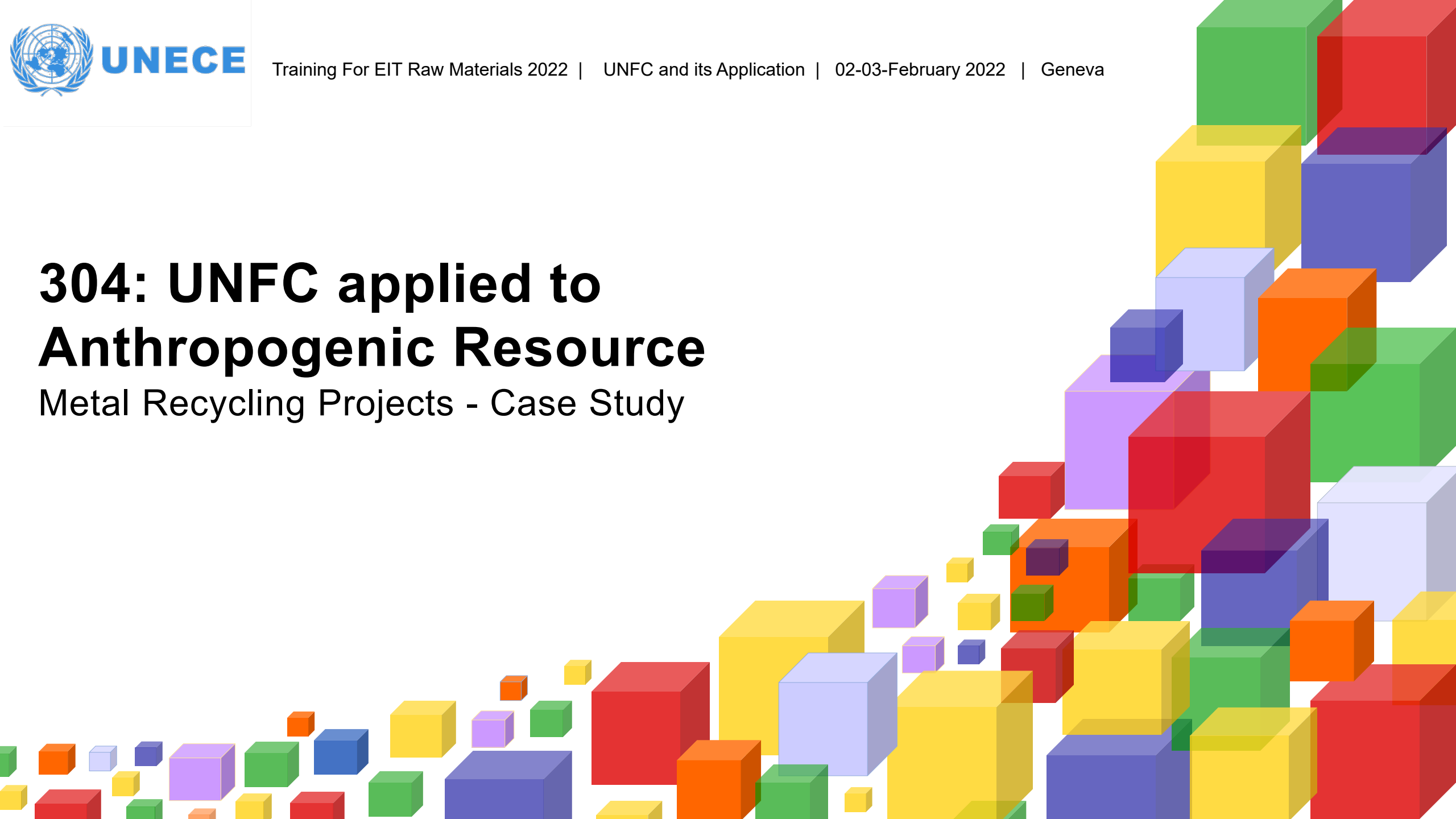
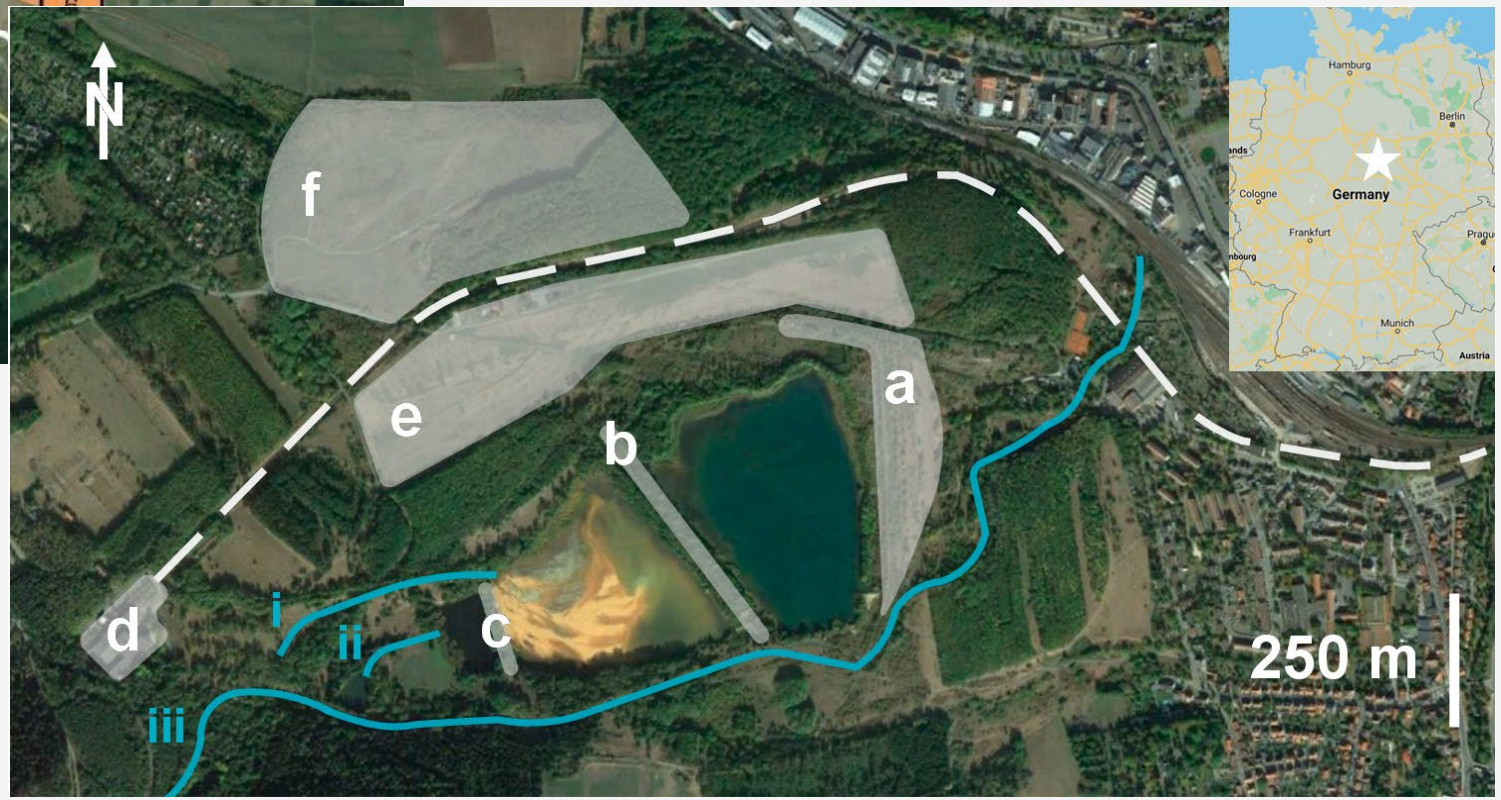
304: UNFC applied to Anthropogenic Resource

Metal Recycling Projects - Case Study



Case Study

Tailings Storage Facility (TSF)
Bollrich / Germany



How to evaluate and classify tailings?

Part 1 Screening based on remote data assessment
→ aimed to identify a potential project

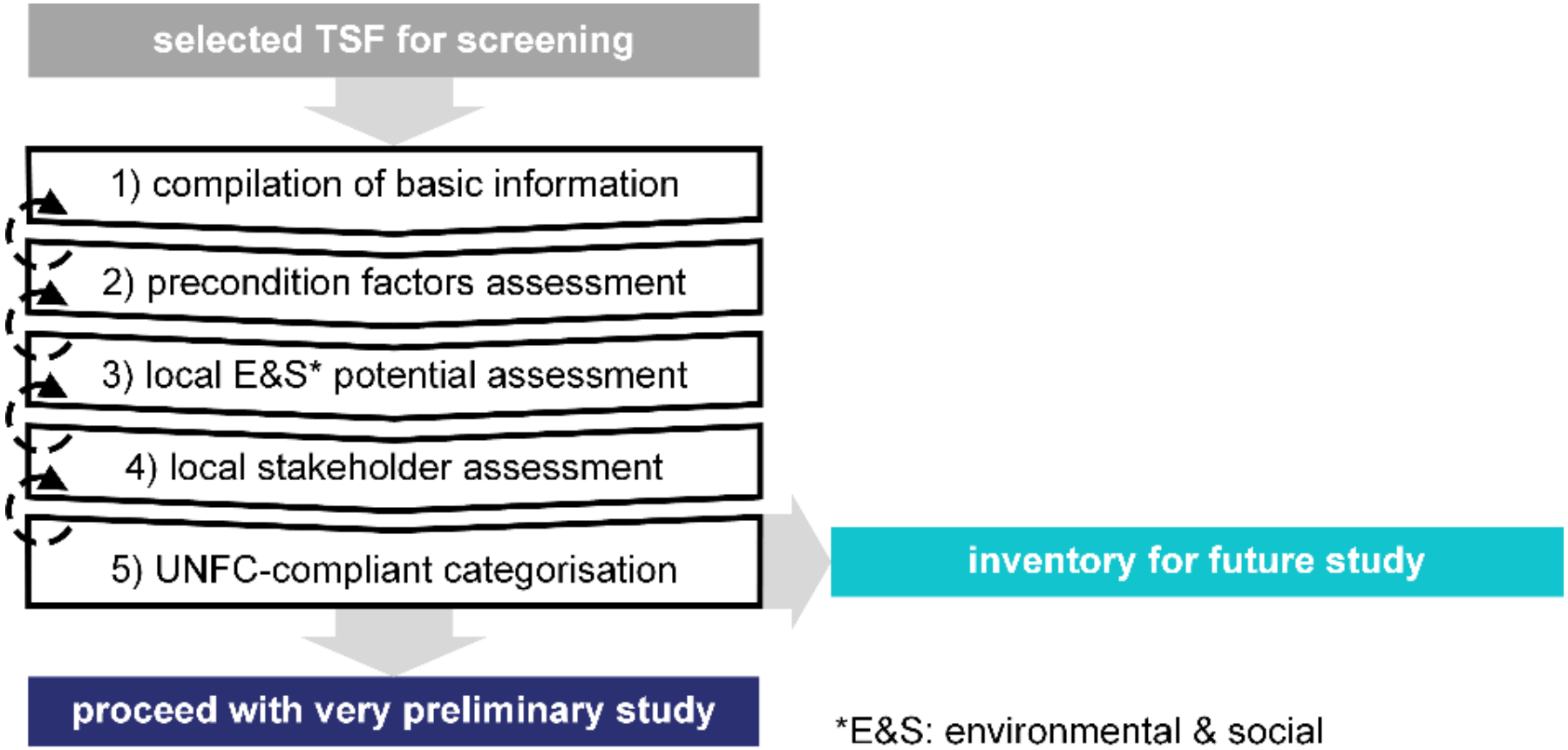
Part 2 Preliminary assessment based on first on-site results
→ aimed to identify the qualification as a potentially viable project

Suppes R & Heuss-Aßbichler S (2021). How to Identify Potentials and Barriers of Raw Materials Recovery from Tailings? **Part I: A UNFC-Compliant Screening Approach for Site Selection**. Resources, 10(3), 2 https://doi.org/10.3390/resources10030026

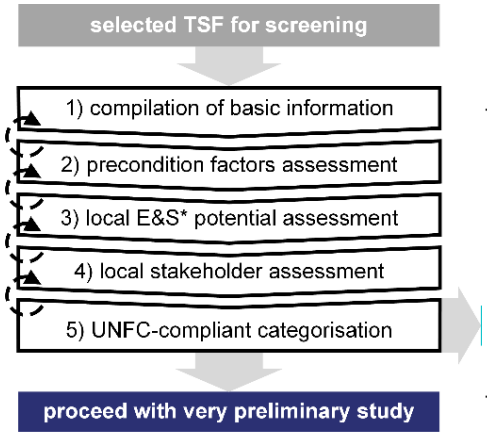
Suppes R & Heuss-Aßbichler S (2021). How to Identify Potentials and Barriers of Raw Materials Recovery from Tailings? **Part II: A Practical UNFC-Compliant Approach to Assess Project Sustainability with On-Site Exploration Data.** Resources, 10(11), 110. https://doi.org/10.3390/resources10110110

Part I

Remote Screening



*E&S: environmental & social



Screening Step	Generated Knowledge	General Positive Rating Criteria
(1) basic TSF information compilation	→ a general project definition. → aspects, such as project location, environment, etc	
(2) precondition factors assessment	→ are technological and investment conditions favorable → determine whether economic, environmental and/or social aspects aspect could be a project's driver	
(3) local E&S potential assessment	→ potential to reduce environmental and/or social risks by removing the TSF	
(4) local stakeholder assessment	→ Stakeholders directly affected by the TSF or its removal	
(5) UNFC-compliant categorisation	→ project potentials and barriers → decision regarding the further proceeding	

Part I

Remote Screening

Step 2 : Precondition Factors

Precondition Factor	Assessed Aspect	UNFC Axis [1]
(1) TSF volume	justification for mid- to long-term investment	G
(2) local infrastructure	cost savings due to accessible infrastructure or incurred costs due to necessary disposal of existing infrastructure	F
(3) TSF condition	necessity of special safety measures during mining or extensive environmental rehabilitation due to contamination	F
(4) resource criticality	economic importance of targeted minerals	Economy
(5) climatic conditions	enhanced environmental risks due to TSF's location	Environment
(6) proximity to human settlements	necessity of special protective measures during mining	Social aspects
(7) investment conditions	general regulatory conditions in a country	Legal aspects

[1] econ.: economic aspects, env.: environmental aspects, soc.: social aspects, leg.: legal aspects.

Part I

Remote Screening

Step 3 Benefits derived from TSF removal

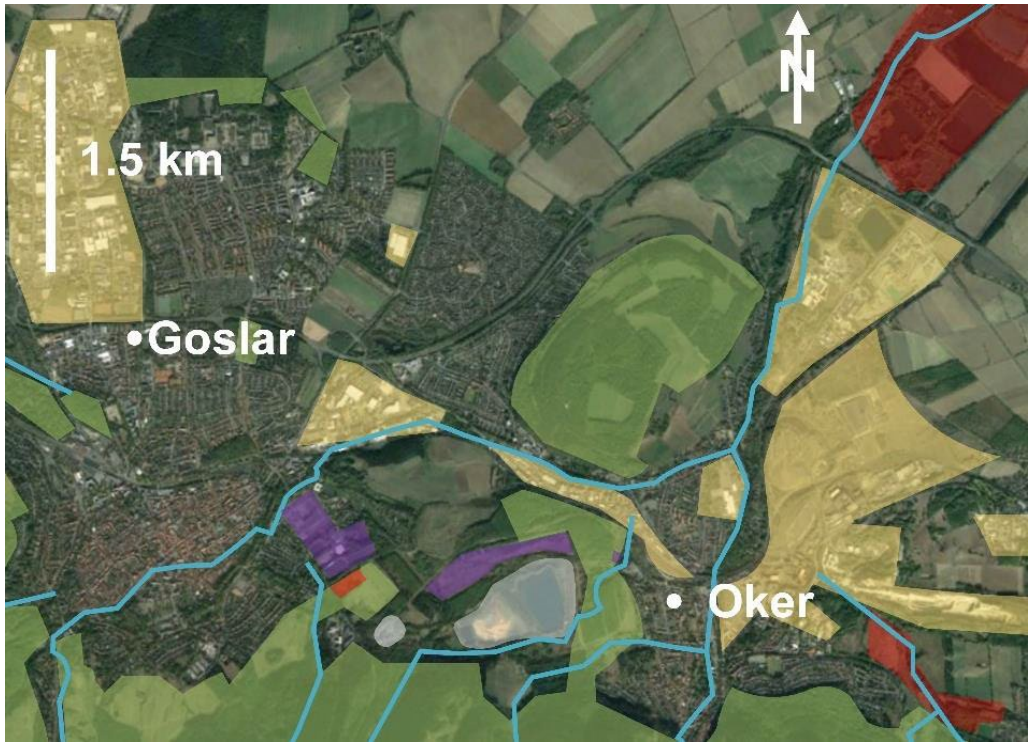
Category	Derived Benefits from TSF Removal	UNFC Axis [1]
(1) waste	reduced exposure to potential tailings flood by TSF collapse	Environment
(2) water	reduced risks to scarce water, aquatic ecosystems & drinking water	
(3) landscape	reduced risk to ecosystems, aesthetically valuable lands & recreational lands	
(4) biodiversity	reduced risk to nearby ecosystems	
(5) land use	reduced social tensions due to land use conflicts	Social aspects
(6) social vulnerability	reduced risk of harm to human health & social unrest	

[1] env.: environmental aspects, soc.: social aspects.

Part I

Remote Screening

Step 4: local stakeholder assessment



- Complex social setting
  due to proximity to human settlements

Step 5: E3F3G4 → Prospective Project

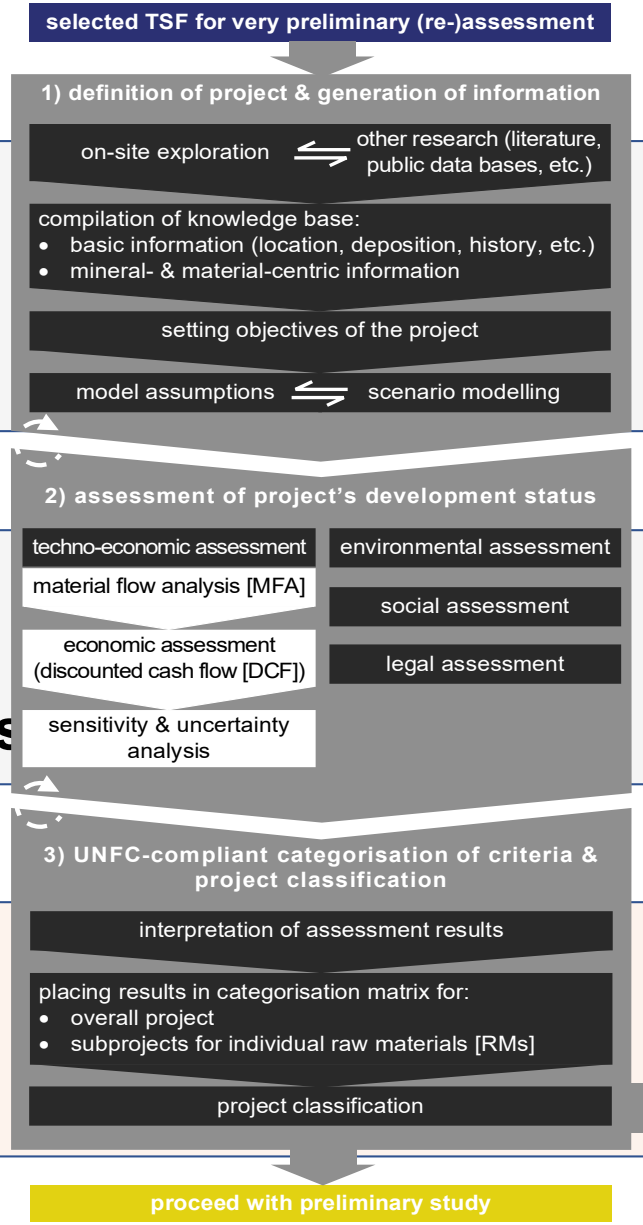
Part II

Preliminary assessment

1) Project definition & generation of information

2) Assessment of projects's development status

3) UNFC compliant categorization



3 scenario modeling

Sensitivity & uncertainty analysis

Project classification

Part II

Categorization matrix	
G-axis	**Geological conditions**
F-axis	TSF condition & risks
	Mine planning
	Infrastructure
	Post- mining state
E-axis	**Environmental-social-economic conditions**

33 Factors	Influence on
overall project rating	
geological conditions (relevant for project development)	
(1) quantity, (2) quality, (3) homogeneity	potential profitability, mine planning, overall uncertainty
TSF condition & risks (relevant for project development)	
(4) ordnance	exploration costs, overall project safety
mine planning considerations (relevant for project execution)	
(5) mine/operational design, (6) metallurgical testwork, (7) water consumption	reliability of the financial analysis, efficiency of the operation, environmental footprint
infrastructure (relevant for project development)	
(8) real estate, (9) mining & processing, (10) utilities, (11) transportation & access	project viability, ramp-up time
post-mining state (relevant for future impacts)	
(12) residue storage safety, (13) rehabilitation	necessary aftercare measures, public acceptance
microeconomic aspects (relevant for project development)	
(14) economic viability, (15) economic uncertainty	potential returns, investor interest
financial aspects (relevant for project development)	
(16) investment conditions, (17) financial support	potential returns, investor interest, security of investment
environmental impacts during project execution	
(18) air emission, (19) liquid effluent emission, (20) noise emission	mine planning, local population, local ecosystems
environmental impacts after project execution	
(21) biodiversity	quality of ecosystem after the project
(22) land use	land which can be repurposed
(23) material reactivity	aftercare measures, local ecosystems
social impacts during project execution	
(24) local community, (25) health & safety, (26) human rights & business ethics	social acceptance, peace & wellbeing, (unforeseeable) costs for compensation
social impacts due to project execution	
(27) wealth distribution, (28) investment in local human capital (29) degree of RM recovery, (30) RM valorisation	social peace & wellbeing, employment of local population, valuable legacy for workers & society after mine closure amount of new residues, ecological risks, effort for & efficiency of future RMs recovery
social impacts after project execution	
(31) aftercare, (32) landscape	social risks, social wellbeing, external costs
legal situation (relevant for project development)	
(33) right of mining, (34) environmental protection,(35) water protection	project feasibility, social acceptance, effort for formal project planning

Part II

Categorization matrix		
G-axis	**Geological conditions**	
F-axis	TSF condition & risks	
	Mine planning	
	Infrastructure	
	Post- mining state	
E-axis	**A**	**Microeconomic aspects Financial aspects**
	B	**Environmental impacts during … … after project execution**
	C	**Social impacts during … due to …. after project execution**
	D	**Legal situation**

33 Factors	Influence on
overall project rating	
geological conditions (relevant for project development) (1) quantity, (2) quality, (3) homogeneity	potential profitability, mine planning, overall uncertainty
TSF condition & risks (relevant for project development) (4) ordnance	exploration costs, overall project safety
mine planning considerations (relevant for project execution) (5) mine/operational design, (6) metallurgical testwork, (7) water consumption	reliability of the financial analysis, efficiency of the operation, environmental footprint
infrastructure (relevant for project development) (8) real estate, (9) mining & processing, (10) utilities, (11) transportation & access	project viability, ramp-up time
post-mining state (relevant for future impacts) (12) residue storage safety, (13) rehabilitation	necessary aftercare measures, public acceptance
microeconomic aspects (relevant for project development) (14) economic viability, (15) economic uncertainty	potential returns, investor interest
financial aspects (relevant for project development) (16) investment conditions, (17) financial support	potential returns, investor interest, security of investment
environmental impacts during project execution (18) air emission, (19) liquid effluent emission, (20) noise emission	mine planning, local population, local ecosystems
environmental impacts after project execution (21) biodiversity (22) land use (23) material reactivity	quality of ecosystem after the project land which can be repurposed aftercare measures, local ecosystems
social impacts during project execution (24) local community, (25) health & safety, (26) human rights & business ethics	social acceptance, peace & wellbeing, (unforeseeable) costs for compensation
social impacts due to project execution (27) wealth distribution, (28) investment in local human capital (29) degree of RM recovery, (30) RM valorisation	social peace & wellbeing, employment of local population, valuable legacy for workers & society after mine closure amount of new residues, ecological risks, effort for & efficiency of future RMs recovery
social impacts after project execution (31) aftercare, (32) landscape	social risks, social wellbeing, external costs
legal situation (relevant for project development) (33) right of mining, (34) environmental protection,(35) water protection	project feasibility, social acceptance, effort for formal project planning

heat map-like categorisation matrix

Table 3. *Continued.*

Factor	Scenario		
	NRR0	CRR1	ERR2
	UNFC E Category [1]		
microeconomic aspects (relevant for project development)			
(14) economic viability	E3.3a	E3.1a	E3.1a
(15) economic uncertainty	-	E3.3a	E3.1a
financial aspects (relevant for project development)			
(16) investment conditions	-	E3.1a	E3.1a
(17) financial support	E3.3a	E3.1a	E3.1a
environmental impacts during project execution			
(18) air emission	E3.3b	E3.1b	E3.1b
(19) liquid effluent emission	E3.1b	E3.1b	E3.1b
(20) noise emission	E3.2b	E3.2b	E3.2b
environmental impacts after project execution			
(21) biodiversity	E3b	E3b	E3b
(22) land use	E3.2b	E3.2b	E3.2b
(23) material reactivity	E3.3b	E3.1b	E3.1b
social impacts during project execution			
(24) local community	E3.3c	E3.2c	E3.2c
(25) health & safety	E3.3c	E3.3c	E3.3c
(26) human rights & business ethics	E3.3c	E3.3c	E3.3c
social impacts due to project execution			
(27) wealth distribution	E3.3c	E3.3c	E3.3c
(28) investment in local human capital	E3.3c	E3.3c	E3.3c
(29) degree of raw materials recovery	E3.3c	E3.2c	E1c
(30) raw material valorisation	E3c	E3c	E1c
social impacts after project execution			
(31) aftercare	E3c	E1c	E1c
(32) landscape	E2c	E1c	E1c
legal situation (relevant for project development)			
(33) right of mining	E3.3d	E3.3d	E3.3d
(34) environmental protection	E3.3d	E3.3d	E3.3d
(35) water protection	E3.3d	E3.3d	E3.3d

Part II

Preliminary assessment

Total rating

Factor	Scenario		
	NRR0	CRR1	ERR2
total rating	G2	G2	G2
	F3	F3	F3
	E3.3a	E3.3a	E3.1a
	E3.3b	E3.2b	E3.2b
	E3.3c	E3.3c	E3.3c
	E3.3d	E3.3d	E3.3d

[1] a: economic aspects, b: environmental aspects, c: social aspects, d: legal aspects.

Part II

Preliminary assessment

heat map-like categorisation matrix for individual raw minerals

Factor	Subprojects for Individual Raw Materials								
	$BaSO_4$	Cu	Pb	Zn	Co	Ga	In	FeS_2	inert material [1]
UNFC G Category									
geological conditions (relevant for project development)									
(36) quantity	G2	G2	G2	G2	G3	G3	G3	G2	G2
(37) quality	G2	G2	G2	G2	G3	G3	G3	G2	G2
(38) homogeneity	G2	G2	G2	G2	G3	G3	G3	G2	G2
UNFC F Category									
mine planning considerations (relevant for project execution)									
(39) recoverability	F2	F2	F2	F2	F3	F3	F3	F1	F1
UNFC E Category [2]									
microeconomic aspects (relevant for project development)									
(40) demand	E3.1a	E3.1a	E3.1a	E3.1a	E3.1a	E3.1a	E3.1a	E3.2a	E3.3a
(41) raw material criticality	E1a	E2a	E2a	E2a	E1a	E1a	E1a	E2a	E3a
(42) price development	E3.1a	E3.3a	E3.2a	E3.2a	E3.1a	E3.3a	E3.1a	-	-
impacts after project execution									
(43) solid matter	-	E3.1b	E3.2b	E3.1b	-	-	-	-	E1b
(44) eluate	E3.1b	E3.1b	E3.2b	E3.1b	-	-	-	-	E1b
total rating	G2	G2	G2	G2	G3	G3	G3	G2	G2
	F2	F2	F2	F2	F3	F3	F3	F1	F1
	E3.1a	E3.3a	E3.2a	E3.2a	E3.1a	E3.3a	E3.1a	E3.2a	E3.3a
	E3.1b	E3.1b	E3.2b	E3.1b	-	-	-	-	E1b

[1] Wissenbach shales & ankerit. [2] a: economic aspects, b: environmental aspects, c: social aspects, d: legal aspects.

- Transparency

Summary

Metal Recycling Projects - Case study

- **Part 1 - Remote screening**
  → overview on the sustainability aspects of a project
  → stakeholders to be considered

- **Part 2 - Preliminary study**
  → identify strong arguments for raw materials recovery

  → basis for discussion on how stakeholders should proceed

Thank you!

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