UNFC evaluation of Critical Raw Material projects in France

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Introduction

French context

- **France is not a mining country**
  - No active mine since the 1990s
  - With the exemption of bauxite, industrial minerals, gold in Guyana and Ni/Co in New Caledonia

- **No standardised data** for resources classification

  - Legislative frameworks
    - environment code (industrial minerals)
    - mining code (metals)
  - But it is not mandatory to classify reserves & resources using reporting systems such as CRIRSCO-PERC-JORC

→ Mineral resources national database uses terms such as "measured", "estimated", etc. but without consistency with standards

- **Data sources**
  - Mineral resource national database for primary and mining wastes (BRGM)
  - Mineral cadaster (Environment Ministry)
  - Mining companies (public data)

Introduction

European context

- **DG GROW request** to map Critical Raw Materials (CRM) projects with UNFC

- **CRM Act**
  - **Recital 12, Art 6:** for strategic projects, promoters have to provide classification according to UNFC
  - **Art 18:** Member States (MS) require to make use of UNFC for national exploration programs to be carried out
  - **Art 20:** MS have to support monitoring of supply risk by providing information using UNFC on any new critical raw material project
  - **Art 26:** to promote recovery of CRM from extractive wastes, MS require to set up database on closed/abandoned extractive waste facilities with information on quantities and concentration of critical raw materials using if possible the UNFC

European Commission - Press release

Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future

Brussels, 16 March 2023

Today, the Commission proposes a comprehensive set of actions to ensure the EU's access to a secure, diversified, affordable and sustainable supply of critical raw materials. Critical raw materials are indispensable for a wide set of strategic sectors including the net zero industry, the digital industry, aerospace, and defence sectors.

While demand for critical raw materials is projected to increase drastically, Europe heavily relies on imports, often from quasi-monopolistic third country suppliers. The EU needs to mitigate the risks for supply chains related to such strategic dependencies to enhance its economic resilience, as highlighted by shortages in the aftermath of the Covid-19 and the energy crisis following Russia's invasion of Ukraine. This can put at risk the EU's efforts to meet its climate and digital objectives.

The Regulation and Communication on critical raw materials adopted today leverage the strengths and opportunities of the Single Market and the EU's external partnerships to diversify and enhance

French UNFC adaptation

Methodology

- Classification methodology using **decision trees**
  - Tom Bide's decision trees (BGS)

  → Adapted to take into account the French legislative framework to obtain the authorizations and permits for exploration and exploitation

→ Facilitate **objectivity** and **replicability** of the evaluations

→ **Improve empirically** the methodology by iteration as projects are classified

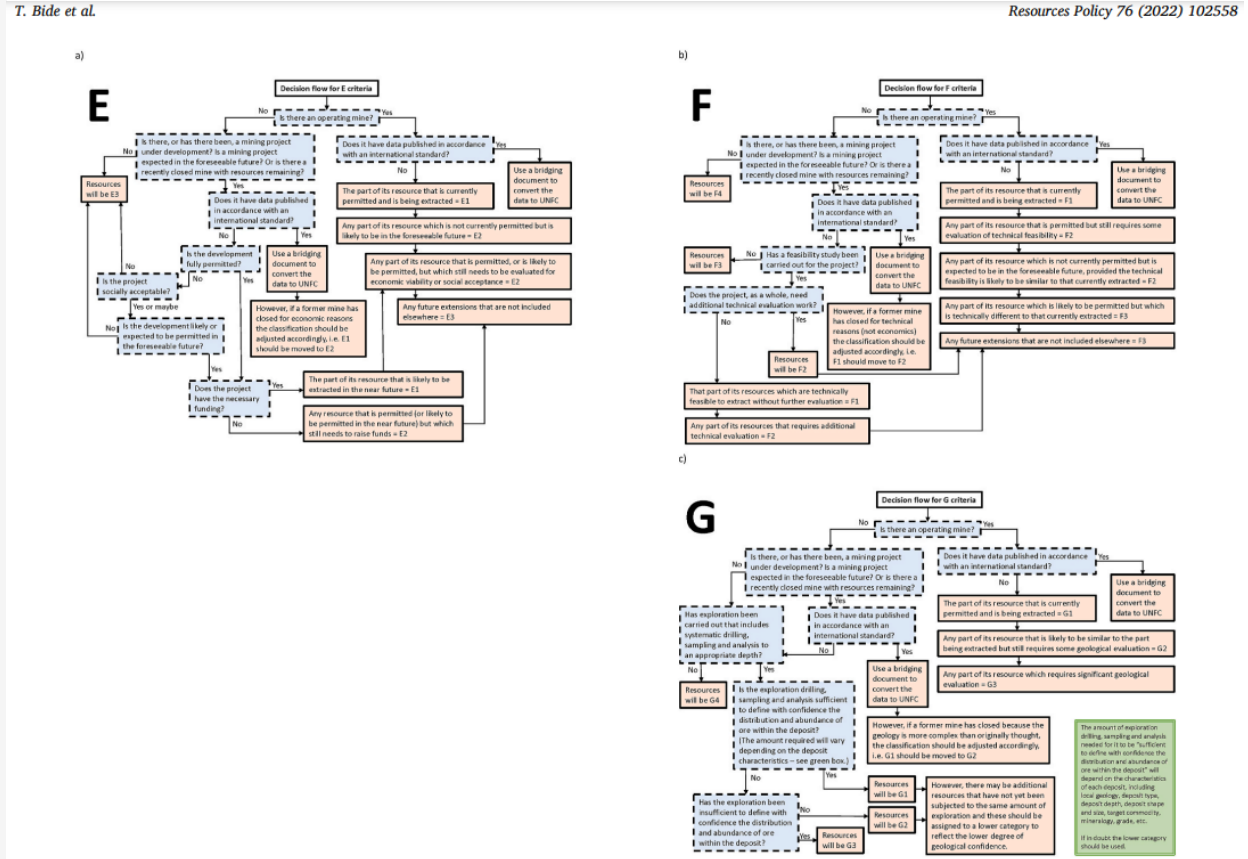
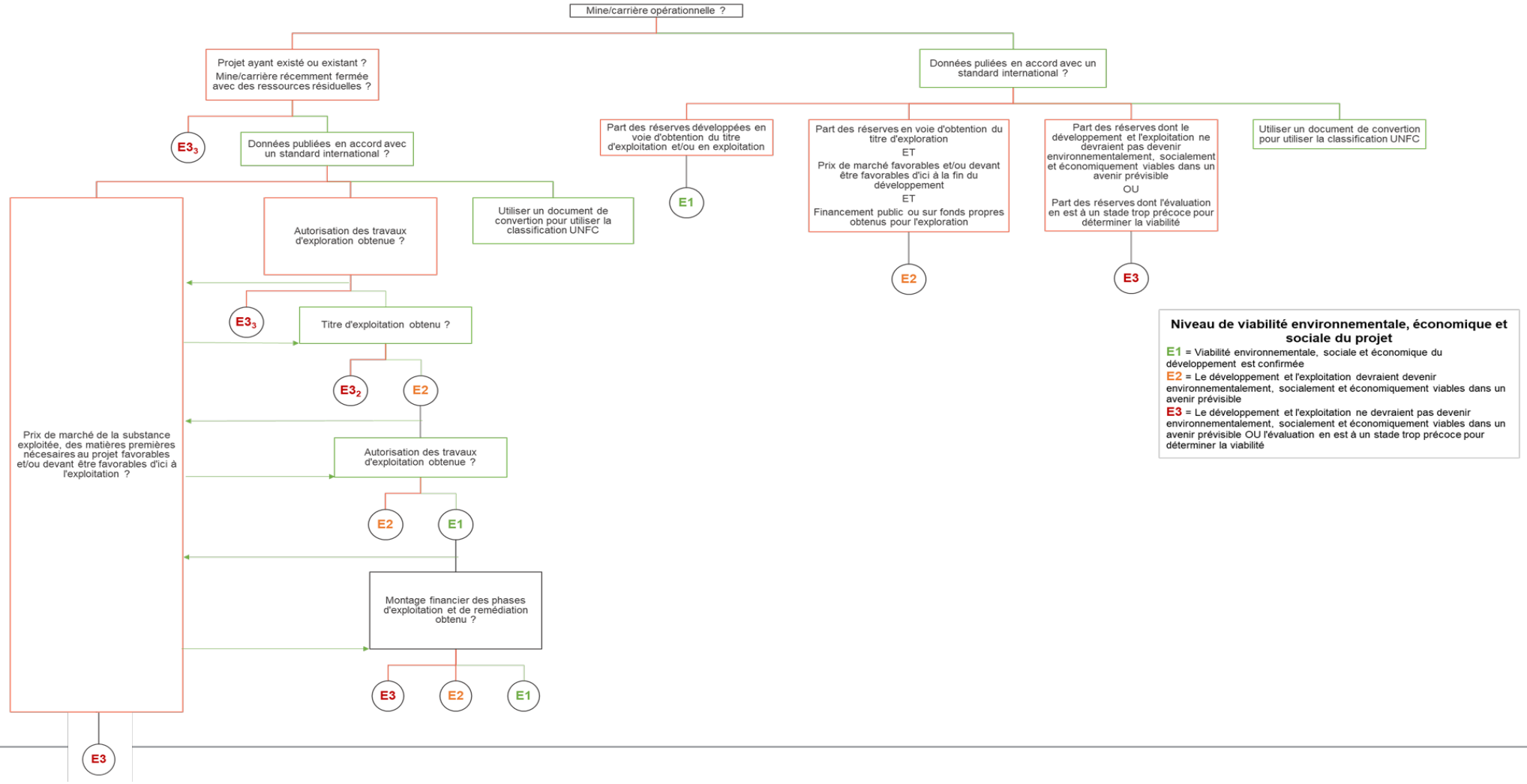


Fig. 2. Decision-flow tools for determining UNFC classes: a) represents the E axis; b) represents the F axis; and c) represents the G axis. Dashed lines represent decision steps and solid lines represent end points (Brown et al., 2019). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

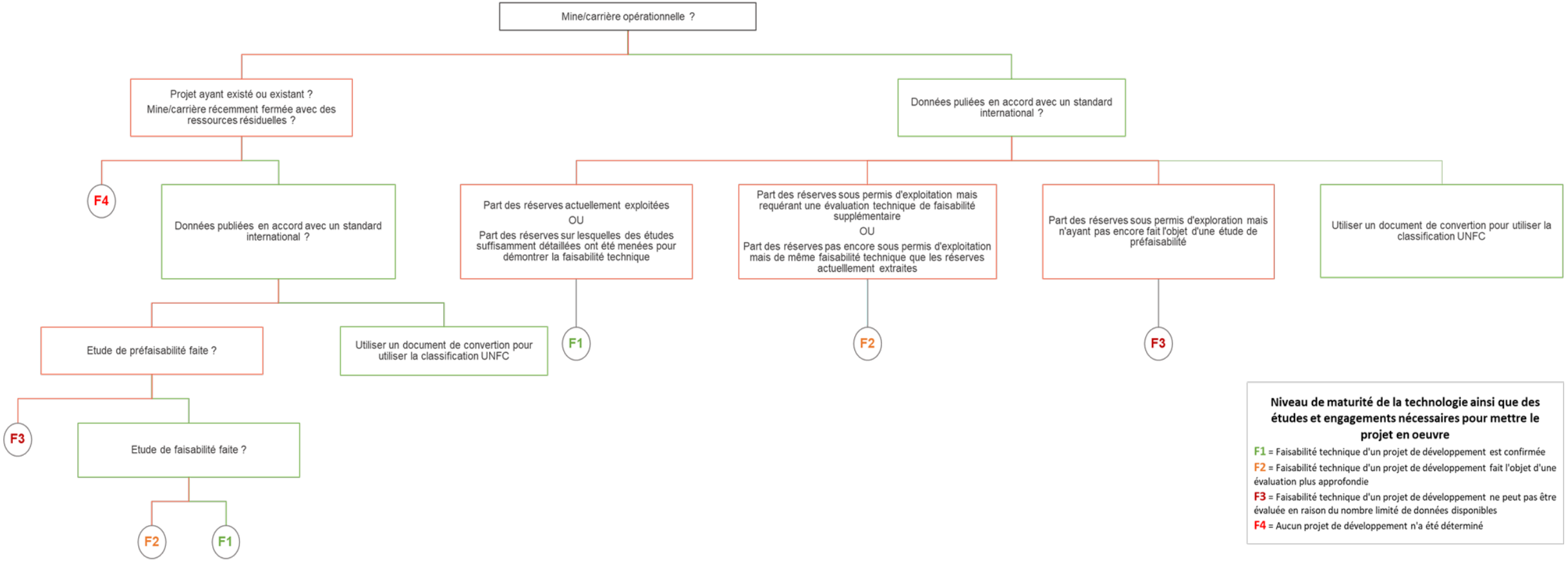
French UNFC adaptation

E-axis decision tree for French projects evaluation



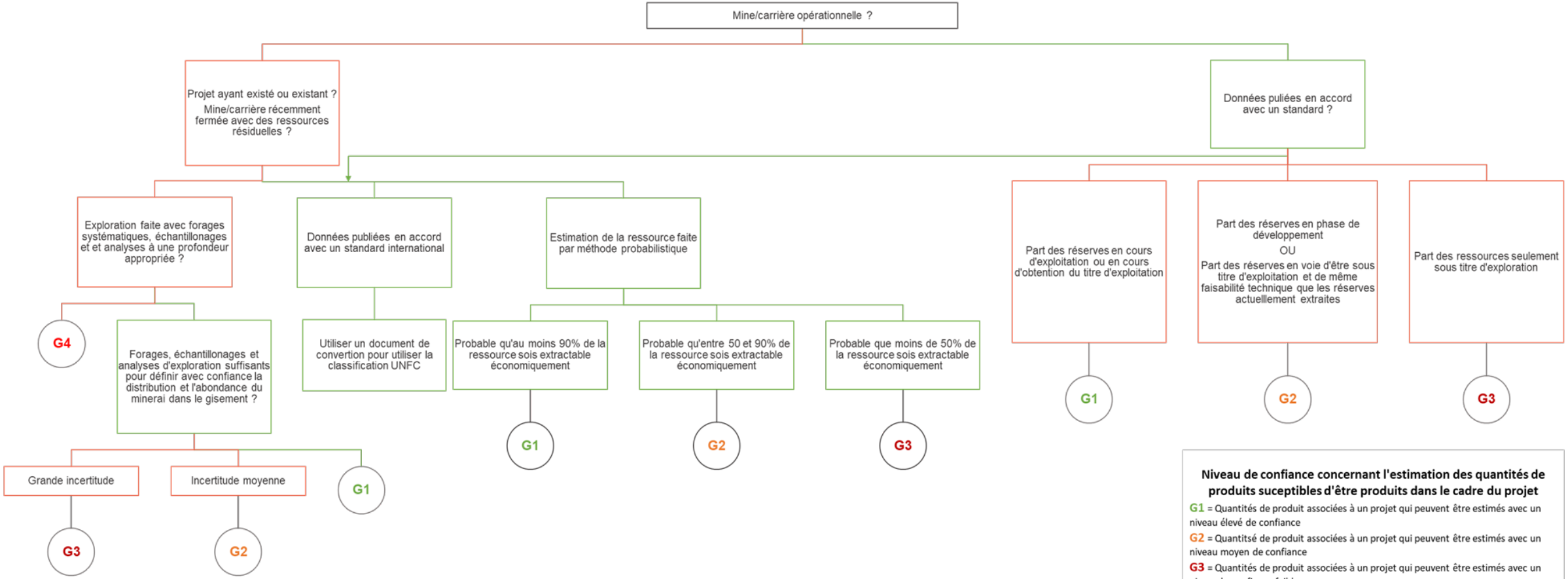
French UNFC adaptation

F-axis decision tree for French projects evaluation



French UNFC adaptation

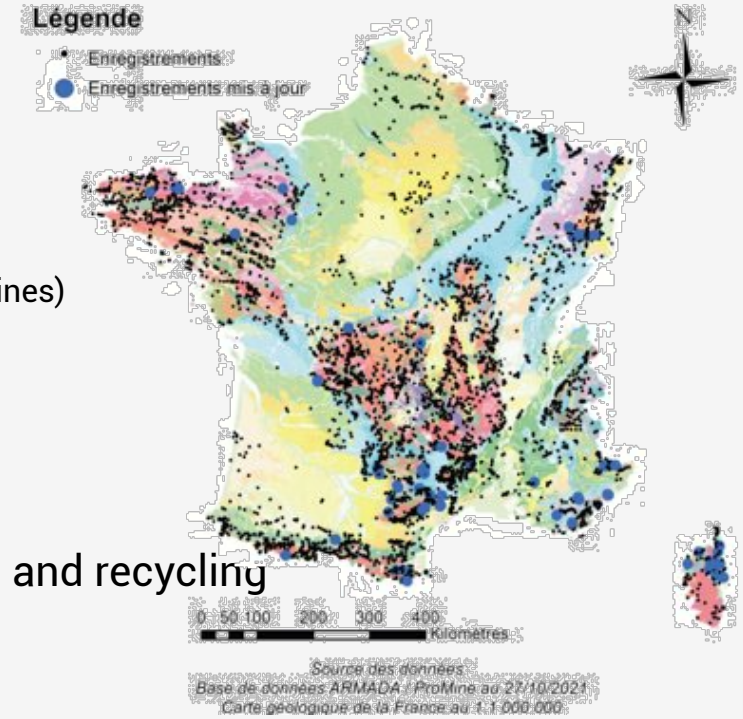
G-axis decision tree for French projects evaluation

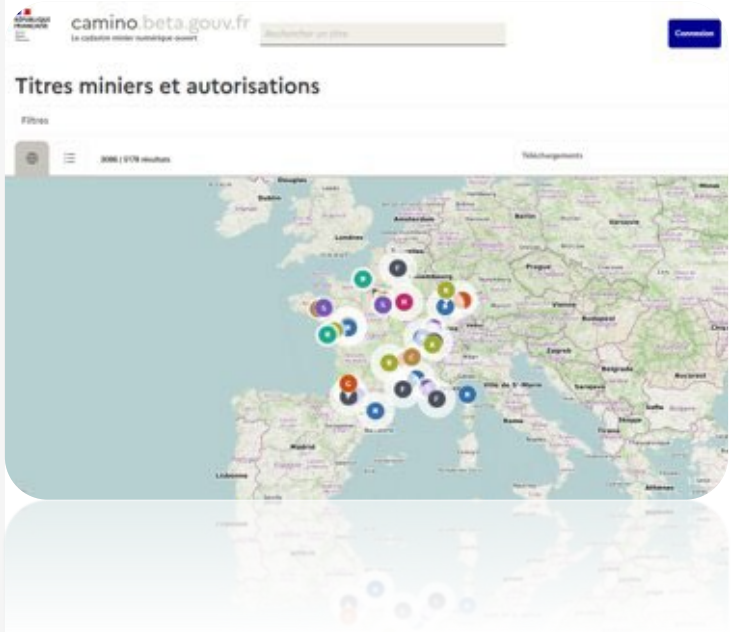


Selected projects

From active to inactive projects

- Projects under exploitation
  - 2 **bauxite** mines
  - Quarries of **silicon** high purity
  - Quarries with **dolomite** for metallurgy industry
  - **Cobalt** in New Caledonia
- Projects exploration ongoing
  - **Lithium** (rare metal granites and geothermal brines)
  - **Tungsten**
- Old or inactive projects
  - **Sb, W, F, Mo**
- Active industrial by-products production and recycling
  - WEEE recyclers
  - **Hf** from Zr and **In** from Zn industrial production
- Recycling projects in industrial upscaling
  - Batteries and WEEE





Example of primary resources project classification

Beauvoir - Echassières (Li mine project)

- In **exploration phase** ("Permis exclusif de recherches")
- Lithium in granite in Massif central region
- Evaluation based on Imerys Ceramics **public information**

- **E axis - Social, economic and environmental axis**
  - Lithium mine project in a kaolin quarry under exploitation by Imerys group
  - For the Li mine
    - **Environment**
      - 1st ecological diagnostic done but additional impact assessment and diagnostics required prior exploitation
      - Underground mine to avoid landscape impacts
    - **Economic**
      - Increasing and high lithium demand for batteries in coming years
      - Expected lithium production cost competitive with EU lithium market (7 €/kg to 9 €/kg)
    - **Social**
      - The mine project expects to be aligned with IRMA standard
      - In an exploited quarry → assumes better acceptability than if the project had been in an area without mining culture

Kaolin quarry – Beauvoir – Imerys Group

E2	Project potentially viable in the future	• Exploration permit ongoing • First estimations of economic costs • First environmental diagnostics but more diagnostics required

Example of primary resources project classification

Beauvoir - Echassières (Li mine project)

- **F axis – Technical feasibility axis**
  - First assessments in the 1980s
  - Presently: technical assessment and engineering
  - Extraction of Li at pilot scale

F2	Project potentially viable in the future	• Pre-feasibility phase

- **G axis – Geological knowledge axis**
  - Historical data: from "measured resources" to "estimated" but not in certified standards
  - Imerys communicated in October 2022 a global classification for resources as “inferred" due to the complexity of the deposit in depth
  - 34000 tons/y of Li hydroxide during 25 years

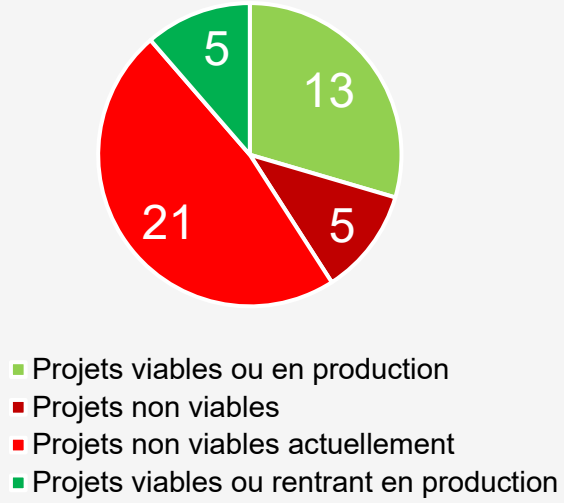
G3	Project potentially viable in the future	• Need of additional data • Data with uncertainties • Inferred (PERC)

Conclusion and perspectives

Overview of the results

- **44 projects** have been classified in France with UNFC
  - for **primary** (Sb, bauxite, fluorite, Ge, Li, Mg, Mo, Ta, W)
  - and **secondary resources** (Co, Ni, Li, In, Hf, PGMs)

- Projects range from “non viable” to “producing”



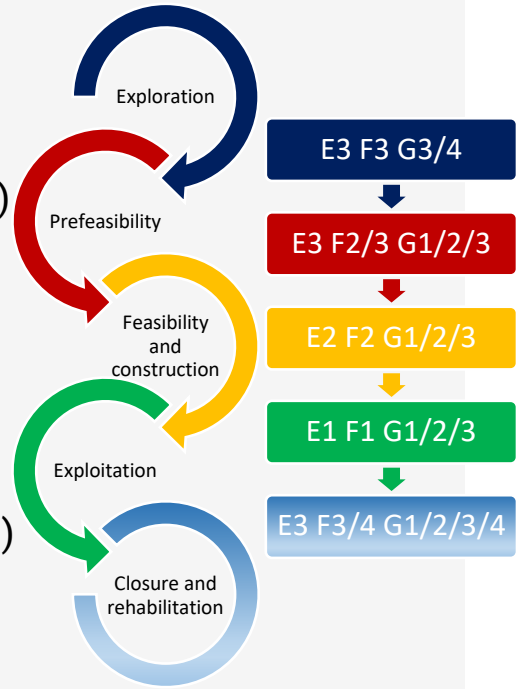
Commodity	UNFC class	Number of projects	
Antimony	322	1	5
	332	2	
	333	1	
	334	1	
Bauxite	111	2	2
Cobalt	211	1	1
Cobalt, nickel, lithium	223	1	2
	233	1	
Fluorine	322	2	6
	332	1	
	333	3	
Germanium	334	2	2
Hafnium	111	1	1
Indium	111	1	1
Lithium	222	1	7
	223	1	
	332	3	
	334	1	
	343	1	
Magnesium	111	2	2
	211	1	
Molybdenum	333	1	1
PGMs	112	1	2
	233	1	
Silicon	111	7	7
Tantalum	333	3	3
Tungsten	323	1	2
	333	1	

Conclusion and perspectives

Take away messages

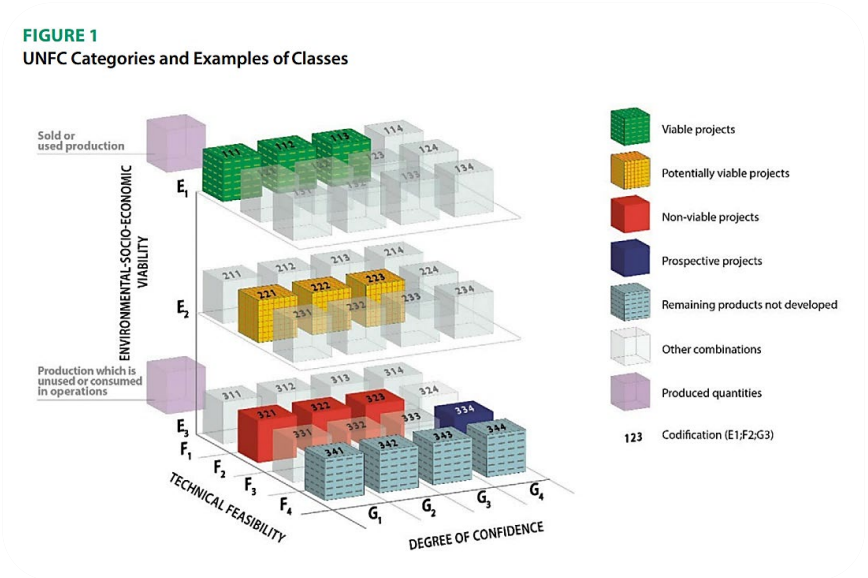
- A simplified multicriteria project approach and not only deposit → evaluate CRM supplies
- Harmonization → facilitated international coordination
- Allows you to classify any type of project (primary, secondary resources, different technologies, various cost structures, etc.)
- Decision tree methodology
  - → Facilitate the objectivity and reproducibility of assessments
  - → Empirical improvement of the method by iteration as the classification of projects progresses

- French case: active but mainly inactive projects (old mines and projects never achieved) → (E3;F3;G3/4)
- Need to regularly revise the classification of projects as they progress
- Needs concerning data
  - Transparency between producing companies and geological surveys
  - Assessment of the reliability of data from old reports
  - Harmonization of classification terms in historical database
  - Bridging historical mineral resources database with UNFC codes. Thanks to BGS and GTK documents!
- Complex case of lithium in geothermal brines (induced seismicity, technology barrier, reservoir size, etc.)



- UNFC & Secondary raw materials
  - Easy for ongoing projects (recyclers) but difficult to assess G/F axis
  - For mining wastes: integrate data from environmental monitor (FutuRaM)

Géosciences pour une Terre durable
brgm



Thank you for your attention!

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