Application of UNFC: Minerals Classification

The Basics

Hendrik Falck
Chair, EGRM Minerals Working Group

RESOURCE MANAGEMENT WEEK 2023

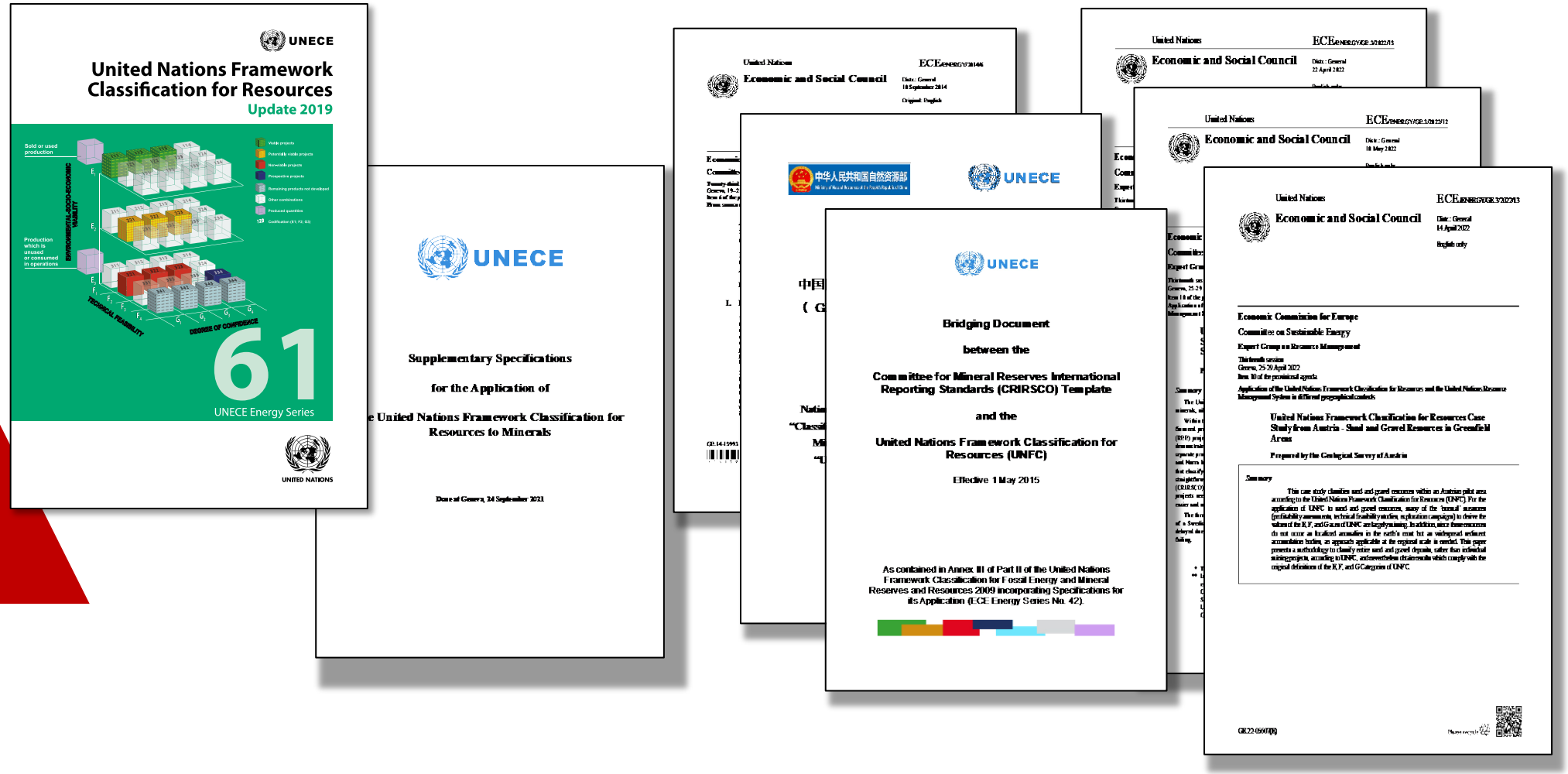
ASSURING SUSTAINABILITY IN RESOURCE MANAGEMENT

UNECE

Categories and Classes

Codification

- Principles
- Rules
- Guidelines



Categories and Classes

Codification

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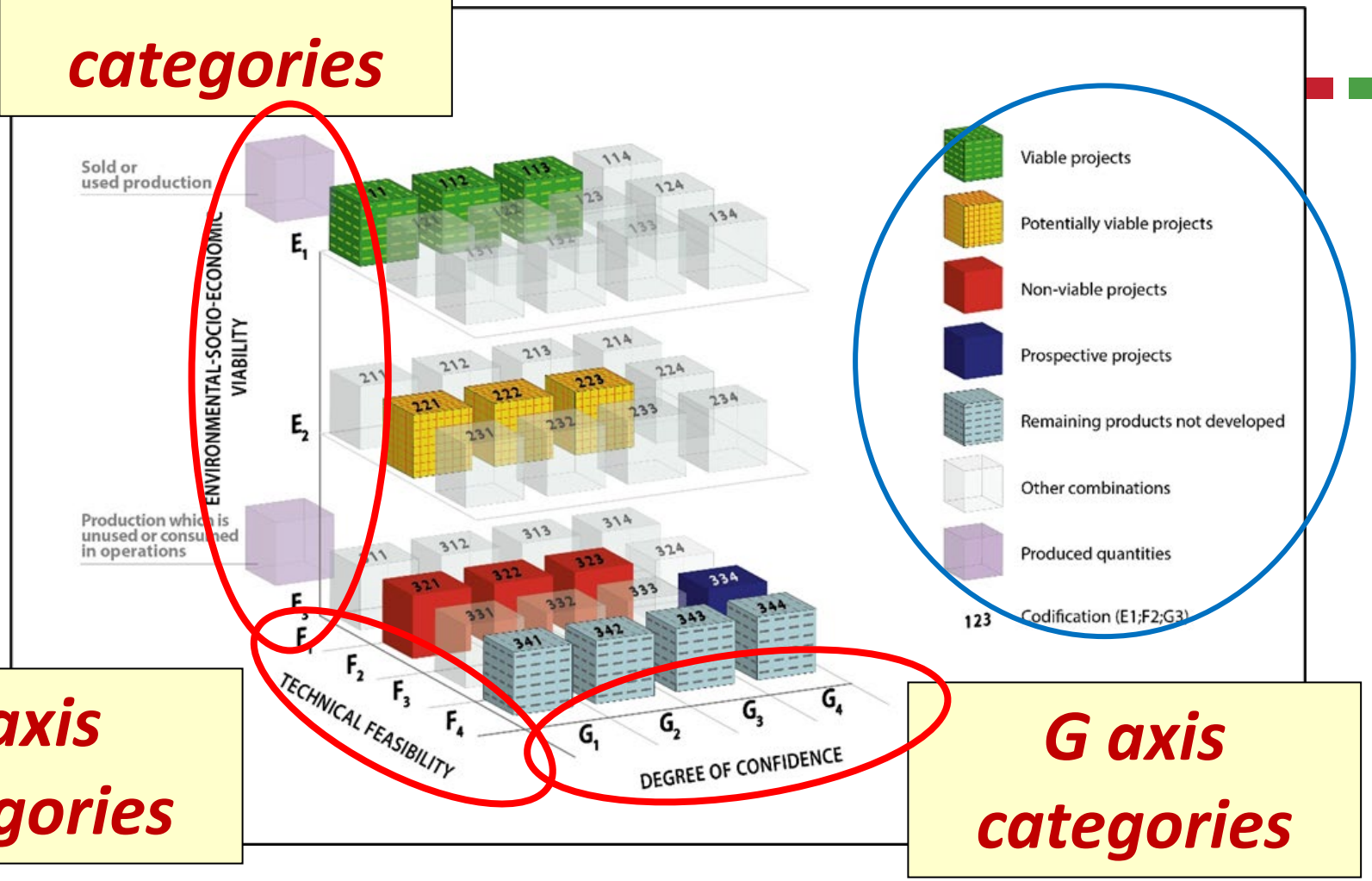
E axis categories



Classes

F axis categories

G axis categories

Category definitions

E axis

- Degree of favourability of environmental social and economic conditions in establishing the viability of the project
- **Includes consideration of market prices and relevant legal, regulatory, social, environmental and contractual conditions**
- E1, E2 and E3 categories
- **E1 is "best"**
- Definitions should always be read in conjunction with supporting explanation

Category	Definition
E1	Development and operation are confirmed to be environmentally-socially-economically viable.
E2	Development and operation are expected to become environmentally-socially-economically viable in the foreseeable future.
E3	Development and operation are not expected to become environmentally-socially-economically viable in the foreseeable future or evaluation is at too early a stage to determine environmental-socio-economic viability.

Category definitions

F axis

- Maturity of technology, studies and commitments necessary to implement the project
- **These projects range from early conceptual studies through to a fully developed project that is producing**
- F1, F2 and F3 and F4 categories
- **F1 is "best"**
- Definitions should always be read in conjunction with supporting explanation

Category	Definition
F1	Technical feasibility of a development project has been confirmed.
F2	Technical feasibility of a development project is subject to further evaluation.
F3	Technical feasibility of a development project cannot be evaluated due to limited technical data.
F4	No development project has been identified.

Category definitions

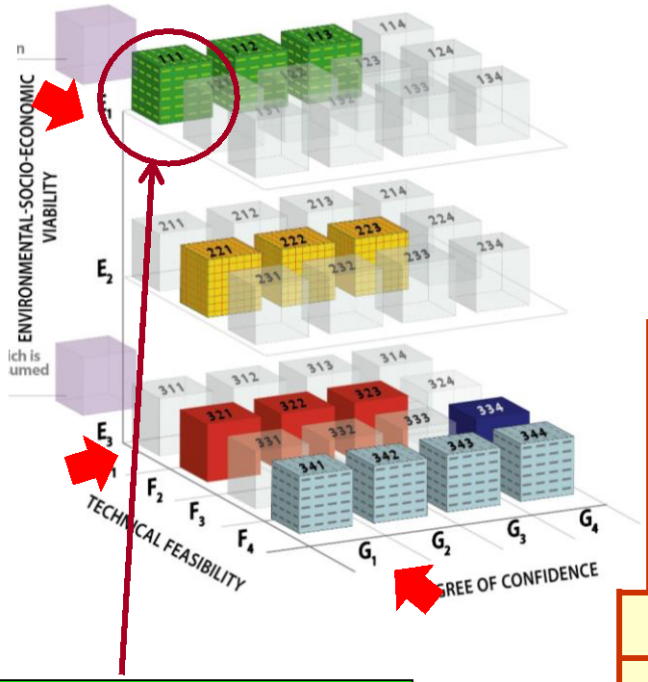
G axis

- Degree of confidence in the estimate of the quantities of products from the project
- **Generally defined as discrete increments for solids (G1, G2, G3), but often defined as scenarios for fluids (G1, G1+G2, G1+G2+G3)**
- G1, G2, G3 and G4 categories
- **G1 is "highest confidence"**
- Definitions should always be read in conjunction with supporting explanation

Category	Definition
G1	Product quantity associated with a project that can be estimated with a high level of confidence.
G2	Product quantity associated with a project that can be estimated with a moderate level of confidence.
G3	Product quantity associated with a project that can be estimated with a low level of confidence.
G4	Product quantity associated with a Prospective Project, estimated primarily on indirect evidence.

Category definitions

Codification



E1;F1;G1

UNFC Class: 111

Category	Definition
E1	Development and operation are confirmed to be environmentally-socially-economically viable.

Category	Definition
F1	Technical feasibility of a development project has been confirmed.

Category	Definition
G1	Product quantity associated with a project that can be estimated with a high level of confidence.

Category definitions

Codification

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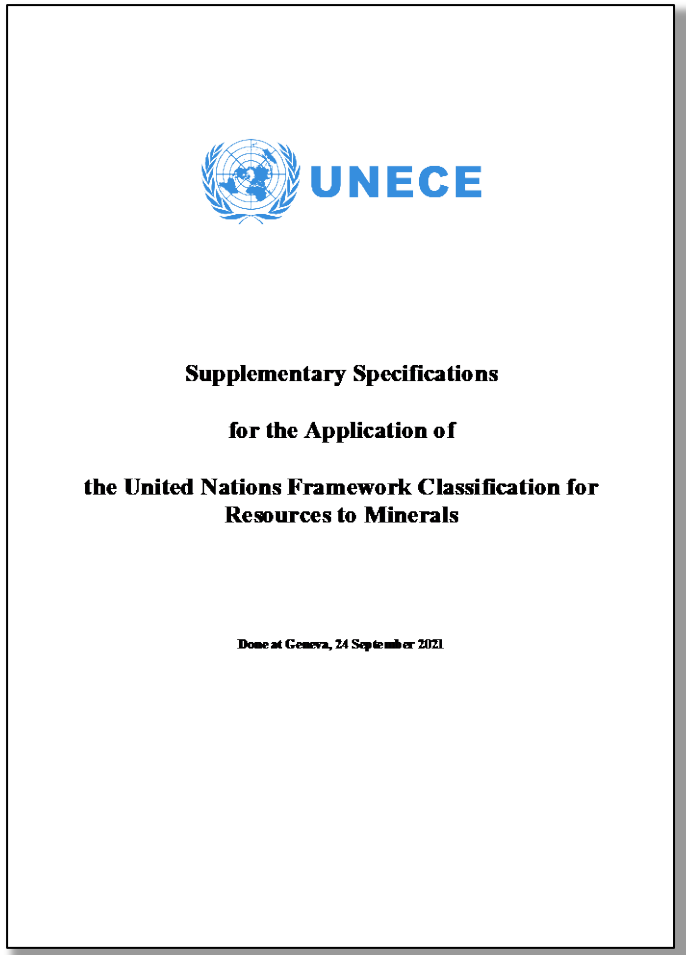
UNFC Classes defined by categories and sub-categories						
Total products	Produced	Sold or used production				
		Production which is unused or consumed in operations				
	Class		Sub-class	Categories E	F	G
	Known Sources	**Viable Projects**	On Production	1	1.1	1, 2, 3
			Approved for Development	1	1.2	1, 2, 3
			Justified for Development	1	1.3	1, 2, 3
		Potentially Viable Projects	Development Pending	2*	2.1	1, 2, 3
			Development On Hold	2*	2.2	1, 2, 3
		Non-Viable Projects	Development Unclarified	3.2	2.2	1, 2, 3
			Development Not Viable	3.3	2.3	1, 2, 3
		Remaining products not developed from identified projects		3.3	4	1, 2, 3
	Potential Sources	**Prospective Projects**	[No sub-classes defined]	3.2	3	4
		Remaining products not developed from prospective projects		3.3	4	4

***Potentially Viable Projects may satisfy the requirements for E1**

Mineral Classification

How it works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Supplementary Specifications

for the Application of

the United Nations Framework Classification for Resources to Minerals

Done at Geneva, 24 September 2021

These minerals specifications are intended to support the attainment of the Sustainable Development Goals as relevant to the minerals industry.

Through their application, the collective industry will be directed towards the shared global goals.

This document incorporates the changes introduced by the recent update of UNFC (2019).

Mineral Classification

Supplemental Specifications for Mineral Projects

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Mineral project plan and definition

- Prospecting/Exploration
- Mining
- Beneficiation / Processing
- Decommissioning
- Remediation

Mineral Project Lifetime

Project Lifetime is the remaining period of time that a project is expected to operate, constrained by technical, economic, regulatory or other permit/license cut-offs.

Mineral project lifetime is normally constrained by the period for which prospecting, exploration or mining license may apply for the project.

Mining license may include beneficiation, processing, decommissioning and remediation stages of the mineral lifecycle.

Mineral Classification

Supplemental Specifications for Mineral Projects

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Mineral project evaluation

Mineral projects may adopt various methodologies in the various stages of the mineral lifecycle including in the estimation of quantities as appropriate to the project. The basis for any estimations shall be appropriately referenced in the evaluation. This includes not only third-party data but also methodologies or procedures that have been used by the evaluating entity to generate in-house data.

Mineral Classification

Supplemental Specifications for Mineral Projects

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Project Classification

Classification of projects based on the level of maturity

Where it is considered appropriate or helpful to sub-classify mineral projects to reflect different levels of project maturity, based on the current status of the project, optional sub-classes may be adopted.

Distinction between Environmental-Socio-Economic assumptions

The environmental-socio-economic axis categories encompass the non-technical issues that directly impact the viability of a project, including product prices, costs, legal/fiscal framework, environmental regulations and known environmental or social impediments, barriers or benefits

Distinction between potentially produced quantities and undeveloped quantities

Quantities of products associated with projects are categorized as F1 to F3 as potentially developable using existing technology or technology currently under development or operation. There may be remaining quantities with no development project. The product quantity associated with these are categorized as F4. These are quantities which, if produced, could be bought, sold or used.

Category definitions

G axis

- Degree of confidence in the estimate of the quantities of products from the project
- **Generally defined as discrete increments for solids (G1, G2, G3), but often defined as scenarios for fluids (G1, G1+G2, G1+G2+G3)**
- G1, G2, G3 and G4 categories
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Category	Definition
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Mineral Classification

Supplemental Specifications for Mineral Projects

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G-Axis Considerations

- **Product quantity estimates may be categorised discretely as G1, G2 and/or G3 (along with the appropriate E and F Categories), based on the degree of confidence in the estimates (high, moderate and low confidence, respectively) based on direct evidence.**

Additional Comments

- **The G axis in minerals and mining conditions primarily reflect geologic uncertainty impacting the estimate forecast for the project. Uncertainties include availability and resolution of direct data such as drill hole density in relation to the mineralisation and or deposit type. In addition, indirect data such as geophysical data might be included, which should be measured against redundancy of methods (e.g. geophysical measurements calibrated against drill core evaluation, drill hole logs. Calibrated methods provide higher certainty than uncalibrated methods.) The accuracy of measurements controls the level of the category (lab assay, rock mechanics, mineralogical phase assessment).**

See Page 16 of the Mineral Specifications

Mineral Classification

International Reporting Standards

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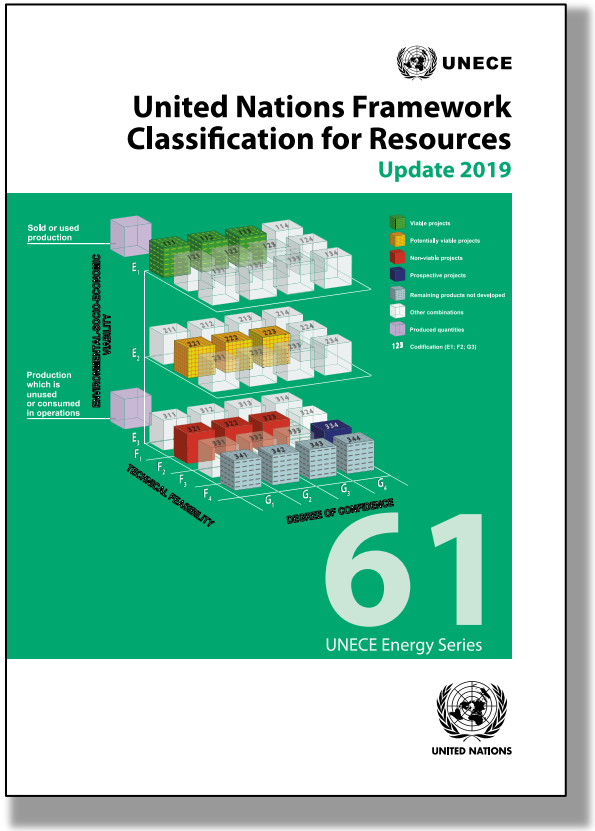

Use of UNFC

UNFC provides a method for governments and NGOs to incorporate published data into databases, mineral inventories, etc.

Use of CRIRSCO/PERC

PERC is recognised by ESMA for use on European Union stock exchanges (ESMA = European Securities and Markets Authority)

Accepted on a number of other stock exchanges around the world (Canada, Singapore, ...)

Mineral Classification

International Reporting Standards

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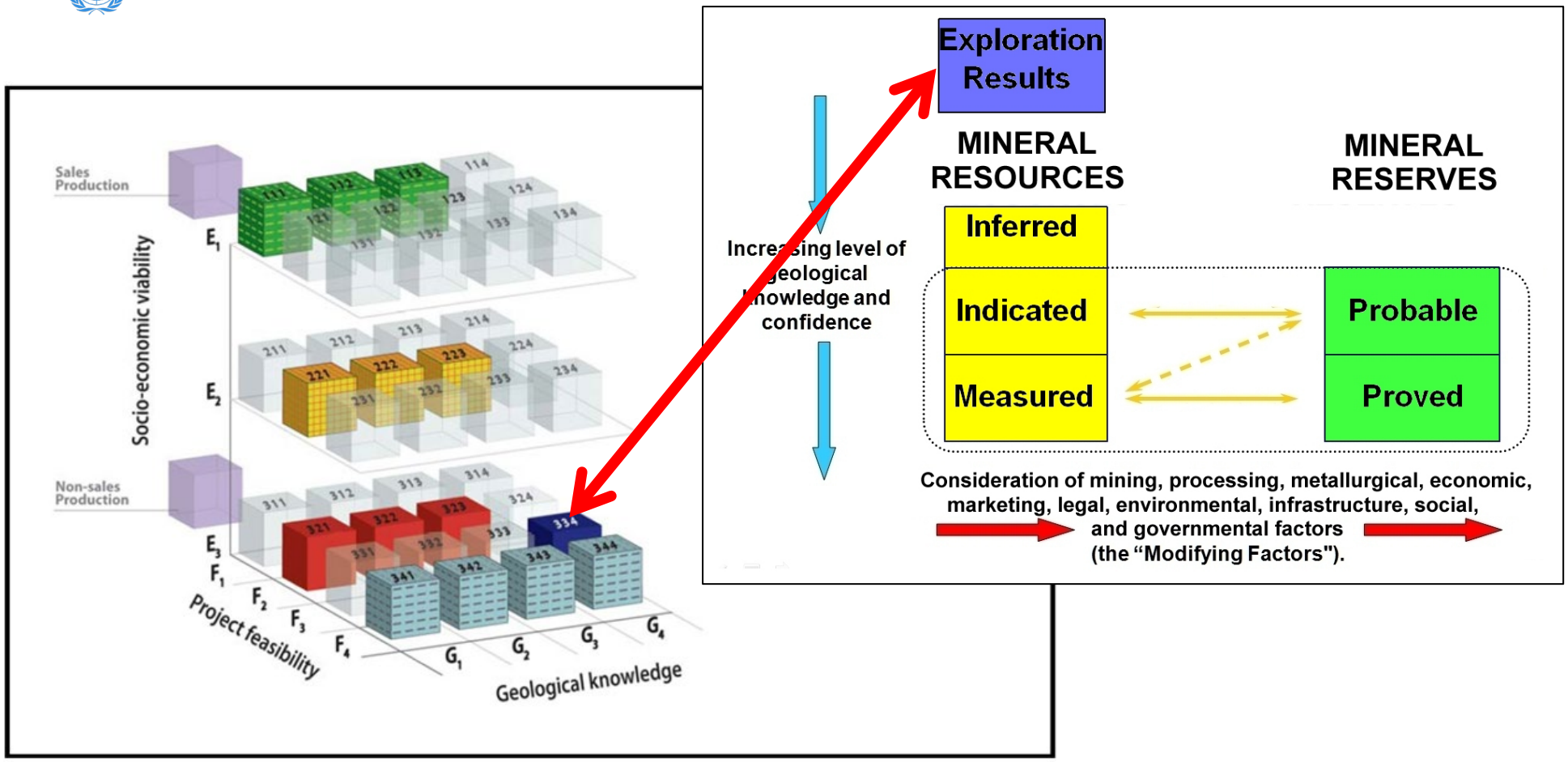
UNFC-2009 Classification					CRIRSCO Template		NEA/IAEA Classification		
UNFC Classes and Sub-classes		UNFC Categories			CRIRSCO Classes and Sub-classes		IAEA-NEA Categories		Status
Class	Sub-Class	E	F	G	Class	Sub-Class			
Commercial Projects	On Production	1	1.1	1	Mineral Reserves	Proved	Reasonably Assured Resources (RAR)		Existing
				2		Probable			
	Approved for Development	1	1.2	1		Proved			Committed
				2		Probable			
	Justified for Development	1	1.3	1		Proved			Planned
				2		Probable			
Potentially Commercial Projects	Development Pending	2	2.1	1	Mineral Resources	Measured	Identified Resources	RAR	Prospective
				2		Indicated			
				3		Inferred		IR*	
	Development On Hold	2	2.2	1		Measured		RAR	
				2		Indicated			
				3		Inferred		IR*	
Non-commercial Projects	Development Unclarified	3.2	2.2	1,2,3	Inventory (not defined in Template)	Development Unclarified (not defined in Template)	Identified Resources RAR IR*		Unclarified
	Development Not Viable	3.3	2.3	1,2,3		Not Viable (not defined in Template)			Not Viable
Exploration Projects		3.2	3.1	4	Exploration Target		Undiscovered Resources	Prognosticated Resources	
		3.2	3.2, 3.3	4				Speculative Resources	

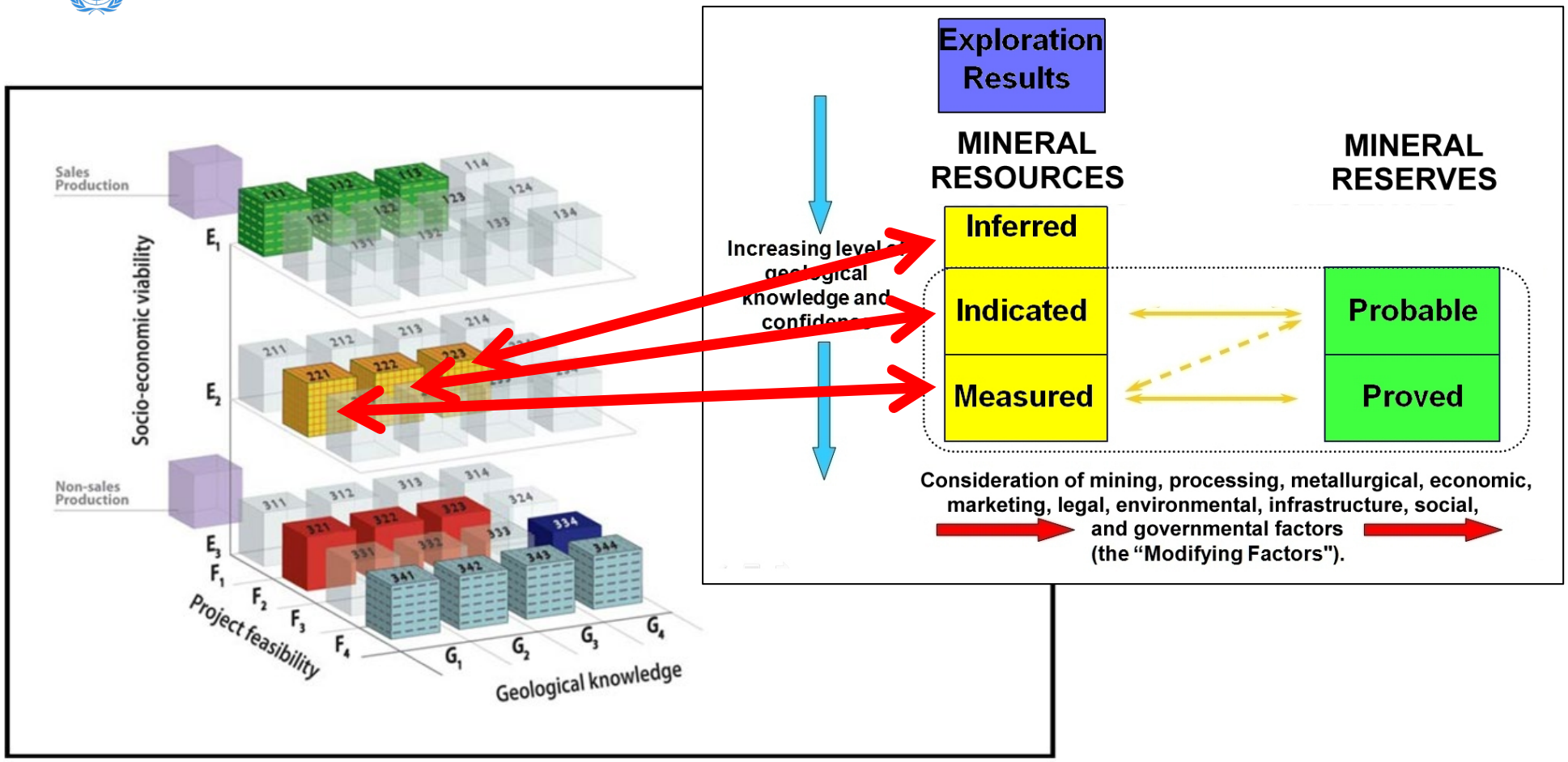
Mineral Classification

UNFC/CRIRSCO Default Mappings



Mineral Classification

UNFC/CRIRSCO Default Mappings



Mineral Classification

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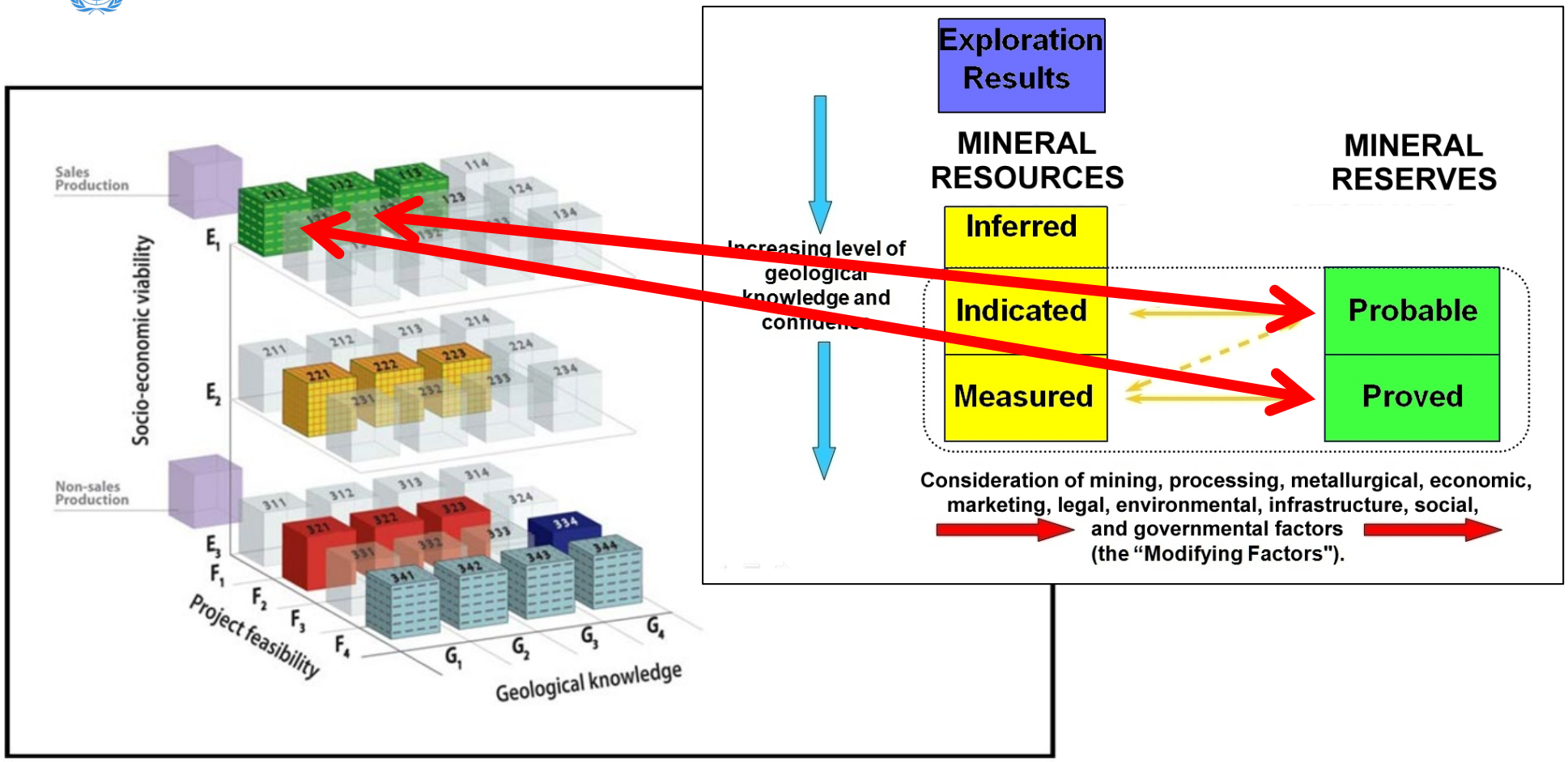

Mineral Classification

Case Studies

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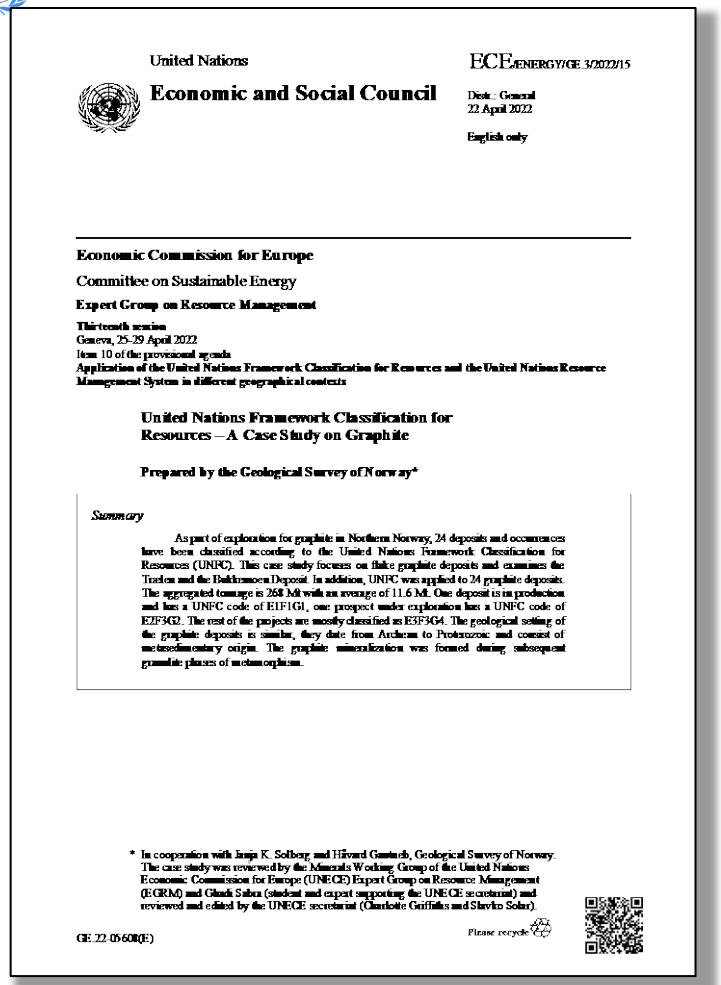

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Economic Commission for Europe

Committee on Sustainable Energy

Expert Group on Resource Management

Thirteenth session
Geneva, 25-29 April 2022
Item 10 of the provisional agenda
Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System in different geographical contexts

United Nations Framework Classification for Resources – A Case Study on Graphite

Prepared by the Geological Survey of Norway*

Summary

As part of exploration for graphite in Northern Norway, 24 deposits and occurrences have been classified according to the United Nations Framework Classification for Resources (UNFC). This case study focuses on flake graphite deposits and examines the Trælen and the Bukkemoen Deposit. In addition, UNFC was applied to 24 graphite deposits. The aggregated tonnage is 268 Mt with an average of 11.6 Mt. One deposit is in production and has a UNFC code of E1F1G1, one prospect under exploration has a UNFC code of E2F3G2. The rest of the projects are mostly classified as E3F3G4. The geological setting of the graphite deposits is similar, they date from Archean to Proterozoic and consist of metasedimentary origin. The graphite mineralization was formed during subsequent granulite phases of metamorphism.

* In cooperation with Jasja K. Solberg and Håvard Gautneb, Geological Survey of Norway. The case study was reviewed by the Minerals Working Group of the United Nations Economic Commission for Europe (UNECE) Expert Group on Resource Management (EGRM) and Ghadi Sabra (student and expert supporting the UNECE secretariat) and reviewed and edited by the UNECE secretariat (Charlotte Griffiths and Slavko Solar).

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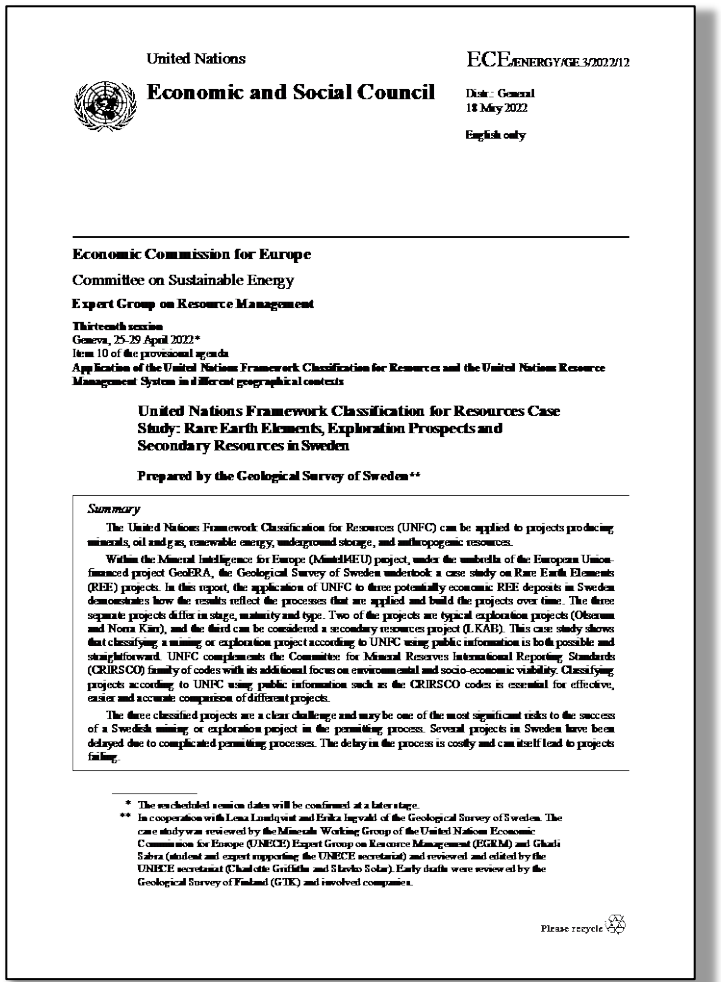

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Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System in different geographical contexts

United Nations Framework Classification for Resources Case Study: Rare Earth Elements, Exploration Prospects and Secondary Resources in Sweden

Prepared by the Geological Survey of Sweden**

Summary

The United Nations Framework Classification for Resources (UNFC) can be applied to projects producing minerals, oil and gas, renewable energy, underground storage, and anthropogenic resources.

Within the Mineral Intelligence for Europe (MineMIEU) project, under the umbrella of the European Union-financed project GeoERA, the Geological Survey of Sweden undertook a case study on Rare Earth Elements (REE) projects. In this report, the application of UNFC to three potentially economic REE deposits in Sweden demonstrates how the results reflect the processes that are applied and build the projects over time. The three separate projects differ in stage, maturity and type. Two of the projects are typical exploration projects (Olserum and Norra Kärr), and the third can be considered a secondary resources project (LKAB). This case study shows that classifying a mining or exploration project according to UNFC using public information is both possible and straightforward. UNFC complements the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) family of codes with its additional focus on environmental and socio-economic viability. Classifying projects according to UNFC using public information such as the CRIRSCO codes is essential for effective, easier and accurate comparison of different projects.

The three classified projects are a clear challenge and may be one of the most significant risks to the success of a Swedish mining or exploration project in the permitting process. Several projects in Sweden have been delayed due to complicated permitting processes. The delay in the process is costly and can itself lead to projects failing.

* The rescheduled session dates will be confirmed at a later stage.

** In cooperation with Lena Lindqvist and Erika Ingvald of the Geological Survey of Sweden. The case study was reviewed by the Minerals Working Group of the United Nations Economic Commission for Europe (UNECE) Expert Group on Resource Management (EGRM) and Ghadi Sabra (student and expert supporting the UNECE secretariat) and reviewed and edited by the UNECE secretariat (Charlotte Griffiths and Slavko Solar). Early drafts were reviewed by the Geological Survey of Finland (GTK) and involved companies.

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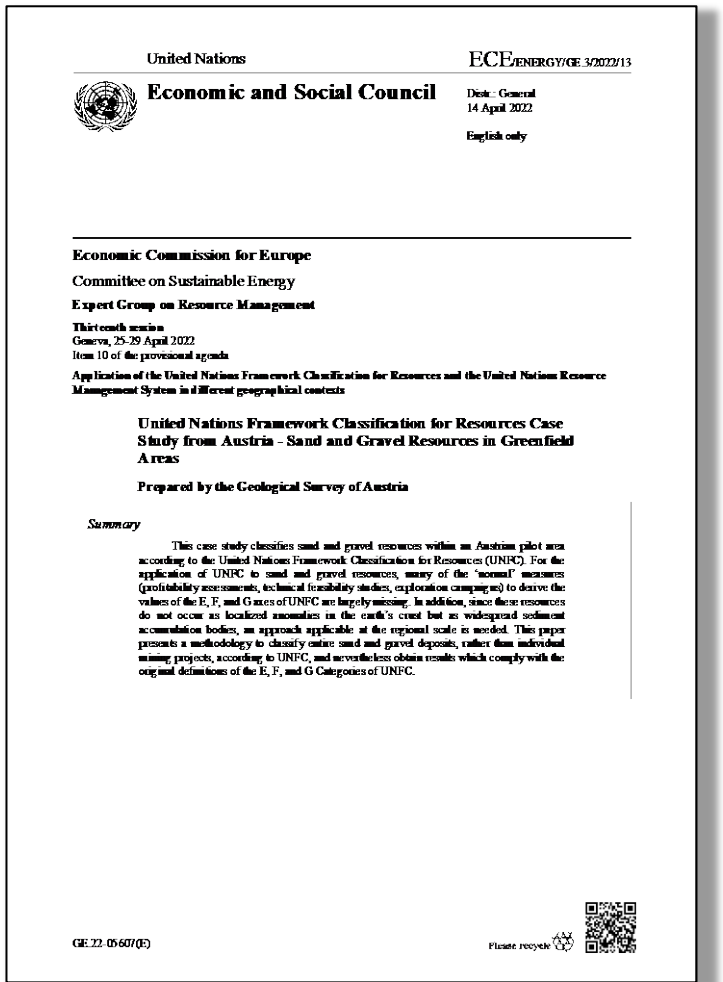

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Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System in different geographical contexts

United Nations Framework Classification for Resources Case Study from Austria - Sand and Gravel Resources in Greenfield Areas

Prepared by the Geological Survey of Austria

Summary

This case study classifies sand and gravel resources within an Austrian pilot area according to the United Nations Framework Classification for Resources (UNFC). For the application of UNFC to sand and gravel resources, many of the 'normal' measures (profitability assessments, technical feasibility studies, exploration campaigns) to derive the values of the E, F, and G axes of UNFC are largely missing. In addition, since these resources do not occur as localized anomalies in the earth's crust but as widespread sediment accumulation bodies, an approach applicable at the regional scale is needed. This paper presents a methodology to classify entire sand and gravel deposits, rather than individual mining projects, according to UNFC, and nevertheless obtain results which comply with the original definitions of the E, F, and G Categories of UNFC.

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Mineral Classification

Case Studies

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Fourteenth session
Geneva, XXXX April 2023
Item X of the provisional agenda
XXXXX

UNFC Case Study: Titanium deposit, the Piampaludo exploration project in Italy.

Prepared by xxxx

Summary

This case study demonstrates the application of the United Nations Framework Classification for Resources (UNFC) to a titanium exploration project (Piampaludo) in Liguria, Italy. This report is an attempt to introduce UNFC to Italy. The Piampaludo exploration project is reported to be one of the largest deposits of titanium in Europe with the potential for significant economic importance, yet its development is constrained by environmental and social considerations. UNFC is a classification tool that provides the end users with an assessment of a resource project to allow informed decision making as part of sustainable resource management. The case study demonstrates the classification process for the Piampaludo exploration project, highlighting the social and environmental constraints according to the transparency needed for UNFC, using only data available to the public. Therefore, the information presented in this case study results in a classification sufficient for local and national mineral inventories. For that purpose, this report emerges as an educational example of the use of UNFC with only publicly available data and not on accessing detailed exploration information that would be available to Compagnia Europea per il Titanio (CET), the current owners of the Piampaludo exploration project.

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USGS
science for a changing world

Titanium

Chapter T of

Critical Mineral Resources of the United States—Economic and Environmental Geology and Prospects for Future Supply

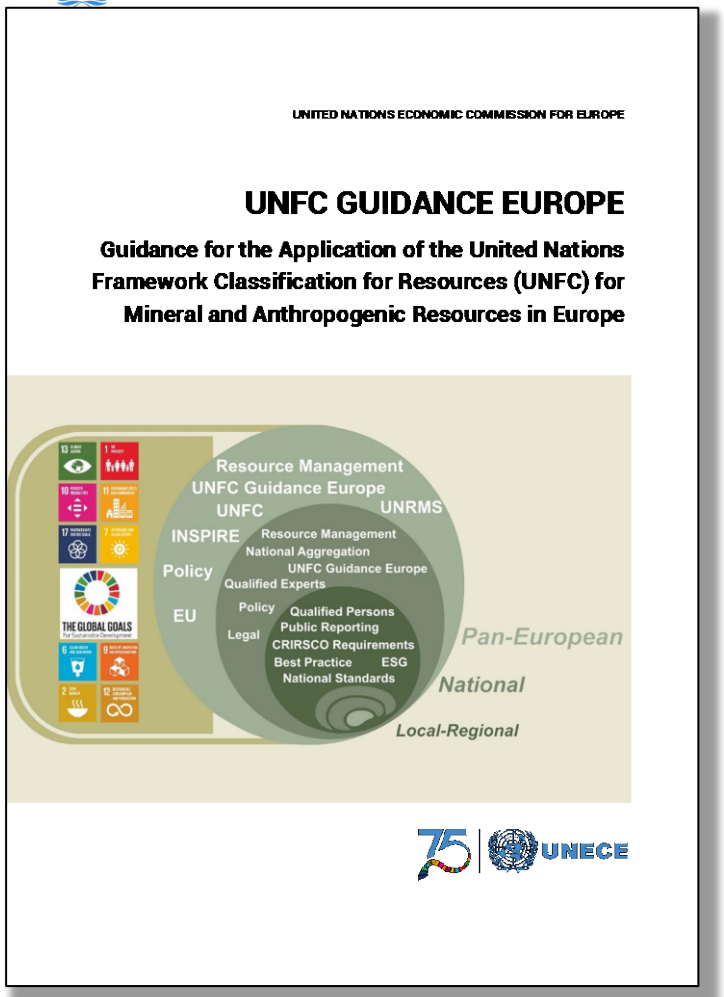



Professional Paper 1802–T

U.S. Department of the Interior
U.S. Geological Survey

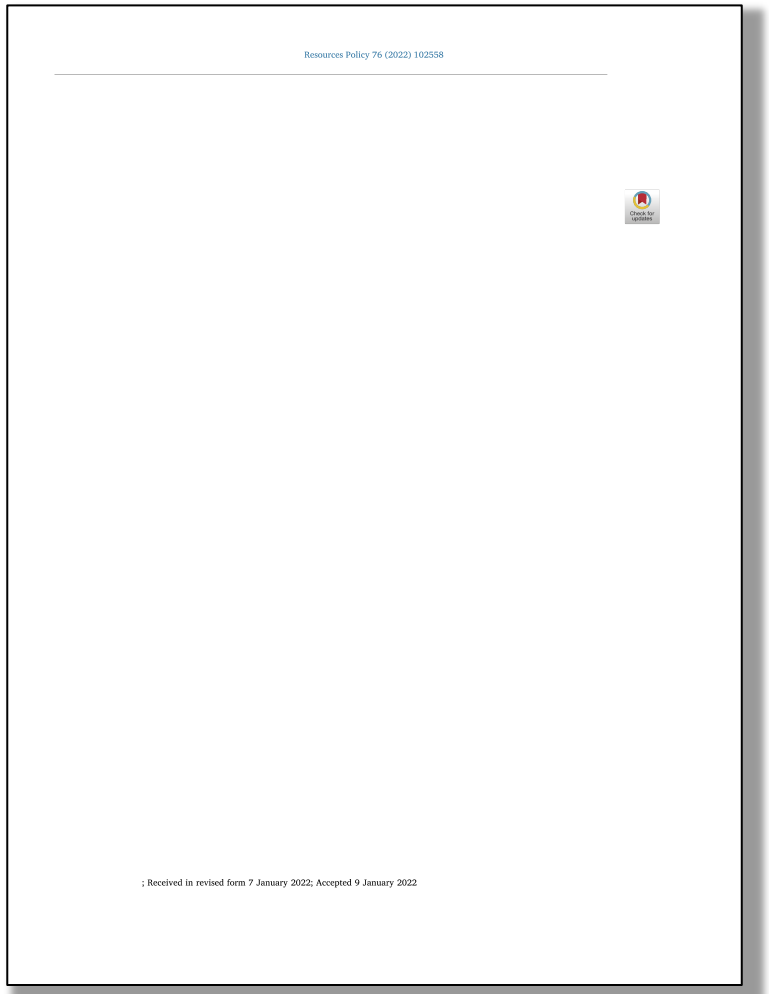
Mineral Classification

Case Studies


UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

UNFC GUIDANCE EUROPE

Guidance for the Application of the United Nations Framework Classification for Resources (UNFC) for Mineral and Anthropogenic Resources in Europe


Resources Policy 76 (2022) 102558

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Development of decision-making tools to create a harmonised UK national mineral resource inventory using the United Nations Framework Classification

T. Bide *, T.J. Brown, A.G. Gunn, E. Deady

Resources Policy
Volume 76, June 2022, 102558

https://www.sciencedirect.com/science/article/pii/S0301420722000113?via%3Dihub

Thank you!

Hendrik Falck
Chair, EGRM Minerals Working Group
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Date 25 I 04 I 2023, Geneva

RESOURCE MANAGEMENT WEEK 2023

ASSURING SUSTAINABILITY IN RESOURCE MANAGEMENT

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