voluntary donations from enterprises. These include transfers for the construction or purchase of cultural centers,

hospitals, museums, schools, and theatres, and gifts of land, buildings, or intangible assets such as patents and copyrights. Buildings could be extended to include roads, bridges, dams, and other civil infrastructure. If the transfer is in the form of a gift that is a completed structure rather than a voluntary payment for construction work, the value recorded should be at either the cost of producing the structure or a fair market value. The amounts recorded under this line item are part of the *GFSM 2014* category Capital transfers not elsewhere classified (1442).

Annex 3.

LIST OF PARTICIPANTS

Countries:

Australia, Azerbaijan, Brazil, China, India, Iran, Kazakhstan, Lesotho, Madagascar, Mexico, Mongolia, Russia, and Vietnam

International Organisations

CISSTAT, IMF, UNESCAP, UNIDO

Individuals:

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