



# GSEU

**GEOLOGICAL SERVICE | FOR EUROPE**

## **GSEU WP2 TRAIN-THE-TRAINER COURSE**

### **Module 2 Historic Estimates**

#### **Level 2**

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## Historic estimates

### Training Level 1

What are historic estimates?

What are the main principles in dealing with historic estimates?

What are the UNFC main classes and sub-classes to be used with historic estimates?

Example of a historic estimate classified as a prospective project

### Training Level 2

UNFC mapping for cases of:

- Historic estimate with extensive background knowledge
- Mine closure
- Ownership change
- Commodities dropped from company estimates

Monitoring aspects regarding historic projects



# Historic Level 1 recap

- UNFC codifications from 111 to 223 are mainly for products with direct evidence of ownership, plans for technical feasibility of development and/or planned activities related to minerals projects
- These are not, for example, for historic or abandoned projects regardless of availability of technical and geological information

UNFC Classes Defined by Categories and Sub-categories						INSPIRE Code List	
Produced	Sold or used production						
	Production which is unused or consumed in operations <i>Future production that is either unused or consumed in the Project operations is categorized as E3.1. These can exist for all Classes of recoverable quantities °</i>						
Total Products	Class	Sub-class	Categories				
			E	F	G <sup>a</sup>		
Known Sources	Viable Projects <i>Estimates associated with Viable Projects are defined in many classification systems as Reserves, but there are some material differences between the specific definitions that are applied within different industries and hence the term is not used here. °</i>	On Production	1	1.1	1, 2, (3)	operating continuously operating intermittently	
		Approved for Development	1	1.2	1, 2, 3	under development	
		Justified for Development	1	1.3	1, 2, 3	pending approval	
	Potentially Viable Projects <i>Not all Potentially Viable Projects will be developed</i>	Development Pending	2 <sup>b</sup>	2.1	1, 2, 3	feasibility evaluation of the ore deposit	
		Development On Hold	2	2.2	1, 2, 3	care and maintenance retention	
	Non-Viable Projects <i>Non-Viable Projects include those that are at an early stage of evaluation in addition to those that are considered unlikely to become Viable developments within the Foreseeable Future. °</i>	Development Unclassified	3.2	2.2	1, 2, 3	resource assessment (geological interpretation, approximate calculation of the resource)	
		Development Not Viable	3.3	2.3	1, 2, 3	closed abandoned historic	
	Remaining Products not developed from identified Projects <i>Remaining Products not developed from identified Projects or Prospective Projects may become developable in the future as technological or environmental-socio-economic conditions change. Some or all these estimates may never be developed due to physical and/or environmental-socio-economic constraints. °</i>			3.3	4	1, 2, 3	
	Potential Sources	Prospective Projects		3.2	3.1	4	subsurface exploration
				3.2	3.2	4	detailed surface exploration
3.2				3.3	4	regional reconnaissance	
Remaining Products not developed from Prospective Projects		3.3	4.1	4			
		3.3	4.2	4			
		3.3	4.3	4			



# E axis sub-categories of UNFC-2019

UNFC 2019, ECE ENERGY SERIES No. 61, Annex I

Category	Definition
<b>E1</b>	Development and operation are confirmed to be environmentally-socially-economically viable.
<b>E2</b>	Development and operation are expected to become environmentally-socially-economically viable in the foreseeable future.
<b>E3</b>	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	Sub-Category	Sub-Category Definition
<b>E1</b>	E1.1	Development is environmentally-socially-economically viable on the basis of current conditions and realistic assumptions of future conditions.
	E1.2	Development is not environmentally-socially-economically viable on the basis of current conditions and realistic assumptions of future conditions, but is made viable through government subsidies and/or other considerations.
<b>E2</b>	No Sub-categories defined	
<b>E3</b>	E3.1	Estimate of product that is forecast to be developed, but which will be unused or consumed in operations.
	E3.2	Environmental-socio-economic viability cannot yet be determined due to insufficient information.
	E3.3	On the basis of realistic assumptions of future conditions, it is currently considered that there are not reasonable prospects for environmental-socio-economic viability in the foreseeable future.

# F axis sub-categories of UNFC-2019

UNFC 2019, ECE ENERGY SERIES No. 61,  
FIGURE 3 & Annex III

## F Axis – Technical Feasibility and Maturity

Category	Definition	Supporting Explanation
<b>F1</b>	Technical feasibility of a development project has been confirmed.	Development or operation is currently taking place or, sufficiently detailed studies have been completed to demonstrate the technical feasibility of development and operation. A commitment to develop should have been or will be forthcoming from all parties associated with the project, including governments.
<b>F2</b>	Technical feasibility of a development project is subject to further evaluation.	Preliminary studies of a defined project provide sufficient evidence of the potential for development and that further study is warranted. Further data acquisition and/or studies may be required to confirm the feasibility of development.
<b>F3</b>	Technical feasibility of a development project cannot be evaluated due to limited data.	Very preliminary studies of a project, indicate the need for further data acquisition or study in order to evaluate the potential feasibility of development.
<b>F4</b>	No development project has been identified.	Remaining quantities of product not developed by any project. These are quantities which, if produced, could be bought, sold or used (i.e. electricity, heat, etc., not wind, solar irradiation, etc.).



Category	Sub-Category	Sub-Category Definition
<b>F1</b>	F1.1	Production is currently taking place.
	F1.2	Capital funds have been committed and implementation of the development is underway.
	F1.3	Studies have been completed to demonstrate the technical feasibility of development and operation. There shall be a reasonable expectation that all necessary approvals/contracts for the project to proceed to development will be forthcoming
<b>F2</b>	F2.1	Project activities are ongoing to justify development in the foreseeable future.
	F2.2	Project activities are on hold and/or where justification as a development may be subject to significant delay.
	F2.3	There are no plans to develop or to acquire additional data at the current time due to limited potential.

Category	Sub-Category	Sub-Category Definition
<b>F3</b>	F3.1	Site-specific studies have identified a potential development with sufficient confidence to warrant further testing.
	F3.2	Local studies indicate the potential for development in a specific area but requires more data acquisition and/or evaluation in order to have sufficient confidence to warrant further testing.
	F3.3	At the earliest stage of studies, where favourable conditions for the potential development in an area may be inferred from regional studies.
<b>F4</b>	F4.1	The technology necessary is under active development, following successful pilot studies, but has yet to be demonstrated to be technically feasible for this project.
	F4.2	The technology necessary is being researched, but no successful pilot studies have yet been completed.
	F4.3	The technology is not currently under research or development.

# G axis sub-categories of UNFC-2019

UNFC 2019, ECE ENERGY SERIES No. 61, FIGURE 3 & Annex III

Category	Definition	Supporting Explanation
<b>G1</b>	Product quantity associated with a project that can be estimated with a high level of confidence.	Product quantity estimates may be categorized 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.
<b>G2</b>	Product quantity associated with a project that can be estimated with a moderate level of confidence.	Alternatively, product quantity estimates may be categorized as a range of uncertainty as reflected by either (i) three specific deterministic scenarios (low, best and high cases) or (ii) a probabilistic analysis from which three outcomes (P90, P50 and P10) <sup>3</sup> are selected. In both methodologies (the "scenario" and "probabilistic" approaches), the estimates are then classified on the G Axis as G1, G1+G2 and G1+G2+G3 respectively.
<b>G3</b>	Product quantity associated with a project that can be estimated with a low level of confidence.	<p>In all cases, the product quantity estimates are those associated with a project.</p> <p>Additional Comments: The G axis Categories are intended to reflect all significant uncertainties (e.g. source uncertainty, geologic uncertainty, facility efficiency uncertainty, etc.) impacting the estimate forecast for the project. Uncertainties include variability, intermittency and the efficiency of the development and operation (where relevant). Typically, the various uncertainties will combine to provide a full range of outcomes. In such cases, categorization should reflect three scenarios or outcomes that are equivalent to G1, G1+G2 and G1+G2+G3.</p>
<b>G4</b>	Product quantity associated with a Prospective Project, estimated primarily on indirect evidence.	<p>A Prospective Project is one where the existence of a developable product is based primarily on indirect evidence and has not yet been confirmed. Further data acquisition and evaluation would be required for confirmation.</p> <p>Where a single estimate is provided, it should be the expected outcome but, where possible, a full range of uncertainty should be calculated for the prospective project.</p> <p>In addition, it is recommended that the chance of success (probability) that the prospective project will progress to a Viable Project is assessed and documented.</p>

## G – Degree of Confidence

Category	Sub-Category	Sub-Category Definition
<b>G4</b>	G4.1	Low estimate of the quantities.
	G4.2	Incremental amount to G4.1 such that G4.1+G4.2 equates to a best estimate of the quantities.
	G4.3	Incremental amount to G4.1+G4.2 such that G4.1+G4.2+G4.3 equates to a high estimate of the quantities.



# Case study: Historic estimate with extensive background knowledge

## Case Study Name: Au-Co-Cu case study

### Project Background

#### Commodities:

Au, Co, Cu

#### Location:

Ostrobotnia, Finland

#### Project status:

Non-Active Project, Non-Viable Project (Historic)

#### Current holder/ownership:

Project non-active

#### Geology:

The deposit consists of disc-shaped subparallel Au-Co-Cu ore bodies or mineralized zones in meta-andesite.

#### Project history:

It is a Co-Cu-Au deposit that was first discovered in the 1980s after a company drilled into a combined electromagnetic and till geochemical (Co-Cu) anomaly. The initial reconnaissance drilling consisted of 43 diamond-drill holes which were later filled in by 39 additional diamond drill-holes. A block model was created, and data density was evaluated to decide what to include in a resource. A non-CRIRSCO compliant resource was published in 1984 divided into **what can be translated as inferred and indicated resources**. The resource totals 448530 t of ore at 0,811% Cu, 0,182% Co and 0,8 ppm Au. 5000 t of ore was test mined in 1984. Beneficiation tests were performed for the ore, and economic and technical feasibility were evaluated.



# Case study: Historic estimate with extensive background knowledge

## Production

### Historic Production:

### Current Production:

### Recognized Challenges and/or Block Factors

The resource estimate has no CP/QP sign-off. The estimate was carried out prior to international reporting standards. There is no information on the QA/QC related to e.g., sampling, and chemical assays. The original owner has abandoned the project, and the deposit has gone through a few owners since then, but no new updated resource has been published. There are several outdated aspects of the original published resource: the results of the beneficiation test, feasibility studies and the chemical analyses (lack of QA/QC).





## Case study: Historic estimate with extensive background knowledge

Non-compliant resource	Mt	Au	Co	Cu	UNFC
'Indicated' and 'Inferred'	0,45 Mt	0,8 ppm	0,18%	0,81%	



## Viable to non-viable projects: Mine closure

- When a mine is fully closed, all remaining reserves and resources reported previously, but that were not mined, mapped into E3.3;F2.3;G1-4
  - **E3.3:** Based on realistic assumptions of future conditions, it is currently considered that there are not Reasonable Prospects for environmental-socio-economic viability in the Foreseeable Future
  - **F2.3:** There are no plans to develop or to acquire additional data at the current time due to limited potential
  - **G-axis** is unaffected
  
- In certain cases **F4** may also be used for closed mining operations

UNFC Guidance Europe Annex II p. 28

Guidance Note on the use of the Bridging Document between the CRIRSCO Template and UNFC p. 26-27



# Case study: Kylylahti

## Kylylahti Cu Case Study

### Project Background

**Commodities:**

Main commodities: Cu, Zn (other: Ag, Au, Ni, Co)

**Location:**

Polvijärvi, eastern Finland about 42 km northwest of the city of Joensuu

**Project status:**

Non-Viable - closed

**Current holder/ownership:**

The company still holds a valid mining permit

**Historic Production:** Total ore mined 6 076 367 t.

**Current Production:** No production, mine is closed.

Total production:	
Product	Product measure
silver	5,74 t
copper	74268 t
cobalt	6149 t
gold	4049 kg
zinc	13325 t
nickel	3138 t



# Case study: Kylylahti

## Resource and Reserves

The company has released resource estimate 2019 under PERC- reporting standard (Summary report). The mineral resources were not converted from 2019 onwards into reserves, and therefore they are assumed to still exist after mine closure.

UNFC after mine closure:

<b>Resources 2019:</b>	Mt	Cu %	Au g/t	Zn%	Ni%	Co%
Measured	2,5	0,56	0,24	0,3	0,25	0,14
Indicated	3,7	0,34	0,36	0,21	0,27	0,11
Inferred	0,7	0,08	0,02	0,05	0,42	0,04

Resources in 2019

Measured: 221

Indicated: 222

Inferred: 223

Resources during the process of mine closure

Measured: E2;F2.2;G1

Indicated: E2;F2.2;G2

Inferred: E2;F2.2;G3

Resources after mine closure?



## Viable to non-viable projects: Ownership change

- When mineral resources are reported by a mineral company, but the company has since abandoned the project, the resource must be downgraded
- The same applies even if the project has a new owner, but they have not confirmed the resource reported by the earlier holder
- In some CRIRSCO-aligned systems, these are considered 'historical estimates' (NI43-101/CIM) or 'foreign estimates' (ASX/JORC) which do not represent mineral resources



## Viable to non-viable projects: Ownership change

- Companies reporting under a CRIRSCO-family code are not allowed to report the historic estimates as resources without a sign-off from a CP
- The suggestion in the CRIRSCO-UNFC bridging document is to classify historic estimates as E3;F3 (G-axis unchanged); however this is mostly relevant for the operators perspective
- From a GSO perspective, however, UNFC mapping of these quantities is best reflected by the categories **E3.2;F2.2;G1-3**

UNFC Guidance Europe, Annex II p. 29

Bridging Document between the Committee for Mineral Reserves International Reporting Standards Template and the United Nations Framework Classification for Resources p. 17



## Viable to non-viable projects: Ownership change

- The changes in the E and F Categories, from 1 and 2 to 3, relate to the Project status which means that assessments related to the environmental-socio-economic viability (E-axis) and technical feasibility (F-axis) can no longer be regarded as valid
- Often the new entity needs to make a full reassessment of the factors relating to the E and F axes, because of
  - Different strategic interests than the previous project
  - New technologies have become available
  - Metal prices have changed
  - Environmental regulations and the values of society have changed
- Contrary to the E and F axes, the degree of confidence (G-axis), that is, the degree of uncertainty related to geology, is not essentially changed. This is unless the work done on acquiring geological information becomes outdated, too.



## Viable to non-viable projects: Ownership change

- In cases of ownership change, E1 and E2 become E3.2 or E3.3
  - **E3.2:** Environmental-socio-economic viability cannot yet be determined due to insufficient information (**when the project has a holder**, but has not confirmed the earlier resource)
  - **E3.3:** Based on realistic assumptions of future conditions, it is currently considered that there are not Reasonable Prospects for environmental-socio-economic viability in the Foreseeable Future (when the project is abandoned by the reporting company, and **does not have a current holder**)
- Similarly, F1 and F2 become F2.2 or F3
  - **F2.2:** Project activities are on hold and/or where justification as a development may be subject to significant delay (**project has holder**, but has not confirmed earlier resource)
  - **F3:** Technical feasibility of a development Project cannot be evaluated due to limited data
    - Subclasses F3.1, F3.2, F3.3 may all be used





## Viable to non-viable projects: Ownership change

- Ownership change has no effect on G-axis
- If the new owner confirms the resource from the previous holder, the UNFC class is as if it had been reported by the current owner
- To summarize:
  - If the project has a new owner, but has not confirmed the previous resource:
    - 111, 112, 113, 221, 222, 223 -> **E3.2; F2.2; G1-3**
    - Class: Non-viable project
    - Sub-class: development unclarified
  - If the project has been abandoned, and currently has no holder
    - 111, 112, 113, 221, 222, 223 -> **E3.3; F2.3;G1-4** or **E3.3;F3;G1-4**
    - Class: Non-viable project or Prospective project



# Case study: Hannukainen

## Project Background

**Commodities:** Fe main product. Au and Cu as by-products.

**Location:** Municipality of Kolari in the Northern Finland

**Project status:** Active Project, Potentially-Viable Project (Feasibility/Development)

**Current holder/ownership:** Under the current owner since 2015. The Mineral Company is currently holding a claim and submitted application for mining concession in 2022 (status:pending).

### Geology:

Hannukainen Fe-Au-Cu-Co deposit is classified as IOCG deposit having several plate or lensoidal bodies up to 50m thick along a thrust zone. The main host to mineralization consists of diorite, hornblende-diopside and magnetite metasomatic rocks.

### Project history:

The deposit was discovered in 1974 by Rautaruukki company after a subcrop was discovered beneath till and gravel following airborne and ground magnetic surveys. The mine was in production between 1978-1990. The project activated in 2005 when a mineral company started to develop the project through geological data collection (e.g., diamond drilling, geophysical surveys, geological mapping) and successfully applied for a mining permit. The company ran into financial difficulties and ceased its operations, filing for bankruptcy at the end of 2014. In 2015, another company acquired all the rights and research materials related to the project from the bankruptcy estate.



# Case study: Hannukainen

## Recognized Challenges and/or Block Factors

After the bankruptcy of the previous company in 2014 the new company started to develop the deposit in 2015. The Mineral Company has applied for a Mining Permit which is currently pending. The Mining Permit includes e.g. Environmental assessment and Environmental permit to be granted.

Since the resource is **not confirmed** under the current ownership of the project, **the resources must be considered as a historic estimate**. Therefore, the resource cannot be currently considered as a 'CRIRSCO-compliant' resource.

## Resource and Reserves

In 2006, a mineral company released ("Public Report") the following reserve and resource information from a Fe-Cu-Au deposit in 2012 under the NI43-101 and following CIM guideline.

	Mt	Fe %	Cu %	Au g/t
<i>Resources (include reserve tonnages):</i>				
Measured	154	32.24	0.18	0.09
Indicated	6	30.37	0.17	0.07
Inferred	61	32.25	0.15	0.044
Total	221	32.2	0.17	0.077
<i>Reserves:</i>				
Proved	91.8	32.2	0.186	0.088
Probable	0.8	32.6	0.148	0.06

Reported in accordance with CIM best practice guidelines and disclosed within NI43-101



## Case study: Hannukainen

	Mt	Fe %	Cu %	Au g/t	
<i>Reserves:</i>					
Proven	91.8	32.2	0.186	0.088	
Probable	0.8	32.6	0.148	0.06	



## Viable to non-viable projects: Commodity excluded from recent resource estimates

- If a commodity is reported by a company in an earlier stage of a project, but is excluded from updated resource estimates, that resource must be downgraded
- When the company initially reports a resource it will be mapped as the CRIRSCO/a national system bridging instructs
- Once the resource is excluded, from there onwards it must be downgraded into **E3.3;F4;G1-4** (remaining products not developed from identified projects)
  - **E3.3:** Based on **realistic assumptions of future conditions\***, it is currently considered that there are not Reasonable Prospects forenvironmental-socio-economic viability in the Foreseeable Future.
  - **F4:** No development project or mining operation has been identified
  - **G-axis remains unchanged**

\*the company makes this assumption by dropping the commodity from the estimate, this determination is not the job of the UNFC evaluator



# Case study: Rapasaaret

## Project Background

**Commodities:** Li<sub>2</sub>O, (BeO, Nb<sub>2</sub>O<sub>5</sub>, Ta<sub>2</sub>O<sub>5</sub>)

**Location:** Municipality of Kaustinen in the Finnish Ostrobothnia

**Project status:** Active project, Potentially Viable Project. Mining permit granted 2022, but currently under appeal. Pre-feasibility stage updated in 2023.

### Geology:

Li-Cs-Ta- (B, Sn) pegmatite and homogenous albite-spodumene pegmatite in several pegmatite dyke swarms, deposit is open at depth.

### Project history:

A mineral company conducted the first explorations of the lithium pegmatites in the 1960s in the Syväjärvi area which is 1.5 km in NW from Rapasaaret. The exploration in the area continued in the 1980s. GTK's investigations at Rapasaaret began in early 2009. After reviewing the older data from the neighbouring areas, GTK decided to investigate the Rapasaaret area with the objective to discover new lithium bearing pegmatite dikes. Several spodumene-rich pegmatite boulders SE from Rapasaaret form a boulder fan that led to the discovery of the Rapasaaret spodumene pegmatite dike swarms in 2009. GTK released the first mineral resource from the project in 2011 which included lithium, niobium, tantalum and beryllium. Project ownership was transferred to the current holder, a mineral company, in 2014, who began developing the deposit towards a mine alongside other lithium deposits in the area. Their latest mineral reserves and resources only contain information regarding the lithium.



# Case study: Rapasaaret

## Production

**Historic Production:** No production

**Current Production:** No production

## Recognized Challenges and/or Block Factors

**Permitting:** Although several of the required operating permits have been obtained, potential timing delays due to public objection and appeals could impact construction timelines. Environmental permit conditions could also be strenuous, impacting planned mining operations.

**Regarding beryllium, niobium, tantalum:** There are no current plans by the company to produce these commodities.



## Case study: Rapasaaret

### Resource and Reserves

In 2021, a mining company released the following resource information in accordance with the JORC-code:

<b>Resources: 2021</b>	Mt	Li <sub>2</sub> O	
Measured	2,343	1,09	
Indicated	5,762	0,96	
Inferred	1,573	0,91	

Li<sub>2</sub>O resource:





## Case study: Rapasaaret

The beryllium oxide, niobium pentoxide and tantalum pentoxide first included in the resource estimate by GTK in 2011 are not included/developed products in latest update.

Resources 2011	Mt	BeO	Nb <sub>2</sub> O <sub>5</sub>	Ta <sub>2</sub> O <sub>5</sub>	
	0,61	466 ppm	56 ppm	49 ppm	

Other commodities:



## Monitoring of historic projects

- Projects should always be mapped according to the latest estimate; this requires monitoring and updating of UNFC mapping regarding the quantities associated with that project
- When projects that were previously viable or potentially viable undergo an ownership change or are abandoned, their UNFC mapping should be updated accordingly
  - e.g. a previously reported inferred mineral resource initially mapped as E2;F2;G3, but the project is abandoned and should now be mapped as E3.3;F2.3;G3
- Similarly, abandoned projects that have work re-started should be re-mapped
  - Continuing with the same project, if another company resumes work in the same project, the mapping should be upgraded from E3.3;F2.3;G3 to E3.2;F2.2;G3



# Simplified checklist of the most common historic cases

Scenario	UNFC class
Project is <b>active</b> , but has not confirmed the previous, CRIRSCO-compliant (at the time) resource estimate	E3.2 ; F2.2 ; G1-3
Project is <b>active</b> , but has not confirmed the previous, non-CRIRSCO-compliant resource, but where <b>extensive work</b> has been performed	E3.2 ; F2.2 ; G1-4
Quantities associated with a <b>closed or abandoned</b> mining operation	E3.3 ; F2.3 ; G1-4 or E3.3; F4; G1-4
Project is <b>active</b> , but has not confirmed the previous, non-CRIRSCO compliant resource with <b>little background information</b> available	E3 ; F3 ; G4
Project is <b>non-active</b> and has no current holder	E3 ; F3 ; G1-4
Commodity has been <b>dropped</b> from company's most recent resource estimate	E3 ; F4 ; G1-4



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**Thank you for your attention**

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