SUMEX DELIVERABLE D3.1

ANALYTICAL FRAMEWORK

Summary:

This deliverable provides important information for SUMEX stakeholders on project related work processes: meta-analysis of extractive sector practices (WP2) and use case elaboration (WP3). For that purpose, it offers a transparent perspective about SUMEX work processes and analytical frameworks for mapping extractive sector practices as well as a clear methodology for use case elaboration and meta-analysis.

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1 EXECUTIVE SUMMARY

Fostering a transition towards sustainability in the extractives sector is at the core of the SUMEX project. The conceptualisation of sustainable development (SD) in the extractives sector and the identification of practices was an initial step for a more detailed **framework describing the potential of the extractive sector to be part of a sustainability transition**.

This report represents the next step in providing important information for both the SUMEX team and stakeholders on project related work processes: **meta-analysis of extractive sector practices and SUMEX use case elaboration & analysis**. Against this background it offers a **transparent perspective about SUMEX work processes and analytical frameworks** for mapping extractive sector practices as well as a **clear methodology** for SUMEX use cases and meta-analysis.

For that purpose, the SUMEX project utilises a number of methods and frameworks that help to identify extractive sector practices in both the business and public sector with the potential to drive change towards sustainability. The **meta-analysis** is a first step towards building a knowledge base for a sustainable extractives sector in Europe. For guiding the meta-analysis, this report suggests a **taxonomy that helps practitioners to easily identify practices** in both the business and public policy sphere and its potential to initiate learning and change as well as their relevance for extractive sector sustainability. The **SUMEX use cases** have the purpose to provide **in-depth insights on how the extractives sector engages with challenges** that reflect important sustainability tensions and trade-offs. To this end, the use cases will exemplify what lessons learnt and recommendations can be transferred to other extractive sector contexts for both policy and businesses alike.

Ultimately, this report describes the **different analytical lenses used to identify good practices** for both SUMEX use cases and the meta-analysis. The utilised approaches represent different ways to best describe practices and their relevance for a transition towards SD in the extractives sector. Against this background, SUMEX applies a **tensions and trade-offs approach, Leverage Points, Institutional Resource Regime approach, and qualitative policy analysis** along the SUMEX sustainability aspects.

2 INTRODUCTION

Since its inception and conceptualisation phase on sustainable development and the identification of existing practices (see D1.1 and D1.2), the SUMEX project has paved the way for a **more detailed analytical framework to investigate the potential in the extractives to be part of a transition towards sustainable development (SD)**.

This report represents the next step in providing important information for both the SUMEX team and stakeholders on project related work processes: meta-analysis of extractive sector practices (WP2) and use case elaboration (WP3). Against this background it offers a **transparent perspective on SUMEX work processes and analytical frameworks** for mapping extractive sector practices as well as a clear methodology for use case elaboration and meta-analysis.

For that purpose, the SUMEX project utilises a number of **methods and frameworks that help to identify extractive sector practices in both the business and public sector with the potential to drive change towards sustainability**. This report primarily provides guidance for two major projects actions providing practitioners relevant information for the application and transfer of good practices:

1. The **identification, mapping and screening of existing extractive sector practices** (henceforth referred to as **meta-analysis**) gathered from existing Horizon 2020 projects: for more details **see chapter 3 Meta-analysis & taxonomy: identifying and describing extractive sector practices** (meta-analysis; relevant tasks: task 2.3, WP2; and good practice analysis; task 3.2; WP3); and
2. The elaboration of **two case studies** (henceforth referred to as **SUMEX use cases** elaboration; task 3.2 and 3.3; WP3) for metallic mineral and construction materials, respectively: **For more details see chapter 4 SUMEX Use cases for in-depth analysis**.

For guiding the **meta-analysis**, this report suggests a **taxonomy that helps practitioners to easily identify practices** in both the business and public policy sphere and its **potential to initiate learning and change as well as their relevance for extractive sector sustainability.** Consequently, the following criteria, among others, SUMEX stakeholders found most useful for grasping the relevance of extractive sector practices in their daily work: the sustainability aspect it responds to, the extractive sector life cycle stage, commodity type, suitability for knowledge transfer and learning as well as its implication for a sustainability transition.
The **SUMEX use cases** have the purpose to provide in-depth insights on **how the extractives sector engages with challenges that reflect important sustainability tensions and trade-offs (see chapter 5.1)** identified during the initial stage of the project or are of particular importance for the respective case under investigation. As a starting point, this report offers a first overview on **SUMEX use case SD challenges, involved stakeholders, identified practices** to respond to these challenges. This information is important to prepare for a more in-depth analysis during field visits and desk-research using the D3.1 Analytical framework. To this end, the SUMEX project will exemplify how companies and public policy are facing important SD tensions and trade-offs among the SD dimensions and in how far **lessons learnt and recommendations can be transferred to other extractive sector contexts** for both policy and businesses alike.

In **chapter 5 on framework and sustainability implications**, the report describes the **different analytical lenses** used to identify good practices for both SUMEX use cases and the meta-analysis. The utilised approaches represent different ways to best describe practices and their relevance for a transition towards SD in the extractives sector. Against this background, SUMEX applies a **tensions and trade-offs approach**, **Leverage Points**, **Institutional Resource Regime approach, and qualitative policy analysis along the along the SUMEX sustainability aspects.**

- **Tensions and trade-offs among the different aspects related to sustainability are an important starting point for identifying practices driving change in the extractives sector**: SUMEX sustainability aspects describe key components of what sustainable management of the extractive industry in Europe should consider. They represent a set of topics (e.g. valuing social and natural capital, planning beyond the mine

life) and goals (e.g. no bribes, zero greenhouse gas emissions). Tensions and trade-offs among SUMEX sustainability aspects are an important starting point for investigating and identifying what practices public policy and businesses apply to resolve them in order to prevent negative spill-over or side effects among sustainability aspects. Section 5.1 provides for an explanation or for more detailed information see SUMEX report D1.2 (p.17).

- Leverage points – how to initiate system change in the extractives sector: Approaches, such as the Leverage Points (LP), are conceptual models to best understand what are ways to introduce system change with varying degrees of impact. Leverage points range from "shallow", i.e. incremental changes, with only minor leverage on changing a system, to "deep", i.e. transformative and disruptive bringing about the level of change needed for a fundamental shift towards sustainable development (SUMEX D1.2 p.21). Section 5.2 provides an explanation of the 12 LPs and short explanations on their extent with regards to the extractives sector.
- Institutional Resource Regime - How to regulate individual and/or collective uses of resources: An Institutional Resource Regime (IRR), which is a proposed framework for the analyses of institutional arrangements that regulate individual and/or collective uses of resources (SUMEX D1.2 p. 26). Section 5.4 provides an in-depth explanation and justification of the use of an IRR for the analysis of the two use cases.
- Qualitative policy analysis – a view on public policy to resolve sustainability tensions and trade-offs: The SUMEX project will apply qualitative policy analysis building on the IRR to analyse policy instruments (including permitting, land-use planning, access to land, socio-environmental impact assessment) based on the evaluation criteria effectiveness, legitimacy and justice. Section 5.5 provides an in-depth explanation on qualitative policy analysis

Essentially, this report describes the different analytical lenses used to identify good practices for both SUMEX use cases and the meta-analysis that are the starting point for SUMEX knowledge exchange and learning actions. The utilised approaches represent different ways to best describe practices and their relevance for a transition towards SD in the extractives sector.

3 META-ANALYSIS & TAXONOMY: IDENTIFYING AND DESCRIBING EXTRACTIVE SECTOR PRACTICES

The SUMEX project conducts a comprehensive screening of EU industry and policy practices in the extractives sector in order to provide a state-of-the-art review on existing practices identifying potential good practice examples for a sustainable extractives sector. Against this background the project team investigates H2020 projects outputs, research programmes on EU and national level (e.g. Interreg) as well as company approaches and practices. A follow-up meta-analysis describes and structures identified good practices along SUMEX pre-defined criteria (see chapter 4), these include relevance for good practice learning or extractive sector mine life-cycle stage. This analysis will be useful for providing a solid knowledge basis for building an online repository of extractive sector practices relevant for SUMEX target groups. SUMEX physical and digital exchange and learning actions will utilise this repository to best inform practitioners about possible solutions and important information for a sustainable extractives sector.

3.1 METHODOLOGY

The meta-analysis is a first step towards building a knowledge base for a sustainable extractives sector in Europe. The below-mentioned methodology explains a transparent and step-wise approach for identifying & screening (part 1), and structuring data (part 2) on extractive sector practices that are used in the SUMEX project.

3.1.1 SCREENING AND IDENTIFYING EU LEVEL PROJECTS

The first screening focused on research projects and used two main sources to identify relevant EU level extractives and extractives-related projects:
1) The Horizon 2020 Societal Challenge 5 (Climate Action, Environment, Resource Efficiency and Raw Materials) Work Programmes for 2014-2015, 2016-2017 and 2018-2020
2) Deliverable 9.1 from the MIREU (Mining and Metallurgy Regions EU) project which screened extractives-related projects for good practices from the following sources - EIT Raw Materials, Interreg Europe, ERA-NET and all Horizon 2020 funding calls including Research and Innovation Actions, Innovation Actions, Marie Sklodowska-Curie Actions, Coordinating and Support Actions and ERC Consolidator Grants.
The second screening shifted away from research to focus on industry good practices. As it is primarily the major mining companies who have publicly available documents on their websites, relevant documents matching the five core areas of SUMEX were screened from Anglo American, BHP Billiton and Rio Tinto. Recognising that international standards also influence industry's sustainable development practices, four of the International Council of Mining and Metals documents and the Toolbox for Local Actions from the Finnish Network for Sustainable Mining were also screened. Lastly, the industry practices have been supplemented by a survey sent to the European Federation of Geologists (EFG) and their global affiliates. An expert panel from EFG and its affiliates covering Europe, Canada, the USA and South Africa contributed to the first clustering workshop.
An inventory of the research and the industry good practices has been started and serves two purposes as all of the practices will culminate in Deliverable 2.2 for WP2 plus feed into the repository of the digital toolkit to be developed as part of WP4.
H2020 and MIREU D9.1 documents were screened with a qualitative data analysis tool, NVIVO, to find relevant subcalls and projects in the fields of extractives, climate, waste, water innovation, Earth observation, policy and innovation. In the screening process SUMEX's thematic areas (1. Health & safety; 2. Land-use planning; 3. Reporting; 4. Permitting processes and Policy integration; 5. Socio-economic and Environmental impacts) were

used as nodes – a node is a collection of references about a specific theme or case. All identified references found in sources were coded under each SUMEX Theme (node) and the coding reports can be provided for further use.

Screened documents:

1. Climate Action, Environment, Resource Efficiency and Raw Materials H2020 Work Programme 2014-2015
2. Climate Action, Environment, Resource Efficiency and Raw Materials H2020 Work Programme 2016-2017
3. Climate Action, Environment, Resource Efficiency and Raw Materials H2020 Work Programme
4. MIREU D9.1 (covering Interreg, EIT RM, RIA, IA, MSCA, CSA, ERG-COG, ERA-NET)
5. Industry practices: Anglo American, Rio Tinto, BHP, ICMM and Finnish Network for Sustainable Mining Toolboxes

Nodes

Name	Files	References	Created On
Health & Safety	1	12	4.2.2021 15.22
Land use planning	1	5	4.2.2021 15.22
Permitting processes & Policy Integration	1	22	4.2.2021 15.23
Reporting	1	1	4.2.2021 15.22
Socio-economic & Environmental Impacts	1	16	4.2.2021 15.23

FIGURE 1: NVIVO NODES, FIRST SCREENING

To show the NVIVO screening report in a readable form, all identified H2020 subcalls have been listed in a Word document. Under each subcall there are references showing why this exact subcall was chosen and which parts of the call text match with the search words. The phrases around the actual keywords are included in the document to provide its reader the context the search word emerged in. This approach supports a transparent screening process and allows external actors to review different stages of the meta-analysis.

NVIVO – SUMEX 5 Themes – Summary

Health & Safety

SC5-13-2016-2017: New solutions for sustainable production of raw materials
Scope:

- Assessment of the related environmental, social and safety risks and a plan to communicate the added value of the proposal to the local communities and society for improving public acceptance and trust should be addressed by all the proposals.

Projects are expected to justify and provide evidence that they lead to:

- Safeguarding environmental stability and improving the health and safety performance of the operations.

SC5-14-2016-2017: Raw materials Innovation actions
All proposals should cover all the following points:

- assess health, safety and environmental risks and their management for all proposed actions to avoid environmental damage and maintain overall environmental stability;
- lead to improving the health and safety performance of the operations

FIGURE 2: NVIVO REPORT, FIRST SCREENING

3.1.1.1 SCREENING WITH WP1 PRIORITY AREAS AND WP2'S OWN ADDITIONAL WORDS

As an experiment, Climate Action, Environment, Resource Efficiency and Raw Materials H2020 Work Programme 2016-2017 was then screened using different search words and nodes. The first stage of the second screening was carried out using the draft D1.2 priority areas provided by the WP1. The second stage of screening was conducted using additional words WP2 considered potentially useful search criteria to provide a more detailed approach. The search words/nodes were changed the following way:

- Circular economy instead of Closed Cycles (WP1)
- Mining in Ecosystem Services instead of Assigning Value to Biological Capital (WP1)
- Mining Landscapes (added)
- Stakeholders and Civil Society (added under Accountability)
- Public Policy, Social Licence to Operate and Social Acceptance (in addition to Corporate Social Responsibility – WP1)
- Post-mining Land use (added)
- Innovation

One of the conclusions of the two coding reports is that the WP1 priority areas are not detailed enough for WP2's purposes. For example, based on the amount of times additional nodes such as Stakeholders, Social Licence to Operate (11 hits), public policy (35), social acceptance (8) and innovation (48) were mentioned, the original priority areas lacked detail. The first screening with the 5 SUMEX Themes pulled up most of the relevant subcalls and the second screening with more precise yet still thematically broad search words captured every single project. To narrow down the results and to capture relevant subcalls additional search words were created.

Nodes

Name	Files	References	Created On
Circular Economy	1	26	20.1.2021 15.18
Biological	0	0	20.1.2021 15.18
Mining in ecosystem services	1	11	20.1.2021 15.18
Mining landscapes	0	0	20.1.2021 15.18
Technological	1	9	20.1.2021 15.18
Sharing, leasing, reuse, repair..	1	7	20.1.2021 15.18
Corporate Social Responsibility, Social License to Operate	1	47	20.1.2021 15.18
Accountability	0	0	20.1.2021 15.18
External and social costs	0	0	20.1.2021 15.18
Life Cycle Analysis	0	0	20.1.2021 15.18
Public-private partnerships	1	1	20.1.2021 15.18
Developing Criteria	1	1	20.1.2021 15.18
Civil society	1	6	20.1.2021 15.18
Stakeholders	1	24	20.1.2021 15.18
Public Policy	1	35	20.1.2021 15.18
Social License to Operate	1	11	20.1.2021 15.18
Social Acceptance	1	8	20.1.2021 15.18
Dialogue and Communication	1	48	20.1.2021 15.18
Control over the environment	0	0	20.1.2021 15.18
Share knowledge	1	24	20.1.2021 15.18
Sustainable learning	1	1	20.1.2021 15.18
Reinventing the economy (i.e. Green Deal)	1	53	20.1.2021 15.18
Indicators of Green Economy	1	1	20.1.2021 15.18
Innovation	1	48	20.1.2021 15.18
Natural capital - financial capital	1	4	20.1.2021 15.18

FIGURE 3: AN EXAMPLE OF NVIVO NODES, ADDITIONAL PRIORITY AREAS FOR THE SECOND SCREENING

For the actual 2nd screening WP2 used the SUMEX D1.2 criteria as well as an additional list of synonyms as search words and nodes. Climate Action, Environment, Resource Efficiency and Raw Materials H2020 Work Programmes 2014-2015, 2016-2017 and 2018-2020 programs as well as MIREU D9.2 and Industry practices from Anglo American, Rio Tinto, BHP, ICMM, Finnish Network Toolboxes were rescreened with the search words presented in the table in Annex I. The table includes the 5 SUMEX Themes (headline), D1.2 priority area categories (first column), D1.2 priority area subcategories (second column) and the actual search words as well as additional search words (third column) used to screen the documents.

Based on the results from the first and second screening, WP2 compiled a list of relevant H2020 subcalls. These subcalls were then used as search words to identify the actual projects in Cordis. After the exhaustive list of EU level projects was compiled, we proceeded to identify project deliverables with results that could be presented as good practices in the SUMEX online repository. These deliverables were pulled out and uploaded into an external database.

	A	B	C	D	E	F	G	H	I	J	K
1	Funding	Project	ongoing	finished	Link	Land use planning	Health and Safety	Reporting	Permitting Processes & Policy identification	Socio-Economic & Environmental Impacts	Deliverable/Document
8	SC5-13-2016-2017 - New solutions for sustainable production of raw materials	SLIM		x	https://cordis.europa.eu/project/id/730294					x	D10.1. Best Practices On Social Awarness Communication D10.2. Social awareness guidelines for local communities D10.3 EDUCATIONAL PROGRAMME ON SOCIAL AWARENESS D10.4 Report on use case results and recommendations
9		SCALE	x		https://cordis.europa.eu/project/id/730105		x			x	D5.1 Environmental, health and safety controls that should be taken into account in SCALE technology development
10		PLATIRUS		x	https://cordis.europa.eu/project/id/730224		x			x	D8.1 Value Chain Stakeholders Analysis D1.6 Safety and Health Risk Management Procedures Report
11		ITERAMS		x	https://cordis.europa.eu/project/id/730480					x	WP7 Clustering: Sustainability and Communication with local communities: D7.3: Final cluster workshop and policy recommendations Short project book including main findings of the demonstrators and LCA
12		NEXT	x		https://cordis.europa.eu/project/id/776804					x	D5.1 KEY FACTORS INFLUENCING SOCIAL LICENSE TO OPERATE DURING THE MINERAL EXPLORATION PHASE
13		PACIFIC	x		https://cordis.europa.eu/project/id/776622						D1.3- Report comparing best practice in active and passive exploration methods
14		Smart Exploration		x	https://cordis.europa.eu/project/id/775971						Deliverable D3.0 Exploitation Activities and Toolbox

TABLE 1: IDENTIFIED PROJECTS AND RELEVANT DELIVERABLES

3.1.2 DESCRIBING EU LEVEL PROJECTS OUTPUTS AND IDENTIFIED PRACTICES

After the first step of identifying and screening relevant programs as well as MIREU D9.2 and Industry practices, the compiled data need to be described and structured in a way that they are useful and fit-for-purpose to integrate into the SUMEX online repository as well as act as a knowledge basis for future SUMEX practitioner exchange and learning actions. The following paragraphs present the taxonomy for describing extractive sector practices according to the SUMEX project's focus and for best preparing data items for good practice learning and exchange actions.

CORRECT AND CLEAR UNDERSTANDING OF PRACTICE

Column D "short description of practice": From the perspective of the Sustainable Development (SD) aspects and Leverage Point (LP) framework mapping, there is a need to have basic information about extractive sector practices in order to clearly discern what SD aspects or LPs are addressed. The guiding questions and examples below should be considered when drafting text or selecting text elements from practice level data items. Sometimes these guiding questions are not distinctively addressed in the short description, but are intertwined and found in the same text elements, which is okay for the short description.

- **What challenge is the practice addressing** (e.g. complex permitting regime with multiple authorities involved)
    - EXAMPLE TEXT A
        - " *It is known from comminution research already from the 1970s that inter-particle breakage in a particle bed provides enhanced energy efficiency when fracturing brittle material under high compressive forces (Schönert). The breakage principle resulted in Schönert's invention of the high pressure grinding rolls (HPGR) and their implementation by different equipment manufacturers (Schönert, 1982)."*
    - EXAMPLE TEXT B
        - *"The Stakeholder SLO Frames are a new way of appreciating what SLO means to a given stakeholder and the reason behind developing them is to supplement more traditional stakeholder mapping techniques"*

- What is the concrete practice/intervention about to achieve the expected goal/impact (e.g. not only buzz words or phrases e.g. one-stop-shop for mine permits, Taxes; voluntary standards etc; but also describing in 2-3 sentences how it works, what is the process, how is the management system applied etc)
    - EXAMPLE TEXT A
        - *"While the patent was first licenced to Polysius and KHD only, later also Koppers, FLSmidth and Alpine acquired a licence. After solving wear-related operational problems the HPGR have become widely used in the cement industry and are now also more and more adapted to ore grinding*.
    - EXAMPLE TEXT B
        - *"While the word 'frames' implies that people will be slotted into certain categories, this is not the intent; rather, it is to suggest that attitudes are complex and people likely do not fit neatly into a single frame but are situated within several frames simultaneously and can change frame priority throughout the life of a project."*
- What is the (expected or proven) impact of the practice (.e.g reduced application to approval time frames)
    - EXAMPLE TEXT A
        - *"The benefits of HPGR are • Production of more fine material at a given crush size than in conventional crushers • Formation of micro-cracks in the crushed rock particles - beneficial for subsequent grinding (weakening) and for downstream leaching (increased surface area) • Generation of less noise and dust compared to conventional cone crushers • Consumption of approximately 20% less power per tonne compared to conventional crushing plants producing the same product. • Dry processing"*
    - EXAMPLE TEXT B
        - *"The negotiation between company and community will vary between individuals and groups, so having these frames identified is a method to prepare the company for the range of potential issues it will need to face and the tasks they will need to focus on. The utility is that by addressing all of these frames, a company or authority can cross-cut traditional stakeholder categories and be assured they are speaking to all SLO-related concerns."*
- Who is the target user group of the practice/intervention or implementing the practice/intervention (e.g. permitting authorities)
    - EXAMPLE TEXT A
        - (Same as above, but relates to user groups) *"While the patent was first licenced to Polysius and KHD only, later also Koppers, FLSmidth and Alpine acquired a licence. After solving wear-related operational problems the HPGR have become widely used in the cement industry and are now also more and more adapted to ore grinding."*
    - EXAMPLE TEXT B
        - *"The utility is that by addressing all of these frames, a company or authority can cross-cut traditional stakeholder categories and be assured they are speaking to all SLO-related concerns. An example: Stakeholder Frame 1: The company works with the local community - the suite of issues that comprise the frame are 1) ensuring part of the profits are reinvested in society, sharing the revenue from resources development with the local community, distributional fairness, contact quality between company and community and companies develop and use voluntary Corporate Social Responsibility standards/sustainability protocols in addition to legal tools."*

MINE LIFE-CYCLE STAGE

This describes the operational stage the mine site is currently in, the five distinct stages in the mine life-cycle are listed below

1. **Pre-exploration (land-use planning):** A sustainable and integrated view on extractives management requires investigating pre-exploration including planning process for land use and development at the earliest stage. These activities prior to the start of the individual project development cycle include policy development, land use planning and resource mapping. In order to effectively address sustainable management in the extractives sector in a pre-exploration stage the following challenges need to be addressed (Endl et al, 2019): 1) Comprehensive data and assessment of mineral resources, current and potential land use available for public decision-making in the land use planning process; 2) Mechanisms for a transparent and fair assessment of minerals resource development next to other land use options; 3) integration of minerals and land use planning policy resorts on a strategic level to connect two distinct but overlapping policy resorts; 4) Mineral and land use planning processes and instruments taking into consideration the safeguarding of mineral resource deposits.
   Against this background, an early stage identification of possible synergies or conflicts at an early stage enhances the steering capacity for the preparation and implementation of sustainable land-use plans that include minerals development

2. **Exploration:** In the exploration phase different experts are tasked to analyse the prospective new site in order to identify potential mineral deposits for future exploitation. The main methods used for this task include geophysical measurements and geochemical analysis as well as geological surface mapping. The aim of this phase is to estimate the size of the mineral reserves, their location and the site-specific characteristics within the deposit, as well as the most suitable methods of exploitation. This data helps to calculate the expected duration and yield of the exploitation stage.

3. **Pre-exploitation / development phase:** The specific actions taken in this stage will vary according to the specific mineral to be extracted at the site. Generally, this stage will take longer than the previous stages as it covers the building of the necessary infrastructure for the operations to commence and run smoothly. Crucial infrastructure includes roads to, from and within the extraction site, the specific processing facilities (e.g. smelting plants, rock crushing plants, screens etc.), environmental management systems, waste management facilities as well as housing for workers and on-site offices for administrative work.

4. **Exploitation and progressive rehabilitation phase:** The exploitation phase consists of two main stages: extraction, and processing. In the extraction phase the raw material is extracted from the ground. This is followed by the processing phase, where the extracted material is crushed or washed and screened by particle size. During exploitation, the operator undertakes measures to rehabilitate areas of the extraction site which have been exploited. Areas which are left untouched for at least one year, could be considered to become zones of temporary nature, in accordance with the legal provision in place. For certain materials i.e. metalliferous minerals a third stage is required; smelting, in which the extracted ore is smelted after separation to extract the desired metals.

5. **Post-exploitation phase (rehabilitation & closure)**: Once a mine site is fully exploited, it will be shut down by the operators. This means that all activities will be halted and equipment and workforce will be removed from the site. This includes the disposal of waste, removal of machines and workforce, repurposing or demolishing of infrastructure such as buildings and the cleaning of the site. After this the operators need to engage in remediation efforts such as ensuring that local ecosystems can return to a

normal state, including the removal of potentially hazardous remnants of the operation. In a final step, companies need to continuously monitor the decommissioned mine site to ensure that the remediation efforts have been effective and if necessary take further actions to mitigate negative legacies of the operation.

DEFINITIONS OF COMMODITY TYPES

1. **Metalliferous minerals**: Minerals or aggregates of minerals from which metal can be extracted. Metals may be present either in their native form (e.g. gold, platinum), but more commonly as oxides, sulphides, sulphates, silicates etc. They include semi-metallic elements or metalloids (e.g. antimony, arsenic, germanium), which are frequently associated with metals. These minerals are commonly used for steelmaking. (https://ec.europa.eu/assets/jrc/minventory/glossarybc72.html?title=&order=title&sort=desc)

2. **Non-metalliferous minerals**: Non-metallic minerals are a special group of chemical elements from which no new product can be generated if they are melted. Non-metallic minerals are, for example, sand, gravel, limestone, clay, and marble –(https://www.statista.com/markets/954/topic/951/nonmetallic-mineral-products/)

3. **Construction minerals (aggregates)**: Natural aggregates, recycled and manufactured aggregates, clays and gypsum, and building stone used for a wide range of construction purposes. These uses may be either directly as aggregates (e.g. sand and gravel) or in making cement, lime, concrete, plasterboard, bricks, asphalt mixes for surfacing roads and other building products. Natural aggregates include crushed rock of sedimentary, igneous and metamorphic origin. The construction minerals sector is the largest one among the non-energy extractive industries in terms of tonnage, companies and employees and annual turnover. (https://ec.europa.eu/assets/jrc/minventory/glossarybc72.html?title=&order=title&sort=desc)

4. **Industrial minerals (excluding construction minerals):** Industrial minerals such as baryte, kaolin or salt are extracted within the EU to supply a wide range of industries. These minerals are not used as fuels or for the production of metals, but they are used for their individual properties in different industrial processes.

FORMAT OF DATA ITEMS

Below is an overview of the different data items that will be included in the SUMEX knowledge repository. The first set of described data items are relevant for giving general overviews on different topics. The second set of data items, are formats with a relevance for good practice learning. As the project has a strong focus for practitioners to learn from each other, such data items are important for the goals of the project.

- **Report:** A document about a specific issue, outlining the situation and specific findings in relation to this topic.
- **Policy document:** A formal document outlining a policy that is issued by the authority behind said policy. A Policy document will include all the binding specificities required by the policy in question.
- **Policy brief:** A document summarising government policies to make them better understandable for interested stakeholders. These can be neutral summaries or include suggestions for changes/improvements to this policy.

DATA ITEMS WITH RELEVANCE FOR GOOD PRACTICE LEARNING

- **Case study**: An in-depth elaboration of a specific real life example, used to illustrate the actions, processes, challenges and outcomes of the approach taken in this context i.e. a case study of the operationalisation of a quarry in Spain by a certain company.
- **Toolkit:** A set of tools (measures/actions) aimed at approaching or to support solving specific problems or issues in a certain context i.e. a toolkit to successfully implement due diligence in the extractive sector.
- **Resource library:** A collection/database of different resources e.g. a resource library can focus on a specific topic or covering a wide range of different topics depending on the target audience of the specific library.
- **Guidance document**: A document giving broad advice on the implementation of a certain procedure/practice. In the context of the SUMEX project they are often related to the implementation of certain policies such as a national/regional mining policy. (https://thelawdictionary.org/guidance-document/)
- **Handbook or Manual:** A set of detailed instructions for the implementation of a certain practice.
- **Webinar:** A seminar or other presentation on a specific topic that takes place on the internet, allowing participants in different locations to see and hear the presenter and engage by asking questions or answering polls. (https://www.dictionary.com/browse/webinar)
- **MOOC (massive open online course):** A free online course that is open to everyone, providing an accessible way to learn about a specific topic/subject.

4 SUMEX USE CASES FOR IN-DEPTH ANALYSIS

The SUMEX project will investigate two case studies of different extraction sites, so called SUMEX use cases. The SUMEX use cases are instrumental in highlighting current challenges and good practices on the ground for the sector of battery minerals as well as aggregates. After an initial selection process, the two selected use cases will undergo an in-depth analysis via different techniques, and will subsequently serve as real life case studies of mine sites which the project will refer to throughout its duration.

For the battery material use case, 3 mine sites operated by Boliden AB have been selected. Selecting Boliden operated mine sites was an obvious step in the project as the company is an official project partner. This has the advantage that the company did not need to be convinced to buy-in to the project and the willingness to openly share information about the operations is given. In addition, the company publishes their official documents, such as annual and sustainability reports, in English. The internal decision-making process was however applied in deciding which mine sites to use. After discussions among all consortium partners, the three mine sites of Kristineberg, Kankberg and Renström have been selected for the SUMEX use case.

For the second use case, the SUMEX consortium had narrowed down the selection to three countries, based on existing contacts that would be helpful in facilitating this process of partnering with a local company to provide information on their operations to the project. These countries were Cyprus, Greece and Spain. The consortium decided that it would be best to choose a Spanish company, as Spanish could be understood by many members of the consortium (as compared to Greek or Turkish), which will facilitate the collaboration with this company and in this national policy framework. UEPG (European Aggregates Association), a member of the SUMEX consortium, had existing contacts with ANEFA (Spanish Association of Aggregates Producers), which supported the project in finding a suitable company to be taken up as a SUMEX use case. The final decision was taken in favour of Canteras La Ponderosa S.A. The company has openly cooperated with the project since then, providing all of the necessary information to present it as the second SUMEX use case.

To present relevant information for other interested stakeholders the SUMEX project will test how pre-identified challenges and trade-offs among the SD aspects (see D1.2) are dealt with on company level. Against

this background the SUMEX project team will conduct field visits, desk-research of company reports, as well as interviews with strategic and management level employees of the selected use cases. To this end, the SUMEX project will exemplify how companies are facing important SD challenges and trade-offs among the SD dimensions and in how far lessons learnt and recommendations can be transferred to other extractive sector context for both policy and businesses alike.

4.1 METHODOLOGY

A variety of analytical approaches will be taken for the in-depth analysis of the two use cases. Concretely, the use cases will be analysed via:

1) Scientific state of the art single-case data collection methods and frameworks (Yin, 2003): A transparent and justified case selection process based on criteria such as relevance, added-value for practitioner learning, convenience;
2) Different framework criteria for the selection of certain segments, practices and events within the case i.e. conflicts of different user regimes of land and related resources such as water or biodiversity investigated by means of an Institutional Resource Regime approach; outsider observation by means of open guided interviews depicting actions taken in upper level management as well as on the strategic and operational level such as mine site or workers perspectives.
3) Covering, in particular, contextual factors (extractive sector actions along the whole mine life cycle are highly contextual) that are relevant for the studied phenomenon e.g. SUMEX focus areas relevant for a sustainable development approach in the extractives sector, such as land use conflicts, implementation of water management goals in the context of sustainable development. These factors are important to consider in order to present a representative case – a study relevant to a larger population or other relevant stakeholders by presenting data that is objective, complete and prior-informed.
4) Identifying important practices responding to sustainability challenges within the cases and their position within the leverage point framework.

The concrete methods to analyse the use cases and examine the operations of the two companies will be:
an Institutional Resource Regime (IRR), which is a proposed framework for the analyses of institutional arrangements that regulate individual and/or collective uses of resources (SUMEX D1.2 p. 26). (See section 5.3 of this document for an in-depth explanation and justification of the use of an IRR for the analysis of the two use cases)
Leverage points (Approaches, such as the Leverage Points (LP) are conceptual models to best understand what are ways to introduce system change with varying degrees of impact (i.e. ranging from “shallow”, i.e. incremental changes, with only minor leverage on changing a system, to “deep”, i.e. transformative and disruptive) (SUMEX D1.2 p.21). see section 5.1 for an explanation of the 12 LPs and short explanations on their extent),
Policy analysis along SUMEX focus areas (see section 5.5)
As well as pre-identified challenges and tensions across SUMEX sustainability aspects (see section 5.2). SUMEX sustainability aspects describe key components of what sustainable management of the extractive industry in Europe should consider. They represent a set of topics (e.g. valuing social and natural capital, planning beyond the mine life) and goals (e.g. no bribes, zero greenhouse gas emissions), which have to be underlined with processes in order to get to such a state. These challenges and tensions inform an important starting point for investigating and identifying good practices in use cases (see section 6.1 for an explanation ore for more detailed information SUMEX report D1.2 p.17)

4.2 USE CASE IDENTIFICATION AND DESCRIPTION

The analysis of the two SUMEX use cases serves several purposes for the future undertakings of the project. First, the analysis will help to fill gaps identified in the analysis (of SD aspects based on interviews) of permitting and planning in regards to policy coordination and agenda setting, through in-depth analysis of the use cases. It will further provide an examination of the whole mine life-cycle, from exploration to rehabilitation. This will support the project in closing the gap on horizontal and vertical policy integration and coordination along the entire value chain, as the use case analysis will contribute to identify these weak points in existing policies and policy-making. Following the meta-analysis on identified gaps of SD aspects, these gaps in the meta-analysis will then be complemented with information on practices from the two SUMEX use cases to address important identified challenges.

In order to ensure other manufacturers can benefit from the use case analysis, relevant good practice information will be transformed into joint actions with a high degree of training and learning relevance. All knowledge and insights gained from the use case analysis will serve as input for the SUMEX toolkit, data repository and training materials to show how companies deploy specific measures to address important SD challenges and trade-offs. In addition, SUMEX partners will disseminate knowledge gained from the use cases to SUMEX target stakeholders. This will allow practitioners at all levels - i.e. company managers and employees, local authorities and municipal representatives, as well as external stakeholders such as other companies and affected communities - to learn from the two use cases in order to deploy presented solutions to challenges in their own contexts.

Below are the two case overview templates presenting relevant information of the two use cases in a concise manner for interested stakeholders to learn about these cases.

4.2.1 USE CASE: CONSTRUCTION MATERIALS (CANTERAS LA PONDEROSA S.A.)

Overview of the Construction Materials Case: Canteras La Ponderosa, S.A. case	
Introductory Information	• This case includes 2 open-pit quarry operations: Alcover and Riudecols • Both quarries & plants belong to the company CANTERAS LA PONDEROSA, S.A., which is a family owned enterprise, founded in 1978, as succession of a unipersonal company from Mr. Aquilino Rodriguez, the father of the current owner. • The Alcover quarry and plant is located in Alcover, close to the populated area. Alcover is 30 km away from the capital of the province Tarragona in Catalonia (Spain). This site has an extraction area of 84,7 Ha. The rocks are mainly limestone with some parts of dolomite and clay as a waste material for rehabilitation purposes. • The Riudecols plant is located near the Les Irles neighbourhood of Riudecols, also 30 km from Tarragona. This site has an extraction area of about 80 Ha, and only produces granite rocks. • The company is an SME that is very well known for its innovation behaviour. The company is investing to develop automation in order to improve productivity, efficiency, safety and environment management.

- Both sites are hard rock quarries where extraction is made by drilling and blasting. In both treatment plants, crushing and grinding processes as well as size classification take place. In one of them there is a small aggregate washing plant for aggregates for railway ballast destined for France.

  More information is available in La Ponderosa website: http://www.ponderosa.es
  The location of the sites is:
  https://www.google.com/maps/d/viewer?mid=1jrVht4WxLKD8MpuQcIRCdoewQds&ll=41.2136583038366%2C1.0431219999999808&z=12

Overview of permits

- The sites are owned 100% by La Ponderosa
- The company does not have a permit for exploration for the sites and the surrounding area.
- The permits for exploitation (extraction and processing) are for the rocks that are extracted and treated: Alcover quarry & plant (Limestone & Dolomite); Riudecols plant (Granite).
- Alcover quarry & plant has a section A (authorisation) permit (see policy framework conditions). The date of the permit is 1964.
- Riudecols plant has a section C (concession) permit (see policy framework conditions). The date of the permit is 1992.

Overview of environmental permits

- The current operating conditions and production levels until the end of life of the two quarries production rates for extracted rocks and for waste rock, placement of waste rock, management of waste rock, water management, noise and vibrations associated with blasting, transport and other operations.
- Due to the fact that the production does not use water for the treatment (dry production) and only for dust & RCS control and for a small washing plant (for small railway ballast volume), the permits required for water are limited to water consumption that is based on a declaration to the Catalonian Agency of Wastes.
- La Ponderosa has a monitoring program for vibrations, dusting and noise.
- Site closure and rehabilitation plans have been approved for each site with financial guarantees for economic security for mine closure and rehabilitation
- La Ponderosa complies with H&S regulations
- There are no particular issues with chemicals and chemical management.

What challenges/issues are faced at this quarry site?	• The two quarries are facing various challenges in relation to the formal permitting process and the Social License to Operate, in order to continue their normal operation: • **Proximity to populated areas on both Sites**. Especially at Alcover, which is at few meters from a residential area. Therefore, control of vibrations, noise and dust is a must. This circumstance does not allow for night shifts or even working on windy days. Blasting operations have to be done with extreme precautions in order to avoid vibrations. In the case of Riudecols, the village of Les Irles is located below the level of the exploitation. In addition to dust, noise and vibrations, they are worried about slippage of stocks of materials that could cover the creek that connects the operative area with the village. • **Proximity to NATURA 2000 or special protection areas**. Both quarries are close to such protected areas, posing an extra challenge in relation to wildlife. Alcover is in the hunting territory of a population of partridge eagles (Aquila Fasciata), birds in danger of extinction. • **Difficulties for the expansion of the operative areas for quarrying**. The phenomena of "Not in my back yard" is extremely problematic around the plants, especially in Alcover, where one NGO, Alveolus, has been able through the Supreme Court to withdraw an authorized expansion of the quarry of 64 Ha, already partially in operation. This pressure potentially influences the municipalities and local authorities, increasing the stringency of the normal safety and environmental controls.
What practices are deployed to address these issues and challenges?	• **Proximity to populated areas**: In order to prevent the issues of dust, La Ponderosa has presented a voluntary plan of measures to the Environmental Department of The Generalitat de Catalunya (autonomous Government) to reduce activity and even stop completely in case of weather circumstances that could produce emissions. This very comprehensive plan including investments in dust reduction and improvement of procedures has been implemented and is controlled by Environmental authorities verifying their effectiveness prior to its presentation to the local population and Municipal authorities. Regarding vibrations the company uses the most modern techniques in order to avoid such effects and transparently measures each blast with the seismograph giving neighbours the opportunity to know and compare the effects. Working on night shifts has been abandoned in order to not disturb the local community's rest. • **Proximity to NATURA 2000**: This is a development that the company cannot prevent, since the protected areas will increase following EU Directives. Despite Catalonia being one of the regions of the EU closest to the fulfilment of the total amount of NATURA 2000 spaces in terms of protected areas, the connectors and other local protected areas will increase. The company cooperates with this effort and proved that Mining is a temporary land use, and the company will revert the area to its original state after the closing and rehabilitation. In that sense, Ponderosa implemented a Rehabilitation Plan that covers all effects in order to restore landscapes, plants and wildlife. This Plan obtained the second award on the Environmental Awards of FdA (Federation of Aggregate's producers of Spain). • As part of this Plan, the company offers food (rabbits and doves) and a hunting area with low vegetation density for the eagles. This also prevents the birds from putting themselves in danger by hunting in the nearby Airport. In addition, the company has studied the habitat of small animals

	(Fishes, snakes, and invertebrates) in order to provide a more convenient place for their reproduction. Regarding plants and landscapes all restoration is done with native plants avoiding exotics species. Canteras La Ponderosa has been participating for years in sectoral programmes to support biodiversity, such as *Gremi d'Àrids de Catalunya* to monitor eagles and other endangered bird species. • **Difficulties of expansion**: The operations are opposed or scrutinized by people, environmental authorities and restrictive laws. Ponderosa's approach is to communicate that mineral resources are where they are, and that they are essential for human life. For that purpose, there are open days where pupils from schools are invited to visit the quarries to look for animals and plant trees in order to show the return of the land to its natural state. There is cooperation with Municipalities to support them in organising events or small projects for citizens. Regarding the other authorities, a clear and open approach is taken to fulfil all norms and regulations to the highest standard. Regarding the local population (activists, local communities), the company tries to engage and resolve any issues that could not be remediated previously by continuously working on solutions to present to these stakeholders.
Who are the involved stakeholders and organisations ?	• Canteras La Ponderosa (Operator & Land Owner) • Mining Regional Authorities • Environment Regional Authorities • Municipalities of Alcover and Riudecols / Les Irles • NGOs (Alveolus and Others) • Neighbours
Who are the affected stakeholders ?	• Local communities of Alcover, Riudecols, Les Irles and Duesaigües • Local ecosystems in the NATURA 2000[1] protected area of Muntanyes de Prades[2]
What are the (local/ national) policy framework conditions?	• The permits for exploitation have been granted in the past • The difficulty of receiving new permits depends on the specific mine site • The development of the issue of the management of the administrative processing of aggregate exploitation is based on the State mining regulations, Law 22/1973 of 21 July 1973 on Mining and Royal Decree 2857/1978 of 25 August 1978 approving the General Regulations for the Mining Regime, which is applied in all the Autonomous Communities (Section A and C). • Section A): The Spanish legislation determines the following as belonging to this section: "*Those deposits whose only use is to obtain fragments of appropriate size and shape for direct use in infrastructure and construction works and other uses that do not require operations other than broken and calibrated extraction, calibration being understood as the mere classification by size. This section also includes deposits of low economic value and at the same time of restricted geographic commercialisation according to the valuation criteria established in accordance with the*

[1] https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=ES5140008
[2] https://www.catalunya.com/espai-natural-protegit-de-les-muntanyes-de-prades-17-17001-11809?language=es

provisions of paragraph 3 of Article 3 of the Mining Law".

- Section C): The Spanish legislation determines that the following belongs to this section: "*All mineral deposits and other resources that are not classified in the previous sections and are subject to exploitation or exploitation in accordance with the Mining Law.*"

Section	Unit of measurement	Maximum length	Maximum duration of validity	Public utility
A	Parcel / Polygon	Those belonging to the same site	According to the project and the established reserves	No implicit declaration
C	Grid (25 Ha)	100	30	Implicit declaration

- In the development of the mining procedure by the substantive body (Mining Administration - Provincial Delegation/Territorial Service, etc.), the mining sector regulations must be taken into account together (among others Mining Law, Royal Decree 2857/1978 and Royal Decree 863/1985, of 2 April, approving the General Regulations of Basic Mining Safety Standards - hereinafter RGNBSM -), the regulations of the common administrative procedure and the concurrent sector regulations.

- Although it is the case that not every mining right has to be submitted to the environmental impact assessment procedure, very few cases will be exempt from this procedure. Therefore, environmental regulations will be decisive in determining the administrative procedure to be followed in obtaining a mining right.

- Prior to processing an application for a mining right, the mining promoter must analyse: the ownership of the land, the compatibility of urban planning and land-use planning instruments, the presence of archaeological or cultural protection, whether it is located in the Natura 2000 Network or in another type of protection that could reduce the chances of success of the mining initiative.

- The procedures required for the commencement of the activity can be summarised in two clearly differentiated blocks, taking into account the competent body. On the one hand, there is the mining right, without including the procedures arising from the application of other sectorial regulations, and on the other hand, the municipal requirements, depending on the autonomous Community and local regulations. The latter, in turn, determine two aspects derived from the applicable regulations:

    - Mandatory nature of the municipal environmental procedure (a): In many cases, the Autonomous Community and municipal regulations require the processing of a municipal environmental licence for mining activities.

    - Municipal environmental proceedings are not compulsory (b): There are regional environmental regulations that do not require the processing of a municipal

environmental licence for mining activities, as the environmental procedure is already included in the processing of mining rights.

- The minimum content of the project that must accompany the initial application must include: Operating project: As specified in section d) of art. 28 RGRM and ITC 07.1.02, all projects must include:

    1. Descriptive report
    2. Justifying calculations
    3. Safety measures
    4. List of equipment and machinery. Use and maintenance
    5. Plans & Maps
    6. Budget
    7. Annexes

- Other key documents needed for the application:

    1. Environmental Impact Study (ordinary EIA): Drawn up in accordance with the provisions of Article 35 and Annex VI of the IA Law and other applicable regional regulations. In the case of having carried out the previous phase, referring to the application for the scope document, the different Administrations will inform about the necessary documentation. In effect this leads to a state where the enormous time saving for requirements of rectification and improvement take place.

    2. Environmental document (simplified EIA): In accordance with the provisions of article 45 and other applicable Autonomous Community regulations.

    3. Restoration plan: Drawn up in accordance with Royal Decree 975/2009, of 12 June, on the management of waste from extractive industries and the protection and rehabilitation of areas affected by mining activities.

    4. Health and safety document: In accordance with Royal Decree 1389/1997, of 5 September, approving the minimum provisions to protect the health and safety of workers in mining activities (paying special attention to art. 3.2 of this regulation) and

	drafted in accordance with ITC/101/2006, of 23 January, which regulates the minimum content and structure of the health and safety document for the extractive industry. • It is common for sectoral regulations to require specific studies for the weighting of specific sectoral interests: archaeological surveys, landscape studies, etc., which must be included in the impact study or environmental document. • It is in the EIA process where, with the participation of the interested public and the technical reports of the affected Administrations, the compatibility (in what way and with what corrective and compensatory measures) of the mining interest with the different concurrent values must be weighed. Therefore, the sectoral regulations determine the minimum contents that these studies or analyses contain, and be integrated into the EIA procedure.
Basic figures of the operation:	• Owner: Canteras La Ponderosa, S. A. • Explotation areas: Alcover (La Ponderosa) and Riudecols (PuigMarí). • Mine type: OPEN PIT QUARRY • Number of employees: 70. • Minerals: Alcover Limestone and Dolomite, Riudecols: Granite. • Mining Surface: Alcover Section A 84.7 Ha, Riudecols Section C, 80 Ha. • Start of Operation: Alcover 1964 (As unipersonal company of Mr. Aquilino Rodriguez), Riudecols, 1996. • Production 2020: Alcover 750.000 tons; Riudecols 179.000 tons. • Profit 2020: 150.000 € • ISO 9001:2015 2018-2021. • Homologation BALLAST SNCF Catégorie C2/C4 (France). • ADIF Quality Mark for Railway Ballast Type 1. • ANEFHOP Quality, Prevention and Environment Certificate. • ANEFHOP 2015 QUALITY POLICY. • Royal Decree Concrete 163/2019.
Policies of the Company	Translation from the code of ethics and conduct of Canteras la Ponderosa  • **Environmental commitment** (specific actions are listed under the section of 'practices to address issues') • Canteras la Ponderosa works for sustainable development and always respects the environment. (50% of the energy produced in the region comes from renewable sources, resulting in a lower CO2 footprint when compared with other aggregates produced in Europe) • Canteras la Ponderosa promotes those behaviours or actions that contribute to the improvement of the environment. • Canteras la Ponderosa is committed to minimising the environmental impact throughout the whole life cycle of its products, developing, at each stage: manufacture, collection, transport and installation, measures to compensate and reduce this impact,

	• Canteras la Ponderosa is firmly committed to the protection, conservation and improvement of the environment and natural capital and therefore carries out its activity under the following premises: - Efficiency in the consumption of resources. - Minimum negative environmental impact. - Pollution prevention. - Protection of ecosystems. • Quality and innovation Canteras la Ponderosa is firmly committed to the highest levels of quality and working standards as well as continuously improving the operations through innovation and therefore carries out its activity under the following premises: Canteras la Ponderosa works every day to achieve the highest levels of quality in their products and services. Canteras la Ponderosa puts at the disposal of its employees its best and most advanced technical knowledge, the best technologies and the best possible material means and encourages the involvement of its employees in the dynamics of innovation. The people of Canteras la Ponderosa will collaborate with this objective with due professionalism, commitment and initiative. Likewise, Canteras la Ponderosa articulates the mechanisms and systems for the and systems of permanent quality management.

TABLE 2: OVERVIEW INFORMATION OF THE CANTERAS LA PONDEROSA S.A. USE CASE

4.2.2 BATTERY MATERIALS (BOLIDEN AB):

Overview of the Boliden AB case[3]	
Introductory Information	• This case includes 3 underground mining operations (Renström, Kristineberg and Kankberg) - therefore also covering 3 affected communities • The area has around 30 old mines sites • Currently undertaking an initiative to develop automation in mines in order to improve safety and productivity • There is a central mineral processing plant in the Boliden area where all extracted material is processed <u>Renström</u> • processing plant 17 km away from the Boliden area Overview of permits • This site has been granted two exploitation concessions and one exploration permit • One permit granted until 2025 on Boliden owned land - no royalties due • One recent permit granted until 2038 on non-Boliden owned land - royalties of 0,15% of minerals value to landowner + 0,05% to the state Overview of environmental permits • Maximum production rate of 520 kt/y • Maximum total concentration of elements in discharged water • Maximum levels of noise, dust, vibrations • Run the operations to follow the technical description Environmental monitoring • Submit a remediation plan before mine closing • Acquire additional tailings sand / waste rock as filled underground • Submission of a guarantee of 20 million SEK to cover all environmental liabilities in case of bankruptcy

[3] Information on the 3 mine sites has been obtained from:
https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2020/resources-and-reserves-renstrom-2020-12-31.pdf
https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2020/resources-and-reserves-kankberg-2020-12-31.pdf
https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/resources-and-reserves-kristineberg-2018-12-31.pdf

- Steps in Mineral processing
- Ore is transported from the mine to the industrial area via truck
- Material is weighed before being processed
- Ore is ground and processed in different stages
- Suitable material is transported to the smelter

Infrastructure

- Dewatering & power supply
- Ramp system connecting all level to the main shaft (at -900m)
- Crusher to prepare ore to be transported to the surface
- Renström mine is joined to the surface via a connection to Petiknäs mine
- On the surface lorries carry the ore to the plant

Kristineberg

- 100 km away from the processing plant
- Largest mine in Boliden area with 750000 t/year
- Located in the village of Kristineberg – nearest houses are 200m away from the industrial area

Permits

- The mine is owned 100% by Boliden
- The company has the permit for exploration in the mine site and the surrounding area
- Boliden holds several exploration permits for different materials (zinc, copper, silver, gold, and lead)
- In addition, the company holds several mining permits for said materials

Environmental permit covers

- Valid from 2014 for the current operating conditions and production levels until the end of life of the mine
- Production rates for mineralised and waste rock,
- Placement of waste rock, management of waste rock
- Water management and water treatment,
- Discharge water quality,
- Noise and vibrations associated with blasting, transport and other operations,
- Monitoring programs for dusting, noise, and water quality,
- Dam safety and management,
- Mine closure and rehabilitation,
- The economic security for mine closure and rehabilitation,
- Chemicals and chemical management

	<u>Kankberg</u> • 10 km from the Boliden Area processing plant Infrastructure • Mine is accessed via a ramp from an older mine • Tailings are deposited at a tailings management facility close to the processing plant
What challenges/issues are faced at this quarry site?	• The company faces various challenges in relation to the formal permitting process and the Social License to Operate. • The implementation of the EU Water Framework Directive made the access to water and waterbodies very difficult. Concentrators with tailing ponds need to be localized under water or be water saturated. Mines need to pump and discharge water, both of which interfere with ground and surface waters. The lower areas in the Boliden area contain waterbodies which cannot be changed or repealed. • This results in a major challenge that once the current tailing ponds are filled, Boliden AB will not be able to find new sites for new tailing ponds. The company is currently working on shifting techniques but this is connected with high costs and effects on the environmental performance. One potential identified solution would be dry stacking. • Other main challenges relate to land use for which there is competing interests for usage by different parties, such as local communities, wind mills producers, indigenous communities (Sami), infrastructure projects, or protected areas (under the EU Green Deal, Nature restoration plan, Natura2000 or similar). To mitigate these impacts, Boliden puts a lot of effort into the Life of Mine planning process, in order to identify potential land use conflicts and address these early on in the operations. To this end there is extensive communication with other land users to resolve (potential) grievances early on and to the best possible outcome.
What practices are deployed to address these issues/challenges?	Alternatives to tailing ponds • Regarding localization studies for tailing ponds, Boliden AB is evaluating new ways to deposit tailings such as dry stacking. For dry stacking the tailings are dewatered, filtered and deposited in dry conditions with successive and extensive rehabilitation measures including covers made out of very fine till or Bentonite to reduce air flux into the tailings. Dry tailings can be deposited in different sites compared to water covered or saturated tailings – which allows for storage away from waterbodies and also eliminates the need for pumping infrastructure. • Another potential solution for tailings storage is to use it as backfill in the mines in order to reduce the volume of tailings that has to be deposited in landfills. • When considering these solutions it is important to always consider different perspectives and wider challenges such as dam safety, Sami interests, technical solutions, landowners and costs, in order to find the best suitable sites to deposit tailings while at the same time understanding, and accommodating as best as possible, the needs of other stakeholders. Competing land use interests There are several approaches to resolve/prevent issues relating to competing land-use interests.

	• The first step is to identify all relevant stakeholders early on in the project and continuously manage them, providing information, engaging in dialogue and building mutual trust. • Solutions need to be tailored to the specific sites and issues, for example in the Strömförs site, during the evaluation of impact reduction measures the idea to transport ore underground into the existing industrial area emerged. This would reduce overground transportation via lorries, therefore reducing noise and air pollution as well as road congestion. • If a landowner is asked to move, they are always offered a house similar to their previous one in another area, or if they wish to receive land or forests in exchange this is also an option that Boliden AB can provide. There are several approaches to engage with the Sami communities. • During the exploration phase of a project, Boliden AB will try to avoid exploration activities in the season that the land is used by the Sami. If this is not possible actions are taken to reduce the impact on the Sami communities by building fences, reducing tracks in the terrain, implementing speed limits etc. • Additional mitigation measures include building paddocks for their livestock, clean areas with pine forests and rehabilitate areas with plants and lichens for reindeer grazing. Any negative impact that cannot be avoided is then settled via monetary payments. Other approaches • Mine rehabilitation now always includes ecological rehabilitation with an ecosystem service approach, involving local stakeholders in order to ensure that the previous or new land-use can be established in the area of the closed mine site.
What are aspects of the company's sustainability strategy?	Boliden's sustainability strategy has three main focal areas: Employees Creating a safe working environment minimising the risk of accidents, and fostering employees' health and well-being. To this end the company is continuously increasing the use of technology and automated work, especially in high risk environments, in order to reduce accidents in these areas. Environmental and Climate • In order to reduce the water consumption in their operations, Boliden works on optimizing the water management and reusing water, to reduce the amount of water being used and discharged. • All operations must include a water plan to manage risks and priorities related to the water consumption. • The company bases its investment decisions on where these investments will provide the most benefit for animals and the environment. When building tailings damns, care is taken to reduce the impact on the surrounding area during construction operation and closure of these dams. Additionally, these dams need to adhere to the national dam safety guidelines as well as to the company's internal guidelines (internal guidelines are being developed with independent dam safety experts of the Independent Technical Review Board).

	• The company follows an objective of increasing the biodiversity in every region it operates in by 2030. For this purpose, actions are taken to preserve and counteract the loss of biodiversity during its operations. Studies are undertaken on biodiversity and the protection of local ecosystems, focusing on avoiding, minimising, mitigating, and compensating damages to local ecosystems. • Boliden also owns 24800 ha of forests and land that is managed sustainably, in order to provide habitat for animals and foster biodiversity in these regions. • In term of emissions, the company is continuously working to reduce total CO2 emissions as well as the CO2 intensity of their operations. This is done by electrification of operations, increasing efficiency and an increased use of electricity from renewable sources. Measures such as increasing the efficiency also have positive effects on the emissions of other pollutants into the atmosphere and environment (such as sulphur dioxide and nitrogen). The long-term climate goal is to reduce the emission of greenhouse gases from the operations by 40% in 2030, compared to 2012 levels. Responsible Business • The company created a department for ethics and compliance that is tasked to ensure that business is done responsibly. This covers areas such as - implementing the internal code of conduct, - preventing infringements on human rights as a result of the operations, - ensuring anti-corruption measures are in place and financial activities are closely monitored to prevent such practices, - managing risks of money laundering - compliance with (international) sanctions on potential business partners.
Who are the involved stakeholders and organisations?	• Boliden AB (operator & land owners) • Mining authorities (for permits etc.) • Private land owners (owning parts of the land of the operation)
Who are the affected stakeholders?	• The residents of 3 local communities (Renström, Kristineberg and Kankberg) • Sami populations • Local ecosystems (i.e. in particular the different water bodies)
What are the (local/national) policy framework conditions?	• The permits for exploitation have been granted in the past. • The difficulty of receiving new permits always depends on the specific mine site. • The implementation of the EU Water Framework Directive and its new governance structures influencing current operations and future expansion (i.e. licencing processes)
Basic figures of the operation:	Owner: Boliden AB • Boliden Area mining operations • Mine type: underground mine • Mining techniques used (proportion in %): Cut & Fill (77%), Open stoping (18,6%), Retreat mining (4%), Bench (0,4%) • Materials: Zinc, Copper, Lead, Gold, Silver, Tellurium • Employees: 650 • Profit in the Boliden Area (2020): 8.6m € • Mine depths (meters): Renström (1500m); Kristineberg (1350m); Kankberg (620m)

	• Start of operations in the area: 1925; Overview of the three mine sites: Renström • Proven mineral reserves: 352 kt • Probable mineral reserves: 4202 kt • Production in 2020 (with % of relative value): 479 kt of mill throughput with concentrations of 2,1 ppm gold (31%); 121 ppm silver (20%); 0,6% copper (8%); 4,7% zinc (36%); 0.9% lead (4%) • Mine lifetime production: 14493 kt • Mine depth: 1500m • Start of production: 1953 Kankberg • Proven minerals reserves: 2610 kt • Probable mineral reserves: 1930 kt • Production in 2020 (with % of relative value): 535618 t concentrations of 3.43g/t gold (96%); 9g/t silver (2%); 157.1 g/t tellurium (2%) • Mine lifetime production: 3.4 Mt • Mine depth: 330m - 530m • Start of production: 2012 (until 2031) • Employees: 115 Kristineberg • Proven minerals reserves: 5 kt • Probable mineral reserves: 4282 kt • Production in 2018: 600000 t concentrations of 0.6g/t gold; 33g/t silver; 0.5% copper; 5,4% zinc; 0,2% lead • Mine lifetime production: 31.5 Mt • Mine depth: 900m - 1250m • Start of production: 1940

TABLE 3: OVERVIEW INFORMATION OF THE BOLIDEN AB USE CASE

5 FRAMEWORK AND SUSTAINABILITY IMPLICATIONS

5.1 TENSIONS AND TRADE-OFFS PERSPECTIVE

An operationalisation of sustainable development often represents an isolated and one-sided perspective of what constitutes environment, society and economy. Such an isolationist view distracts from fundamental linkages between economy, society and the environment and assumes that trade-offs across these dimensions can easily be made. This problematic is exacerbated by the conceptualisation of sustainable development that society is dependent on the environment and exists within the boundaries of the earth system (Giddings, Hopwood, & O'brien, 2002), as well as the fact that stakeholders' norms and values sometimes often prioritise one dimension, creating tensions due to conflicts between the different dimensions (McCollum et al., 2018; Purvis et al., 2019). Therefore, conceptualisation and interpretations of sustainable development inevitably result in tensions between stakeholders or trade-offs among goals across the dimensions of economy, society and the environment.

The pursuit of sustainability in extractive industries and the balancing of environmental, economic and social sustainability aspects unavoidably introduces tensions and trade-offs, as already discussed in the report "D1.2 SD Criteria – SUMEX Sustainability Framework". These tensions and trade-offs are present across the breadth of the extractive system, as extraction activities require land, interfere with nature and impact on surrounding communities. Identifying these tensions and trade-offs among stakeholders, is a first steps towards realising the full potential of a sustainability discourse, as well as to determine and design transformative action. A number of follow up actions are necessary to overcome the isolated view of sustainable development: i) identification of areas of disagreement among stakeholders, as well as the anticipation and transparency of conflicting goals across different dimensions, ii) application of deliberative and participatory learning approaches with societal stakeholders, and iii) development and deployment of mitigating measures to enable a more sustainable mineral extraction.
As part of the SUMEX project, a sustainability framework was developed that specifically targets the European extractive sector. The so-called SUMEX Sustainability Framework contains three main topics – i) transforming the economy (i.e. considering the Green Deal), ii) social and societal responsibility and iii) environmental sustainability – each broken down into sustainability aspects. In interviews with 30 stakeholders representing consultants, governments, industries, industry associations, international organisations, NGOs and civil society organisations, as well as research and education (see D1.2 SD Criteria for the stakeholder distribution in more detail), several tensions and trade-offs in regard to the European extractive sector were identified. The identified tensions and trade-offs can be traced back to one of the three main topics and subsequently to a sustainability aspect of the SUMEX Sustainability Framework.

Interview data demonstrate most of the tensions and trade-offs in the European extractive sector underlie the category 'social and societal responsibility'. Topics such as land use and social acceptance cause the most tensions and trade-offs. These thematic areas can be mapped to the following two SUMEX sustainability aspects of the SUMEX Sustainability Framework: "***Arrangement of different land uses (spatial and temporal) and net positive impact on ecosystem services and biodiversity (incl. from indirect impacts)***" and "***Engage in continuous dialogue with stakeholders, create trusted grievance mechanisms and share investigation and problem-solving processes***".
Furthermore, a notable number of tensions and trade-offs originate from the need of extractives for green technologies (e.g. battery technologies or renewable energy provision), which matches with the SUMEX sustainability aspect "***Understanding of the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries (incl. innovation for technology "jumps", new business models, consumption patterns and "needs" considerations, linkages to other parts of the economy)***".

In contrast, tensions and trade-offs arising from thematic areas such as human rights violations, harmful air emissions, circular economy and recycling were scarcely mentioned in the interviews in the context of the European extractive sector.

5.1.1 COMPETING LAND USES

Tensions and trade-offs associated with the SUMEX sustainability aspect "***Arrangement of different land uses and net positive impact on ecosystem services and biodiversity (incl. from indirect impacts)***" mainly concern land use planning and its dedication towards a certain type of use. The reasons for tensions and trade-offs related with land use are of different nature, comprising the competing land use between sectors/stakeholders such as problems of dedicating land for extractive actions versus other uses such as residential areas. These tensions and trade-offs frequently exist between local communities and extractive companies, but also between governments and extractive companies.

According to the interviews, tensions and trade-offs in the area of land use mainly occur between government and extractive companies where large areas are reserved for nature conservation not allowing for extraction activities (e.g. Natura 2000 and water body protection areas) and where extraction activities are a low priority in land use planning. Nature conservation and the protection of water bodies are often in conflict with extraction activities, as mineral extraction interfere with, change and have impacts on water bodies and natural habitats (eco-system services as well as biodiversity).

Conflicts on land use dedication arise due to various factors:

- While the government designates areas for nature conservation (e.g. Natura 2000) and water body protection where no mining activities may take place, extraction activities are hindered because they are dependent on the location of the deposit.
- Governance processes for designating land-use and planning tools might have imperfect information or are not able to bring to the table the corresponding expertise (due to lack of coordination of different government agencies working on mining and land use planning). Furthermore,
- Competing options of different land uses and the various interests standing behind these are often a starting point for conflicts during the planning phase or conflicts about whose interests are over or underrepresented.
- Extraction activities are one among many important land use options, but processes or data for their consideration are sometimes lacking. Therefore, this often leads to the interpretation of underrepresented interests for extraction activities in the arrangement of land uses where mineral resources are available for exploitation.

With regard to competing land uses, agriculture and nature conservation were often mentioned. *"So even though the extractive sector is a temporary land use, there's still also many competing different areas. So, for example: residential, the need for agricultural land is ever increasing, particularly with climate change, some areas are becoming less suitable for crop growing, which puts pressure on those areas that are more suitable and also making space for nature. […] However, there has been certainly some issues around protected areas and I guess the issue with the extractive sector is that you can only extract where the minerals are present."* (Industry representative). Despite the competing land use between the extractive sector and others, mineral extraction is often not a priority and is overlooked, forgotten or neglected in land use planning. *"Plans are developed in accordance with the current needs of the society or wishes of influential people. They fail to acknowledge that there are some parts of the land that are not to be constructed […]. They fail to consult geologists and miners to include past and future prospects for mining."* (Research and Education).

5.1.2 SOCIAL ACCEPTANCE, TRANSPARENCY AND TRUST

All tensions and trade-offs concerning the SUMEX sustainability aspect *"**Engage in continuous dialogue with stakeholders, create trust grievance mechanisms and shared investigation and problem-solving processes**"* are of social and societal character. The negative perception and image of the extractive industry, as well as the lack of trust and social acceptance towards the extraction of mineral raw materials, are increasingly a challenge for the European extractive industry. Absence of transparency and communication about future plans of the extractive company, impacts on local community, as well as the lack of understanding and unmet expectations of the local community lead to conflicts between extraction activities and local communities.
Mineral extraction, especially on the surface, is related to environmental changes. In addition, extraction and transport of mineral resources may cause noise and dust, potentially leading to conflicts with the surrounding local communities. So, land use conflicts are also generated with the aim to block mining activities. *"More and more land use conflicts actually artificially produced by using environmental arguments against the industry."* (Industry representative).
Interview data demonstrate, the NIMBY effect plays a major role in many of the conflicts identified between extractive industries and local communities: *"First foremost, the largest is probably that people don't want to get affected by something happening nearby. The classical 'Not in my backyard'."* (Industry Association representative); *"everybody needs aggregates but nobody wants quarries. This is a very big problem we face every day as an industry."* (Industry representative). But not only dust, noise and other disturbances are impacts experienced by local communities, changes in the landscape are problematic. *"I have been following several mining projects from the initial stage, from the very beginning, from greenfield projects, and I can say that in speaking with the local people for years, the idea that they have been looking in a hill and this hill will not exist anymore, it's kind of issue for them."* (International Organisation, NGO and Civil Society representative).
A good relationship between extractive industries and local communities is crucial, especially for the company as communities have the power to block or even hinder extraction activities. *"In our policy, it was always to have good relations with the nearby villages […] if you don't have good relations with these communities, smaller or big communities next to you […] is very easy to go on demonstrations and even close a quarry."* (Industry representative). Therefore, a continuous dialogue with stakeholders, a trust grievance mechanism and shared investigations and problem-solving processes are important to strengthen the social acceptance towards the extractive industry and to maintain the social licence to operate. But other aspects of the SUMEX Sustainability Framework are significant supporting or flanking measures to achieve these goals, e.g. "***Partner with host communities and society to deliver a shared vision of the future***" and "***Share data and information transparently (incl. payments and revenues, environmental and social data)***". Even though these two SUMEX sustainability aspects are less subject to tensions and trade-offs in the European extractive sector according to interviews, they are closely linked to the aspect mentioned above. An open conversation, the cooperation between host communities and extractive companies and transparency are essential to avoid potential conflicts between local communities and extraction activities.

5.1.3 GREEN TRANSITION TO A MORE SUSTAINABLE FUTURE

Tensions and trade-offs that can be linked to the SUMEX sustainability aspect *"**Understanding the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries**"* include thematic areas such as permitting processes, environmental protection and raw material consumption and sourcing.
A green transition to a more sustainable future and the transition to renewable and green energies, as well as the achievement of the European Union's climate goals, require mineral resources. But also infrastructures such as roads and buildings, and (new) technologies for resource efficiency and circular economy demand extractives. Despite the high importance of mineral resources for the transition to an inclusive green economy, they are mainly imported from countries outside the EU and even outside Europe. *"Access to primary and secondary raw materials is a prerequisite for getting, for fulfilling the sustainable development goals, for getting*

into a transition into a CO_2 neutral economy." (Government representative); *"I think the biggest tension that I would see is actually reflected in Europe, but also reflected globally, which is a desire for a transition to a green energy future, and the fact that that is simply going to require more mining and extraction."* (International Organisation, NGO and Civil Society representative). The area of tension and conflict here is that extractives are crucial for the transition to a more sustainable future, but the extraction itself impacts the environment and is not, strictly speaking, considered sustainable, as mineral raw materials are not renewable. Moreover, the European Union still imports mineral resources from countries where extraction activities take place under poor conditions. Reducing the overall consumption of raw materials and sourcing mineral resources responsibly would be of great importance.

The reason for outsourcing mineral extraction from the European Union has a variety of reasons, social acceptance and social licence to operate are among them. As extraction activities are decreasingly present and visible in Europe, the connection between end products and mineral extraction has been lost. Many tensions and conflicts between the extractive industry and local communities are caused by low social acceptance of extraction activities and a lack of awareness of the importance and necessity of extractives. Everyday items such as laptops, cosmetics (e.g. toothpaste) and washbasins contain mineral resources, but this is often forgotten. *"Citizens, they do not make a link between a site and what they have around them. So they do not understand why we are making holes in the ground. They do not want to say, we do not want this house, or this road, or this medicine, or this mobile phone, they want everything, but they do not make the link between what they have at their service, and what they have to do to obtain these kind of things."* (Industry Association representative).

Another point of conflict is the permitting process in the European Union for a deposit to be mines. This process is highly complex and often takes many years from the discovery and exploration of a deposit to its extraction, regardless of the material being extracted. *"If we start to promote lithium projects today, they will not be in operation before 2030."* (Industry Association representative).

5.2 LEVERAGE POINTS

The below mentioned table is an orientation how the leverage point framework can be understood in the context of the extractives sector: what events, actions, realities and other implementation examples are comprising the different levels within the LP framework.

List of Leverage Points
1 Power & capacity to transcend & change worldviews Capacity to transcend paradigms goes beyond challenging fundamental mindsets and worldviews (LP2): This LP addresses the most fundamental and basic values that lead to those worldviews and mindsets, mindsets and worldviews are not set and finite: they can be changed and transformed
2 Mindset & worldviews in which the system is rooted Societal paradigms are ideas or unstated assumptions about "how the world works"
3 Goal & intent of the system Overarching goal of the system: e.g. Economic growth, sustainability, social-ecological markets
4 Power to change the rules & structure of the system (here structure means the structure of RULES)
5 Rules & Institutions to build/ "operationalise" the (new) system

6 Structure of information flow & access to information
7 Strengths/awareness of positive and reinforcing feedback loops Positive feedback loops speed up processes and are self-reinforcing
8 Strengths of negative/balancing feedback loops to establish corrective actions Negative Feedback loops are self-correcting!
9 Lengths of delays in relation to the pace of the system change Delays are critical drivers of system behaviour, and can cause overreaction, underreaction or oscillations
10 Material Stock and flows
11 Size of buffer stocks and their stability
12 Parameters, metrics, numbers

Level	Category (descriptions taken from D1.2 p. 23)	Leverage points	Manifestation in the extractives sector – events/actions/realities/implementation
Shallow	Parameters/Material *System parameters are modifiable, mechanistic characteristics (e.g., taxes, incentives and standards), or physical elements such as sizes of stocks or material flows; those are the ones typically addressed by policy makers*	12 Parameters, metrics, numbers *Those are standards and/or parameters to control/mitigate certain stuff (like a faucet) --> adjusting parameters is like how much you open the faucet and how quickly the bathtub is filling (or emptying); Parameters can be perceived as standards that control/cap/adjust e.g. ban of certain chemicals, maximum amount of polluted water discharge/polluting chemical discharge; maximum amount of air pollution or Co2 emissions or maximum number of people dislocated. In this way standards that secure certain level of material and immaterial stocks (see leverage point 10) such as levels of level of biodiversity, level of trust in a community, amount of unpolluted groundwater available etc).* *Parameters or numbers normally do not impact the system behaviour: i.e. standards that cap air pollution have not resulted in changing to other means of production entirely or abandoning the practice which is the source of pollution, etc.* e.g. parameters that affect buffers (level of water pollution / discharge of nitrogen or phosphor) affects water quality which affects the stability of the water body (=buffer) to perform important functions. Actions are targeting a decrease/increase in these system parameters (e.g. a reduction in CO2 emissions or a reduction in biodiversity loss without knowing whether the intended mitigation measures are having an overall impact on the system's performance - I.e. buffer, stocks & flows)	Practices (e.g. Taxes; voluntary standards); affecting parameters (number of people being dislocated or raising complaints); communities and species of animals killed or dislocated in a population pool; leading to biodiversity loss; percentage of revenues from mining activity; community complaints
		11 Size of buffer stocks and their stability *Normally, buffers are PHYSICAL entities, the size of which is critical but can't be changed easily. However, certain buffers can refer to immaterial entities such as the resilience of*	Ground water table (I.e. buffer to deliver water for different uses; ecosystems capacity to recover; capacity to capture soil carbon, built land/land cover (to maintain e.g. certain levels of biodiversity to provide

		a workforce to deal with stress due to overtime or harsh and dangerous working conditions. *A buffer can stabilize a system which is* important when the stock amount is much higher than the potential amount of inflows or outflows*: it is the capacity to balance stock and flow or the inflow and outflow of a system:* minimum breeding *population of a species to ensure its survival/viability to keep the population level (I.e. stock capacity of waterbodies or soil to purify certain pollutants; soil that buffer levels of acid, to maintain more than a minimum population of a species to ensure its survival/viability;* *Buffer stabilize a system – if the buffer becomes too big, it decreases the system's flexibility*	important ecosystem services or, ability to recover land for post-mining land-use;)
		10 Material Stock and flows *The stocks and flows and their physical arrangement, can have an enormous effect on how the system operates. It is considered as a low leverage point since it is hard to change when put in place, and thus, should be used efficiently. It represents the material (stock) that moves through (flow) the physical structure of the system (NOT rules, norms or institutions): think about i.e. a road system, wastewater treatment and plumbing systems, energy infrastructure, schools and kindergartens or population/workforce and its structure as physical social infrastructure --> if you have a baby boom, a couple of years later you must build schools and kindergartens, if the number of kids is again going down you have a lot of physical infrastructure, that one must maintain....* *Physical infrastructure is crucial for the functioning of a system – but perceived as a low leverage point since it is hard to change when put in place, and, thus, so should be used effficiently.*	Infrastructure in mining regions – roads, housing, buildings, energy infrastructure; water, material and energy flows; species population, human population structure or workforce of a mine site or local municipality

	System feedbacks are the interconnections between the elements of the system which steer reinforcing (positive) or dampening (negative) feedback loops **Feedback**	9 Lengths of delays in relation to the pace of the system change *Delays are critical drivers of system behaviour, and can cause overreaction, underreaction or oscillations that lead to potential irreparable system damage or collapse.* *Example: Measure trying to adjust your inventory (= your stock) while only receiving limited or delayed (non realtime) information of the current status of your stock, might lead to undershoot or overshoot from the preferred level of stock.* *Example: delayed information about future demand of electricity (common problem) --> you can't build electricity generation infrastructure that quickly, so the length of delay will drive the duration of over- and under capacity;* *Delayed information --> will lead to a maladjusted response while timely information, might lead to a timely response, but the delay of your measures (deployment of new technologies or infrastructure) might still lead to a delayed response (e.g. One could reduce the information about something and slow-down the delay process (environmental disaster – withhold information about extent of the problem – delay the appropriate response)*	Information provision systems that inform us about needed changes in a system: Monitoring systems and reports on environmental damage; rate of mineral exploitation; polluter pays instruments, adjustment of market prices, technological development and research (delay in dissemination of technology which has an impact); slow down the exploitation of minerals to dissipate the negative effect (e.g. contamination) over a longer period of time; early release or withhold of information
		8 Strengths of negative/balancing feedback loops to establish corrective actions *Negative Feedback loops are self-correcting. Those are feedback loops that slow down processes and support stability; it will keep the stock close to the goal (related to parameters, information flow and buffer size), correcting and limiting actions in a system*	Divestment from the mining sector, polluter pays instruments

		7 Strengths/awareness of positive and reinforcing feedback loops *Positive feedback loops speed up processes and are self-reinforcing* *The more it works – the more power it gains and works even more and/or better and/or quicker, positive feedback loops are considered positively but they can produce severe damage due to their self-reinforcement and the system runs out of control* *Example: incentives to sales (get a bonus when you sell more) – to sell more even though it damages the system much more than the benefits gained of it*	*Interest rates, for example, or birth rates, control the gains around reinforcing feedback loops* Net positive impact on biodiversity and ecosystem services around mine sites
Deep	Design *Characteristics that relate to the core structure of a system: rules, power and self-organisation; social structures and institutions that manage feedback and parameters*	6 Structure of information flow & access to information *Information flow is no parameter, no reinforcing or self-correcting loop – it delivers (new) information and/or provides access to (new) information/knowledge: e.g. regular reports on pollution, web-applications that provide easier access to information/monitoring results, or allows access to information that was not available before*	Accountability and reporting practices; supply chain due diligence, supplier audits, responsible mining practices; transparency of operations and sharing information;
		5 Rules & Institutions to build/ "operationalise" the *(new)* system *Rules and Institutions can be written or unwritten (tacit, e.g., norms); they build the rule-structure of the system (see LP 10 infrastructure system): rules can be laws, regulations, constitutions, punishments (if one decides to infringe certain rules or do not act as expected or show undesired behaviour); they can also demonstrate new formats or collaborations (e.g., cooperation between involved stakeholders – that cooperation can be formalized (e.g., contract/agreement establishing rules how we would like to cooperate, think about the statute of a bylaw organisation – they can arrange and (re-) formalize the rules of their collaboration, (i.e. rules how to implement a project, role and associated rights and responsibilities)*	SLO approaches *in terms of rules for collaboration of different actors* and new channels of cooperation & community engagement; new business models; policy incentives and regulations; standard setting and compliance of actors
		4 Power to change the rules & structure of the system	Self-organised mining communities (ASM) with new forms of labour and

		Structure at this leverage point means the structure of rules. A degree of self-governance and/or self-organisation to change and adapt rules. If and how one can create new structures (rules, institutions), add/omit self-correcting or self-reinforcing feedback loops, change the flow or access to information or set new parameters or make new rules	organisation with the power to influence the status quo;
	Intent *the system intent is concerned with the goal of the system and with the paradigm or mindset (i.e. underpinning values, goal, worldviews) of stakeholders which are shaping the development of the system*	3 Goal & intent of the system Overarching goal of the system: e.g. Economic growth, sustainability, social-ecological markets *The goal of the system is its normative dimension (describes how the world looks like that we want to live in, it's a social construct): if you think about an organisation (like a university or a company) it would be the 'mission statement', or a state's constitution often illustrates the goals of a state;* *The goal is important, because many other variables (e.g. feedback loops, material stock) are shifting with or adapting to the goal(s).*	Role of extractive industry within green economy & planetary boundaries; reduction of consumption; planning beyond mine life; improve workers well-being
		2 Mindset & worldviews in which the system is rooted *Societal paradigms are ideas or unstated assumptions about "how the world works" and how the society is structured and working; paradigms are hard to change, but there is no limit to paradigm chang* . For example, *the Soviet Union transformed property into common property, or property of the state based on their worldview of common ownership and eradication of social classes.*	Valuing social & natural capital and using Responsible Sourcing to preserve it; societal pressures to adopt RS practices in mining; focus on environmental, intergenerational & distributive justice
		1 Power & capacity to transcend & change worldviews *Capacity to transcend paradigms goes beyond challenging fundamental mindsets and worldviews (LP2): this LP addresses the most fundamental and basic values that lead to those worldviews and mindsets, mindsets and worldviews are not set and finite: they can be changed and transformed*	New sustainability narratives; transformative learning, dematerialisation & absolute material consumption reduction

		Example: nature can be understood as stock or capital to be transformed, indigenous communities understand nature as living goddess, worshipped and lived with; Transcending worldviews and challenging values require transformative and experiential learning .	

TABLE 4: 12 LEVERAGE POINTS WITH EXTRACTIVES SECTOR RELATED EXAMPLES

5.3 INTERPLAY OF LEVERAGE POINTS AND SUSTAINABILITY ASPECTS

In addition to the description above, we also contextualised the sustainability aspects - which can be interpreted as stakeholder derived goals aiming for an improved sustainable management of extractive land-uses – within the leverage point framework (see figure 4 below). To assess whether certain aspects support sustainable management or unfold transformative capacity that might trigger or incrementally support a more substantial transformation of the extractive industries, we link the SD aspects to the Leverage Points framework (detailed description in Deliverable D 1.2 "SD criteria – SUMEX Sustainability Framework").

It is not always clear-cut at which level to place an aspect, as much depends on where the system boundaries are drawn (company, community, region, nation or global transformation). Also, our aspects mostly consist of multiple, different elements and the transformative potential of them differs. Overall, this mapping shows that the SUMEX SD aspects are stronger aligned towards the edges of the LP-scale, i.e. towards so called shallow (material focused leverage points) and deep (design and (system's) intent) focused leverage points. Leverage points related to parameters and feedbacks might be supportive and incrementally improve single aspects towards sustainability, while the ones based on design and system intent are pursuing more systemic levels, related to the transformation of the economic system towards a green economy and to respect Planetary Boundaries. The number of aspects belonging to the category feedback (LPs9-7) is comparatively limited.

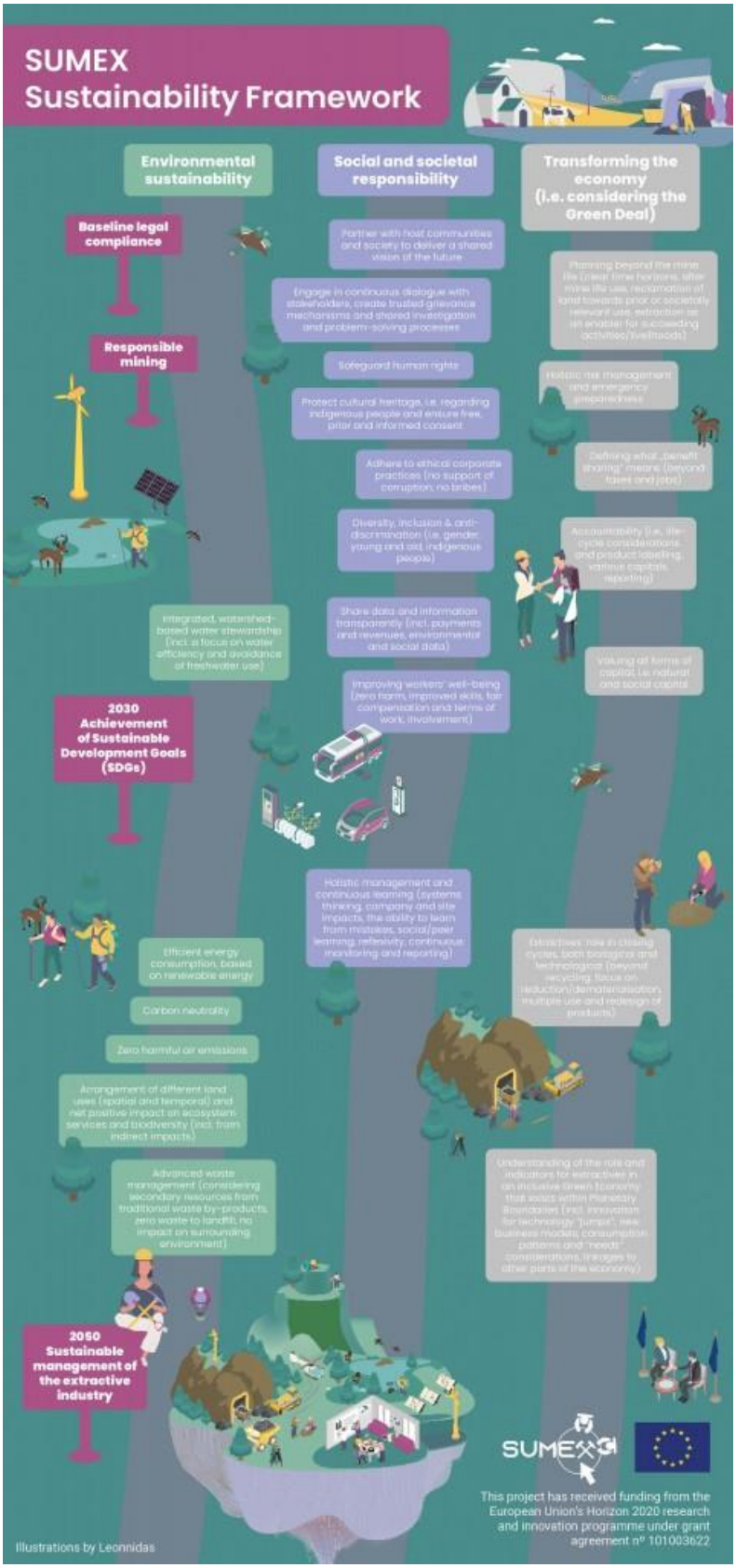

FIGURE 2: SUMEX SUSTAINABILITY FRAMEWORK – SD ASPECTS ALONG THE THREE DIMENSIONS. PLEASE CLICK HERE FOR A LARGER VERSION OF THE IMAGE.

Since SD aspects are framed much broader than 'action-oriented' LP-measures, they can address different LP-categories: for example, the SD aspect "Understanding of the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries (incl. innovation for technology "jumps", new business models, consumption patterns and "needs" considerations, linkages to other parts of the economy)" includes various leverage points, ranging from 'shallow' (LP1) , e.g. "new" indicators measuring important aspects of Planetary Boundaries to various 'deep' leverage points including e.g. new business models (e.g. carbon free extractive operations) (LP 5), the Planetary Boundaries concept and the Green Deal adapting the existing economic system (LP3 and LP2) and a change of "needs" and consumption patterns as a change of worldviews (LP2).

Similar, all of the environmental aspects include a 'shallow' component, where the focus is mainly on targets and indicators and a 'deeper' component, bringing along broader change. For example, a company could execute a project that sets a clear target-goal on reduced freshwater demand and thus increasing its water efficiency. As a stand-alone action, this action-oriented measure is placed into the category LP1 'parameters and numbers'. On the other hand, broad collaboration with different stakeholders in their watershed long-term plan, jointly agreed goals and jointly agreed rules, rights and responsibilities how to use and protect this watershed, considering the needs of all stakeholders and the environment, would belong to category LP4 "change to the rules & structure of the system" (LP4). While both pursue a more sustainable system, the first one is providing an adaptation measure, the latter one addresses more fundamental changes on a deeper system level (rules).

We only considered "Holistic risk management and emergency preparedness" to be a feedback focused (LP 8 and 7) sustainability aspect, since risk management and emergency preparedness influences positive and negative feedback loops when applied in a continuous plan-do-check-act way.

The mapping (see tables below) shows, that context is important for the appropriate placement of the SD aspects to different action-oriented categories of Leverage Points. For example, the aspect "Partner with host communities and society to deliver a shared vision of the future" can be a LP6 (because you share information), LP5 (because of new rules and institutions) or LP4 (as new governance format – depending if it really substantially changes the decision-making structure or creates new forms of decision making). In many cases, we based the placement on the assumption of an "altered" system. For example, "grievance mechanisms and shared investigations" could be LP 12; i.e. if it's done in a traditional, responsive/reactive way; i.e. if mediocre responses destroy trust within the community. However, if established in a new way, where the mechanism is trusted and where investigations are done in a shared way (instead of only by the company or government) in order to achieve meaningful responses, they can be seen as design focused LPs (LP 6-4). The same is the case with "free, prior informed consent": Is it just a tick box to fulfil a legal requirement or is it done in a way that changes the design of the system?

In this context, we did not consider two of the sustainability aspects ("safeguard human rights" and "Adhere to ethical corporate practices (no support of corruption, no bribes)") as leverage points at all. They are either part of legal compliance or should generally be considered as state of the art (minimum requirement).

SUMEX SD Dimension: Transforming the Economy (i.e. Considering the Green Deal)	
SUMEX SD Aspect: Understanding of the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries (incl. innovation for technology "jumps", new business models, consumption patterns and "needs" considerations, linkages to other parts of the economy)	
Leverage Point	Interplay of SD Aspects & leverage point
2 Mindset & worldviews in which the system is rooted	Planetary Boundaries, Consumption patterns and "needs" considerations
3 Goal & intent of the system	Green Deal (as a new means of developing economic growth = still the old system intent is the same)
5 Rules & Institutions to build/ "operationalise" the (new) system	new business models, technology jumps, linkages to other sectors of the economy (in an institutional context
SUMEX SD Aspect: Valuing all forms of capital, i.e. natural and social capital	
Leverage Point	Interplay of SD Aspects & leverage point
2 Mindset & worldviews in which the system is rooted	Valuing all forms of capital, i.e. natural and social capital
SUMEX SD Aspect: Defining what "benefit sharing" means (beyond taxes and jobs	
Leverage Point	Interplay of SD Aspects & leverage point
4 Power to change the rules & structure of the system (here structure means the structure of RULES)	Could also be here – depending on the focus and if that would change the ways and forms of cooperation
5 Rules & Institutions to build/ "operationalise" the (new) system	Defining what "benefit sharing" means (beyond taxes and jobs)
SUMEX SD Aspect: Accountability (i.e., life-cycle considerations and product labelling, various capitals, reporting)	
Leverage Point	Interplay of SD Aspects & leverage point
2 Mindset & worldviews in which the system is rooted	Various capitals
6 Structure of information flow & access to information	Reporting, life-cycle considerations and product labelling

SUMEX SD Aspect: Planning beyond the mine life (clear time horizons, after mine life use, reclamation of land towards prior or societally relevant use, extraction as an enabler for succeeding activities/livelihoods)	
Leverage Point	Interplay of SD Aspects & leverage point
5 Rules & Institutions to build/ "operationalise" the (new) system	Planning beyond the mine life (operational, self binding rules, new closure system, goals)
SUMEX SD Aspect: Holistic risk management and emergency preparedness	
Leverage Point	Interplay of SD Aspects & leverage point
5 Rules & Institutions to build/ "operationalise" the (new) system	Emergency preparedness (in the context of a continuous PDCA process)
6 Structure of information flow & access to information	Holistic risk management (in the context of a continuous PDCA process)

TABLE 5: EXAMPLES OF SD ASPECT & LEVERAGE POINT INTERPLAY IN THE SD DIMENSION OF 'TRANSFORMING THE ECONOMY (I.E. CONSIDERING THE GREEN DEAL)'

SUMEX SD Dimension: Societal & Social Responsibility	
SUMEX SD Aspect: Partner with host communities and society to deliver a shared vision of the future	
Leverage Point	Interplay of SD Aspects & leverage point
4 Power to change the rules & structure of the system	as new governance formats – depending if fundamentally changing the decision-making structure or new forms of decision-making procedures (i.e. Ecologically oriented governance structures; i.e. River Basin District Management focused on Ecological Quality Standards within the EU Water Framework Directive)
SUMEX SD Aspect: Engage in continuous dialogue with stakeholders, create trusted grievance mechanisms and shared investigation and problem-solving processes	
Leverage Point	Interplay of SD Aspects & leverage point
4 Power to change the rules & structure of the system (here structure means the structure of rules)	Engage in continuous dialogue with stakeholders
5 Rules & Institutions to build/ "operationalise" the (new) system	Trusted grievance mechanisms
6 Structure of information flow & access to information	Engage in continuous dialogue with stakeholders shared investigation
SUMEX SD Aspect: Protect cultural heritage, i.e. regarding indigenous people and ensure free, prior and informed consent	
Leverage Point	Interplay of SD Aspects & leverage point
2 Mindset & worldviews in which the system is rooted	Protect cultural heritage, i.e. regarding indigenous people

4 Power to change the rules & structure of the system (here structure means the structure of rules)	Prior and informed consent
SUMEX SD Aspect: Share data and information transparently (incl. payments and revenues, environmental and social data)	
Leverage Point	Interplay of SD Aspects & leverage point
6 Structure of information flow & access to information	Share data and information transparently
SUMEX SD Aspect: Diversity, inclusion & anti-discrimination (i.e. gender, young and old, indigenous people)	
Leverage Point	Interplay of SD Aspects & leverage point
3 Goal & intent of the system	Diversity, inclusion & anti-discrimination (i.e. gender, young and old, indigenous people) – done, but there are still societal / political discussions, e.g. Poland, Hungary
SUMEX SD Aspect: Improving workers' well-being (zero harm, improved skills, fair compensation and terms of work, involvement)	
Leverage Point	Interplay of SD Aspects & leverage point
3 Goal & intent of the system	Improving workers' well-being (zero harm, improved skills, fair compensation and terms of work, involvement) – culture change at company level
SUMEX SD Aspect: Holistic management and continuous learning (systems thinking, company and site impacts, the ability to learn from mistakes, social/peer learning, reflexivity, continuous monitoring and reporting)	
Leverage Point	Interplay of SD Aspects & leverage point
1 Power & capacity to transcend & change worldviews	Continuous learning, reflexivity
6 Structure of information flow & access to information	Continuous monitoring and reporting

TABLE 6: EXAMPLES OF SD ASPECT & LEVERAGE POINT INTERPLAY IN THE SD DIMENSION OF 'SOCIETAL & SOCIAL RESPONSIBILITY'

SUMEX SD Dimension: Environmental Sustainability	
SUMEX SD Aspect: Integrated, watershed-based water stewardship (incl. a focus on water efficiency and avoidance of freshwater use)	
Leverage Point	Interplay of SD Aspects & leverage point
4 Power to change the rules & structure of the system (here structure means the structure of rules)	Integrated, watershed-based water stewardship
12 Parameters, metrics, numbers	Water efficiency and avoidance of freshwater use

SUMEX SD Aspect: Efficient energy consumption, based on renewable energy	
Leverage Point	Interplay of SD Aspects & leverage point
12 Parameters, metrics, numbers	Efficient energy consumption, based on renewable energy
SUMEX SD Aspect: Carbon neutrality	
Leverage Point	Interplay of SD Aspects & leverage point
3 Goal & intent of the system	Company level transition plan in a societal context
12 Parameters, metrics, numbers	Carbon neutrality
SUMEX SD Aspect: Zero harmful air emissions	
Leverage Point	Interplay of SD Aspects & leverage point
3 Goal & intent of the system	Company level transition plan in a societal context
12 Parameters, metrics, numbers	Zero harmful air emissions
SUMEX SD Aspect: Arrangement of different land uses (spatial and temporal) and net positive impact on ecosystem services and biodiversity (incl. from indirect impacts)	
Leverage Point	Interplay of SD Aspects & leverage point
12 Parameters, metrics, numbers	Net positive impact on ecosystem services and biodiversity
SUMEX SD Aspect: Advanced waste management (considering secondary resources from traditional waste by-products, zero waste to landfill, no impact on surrounding environment)	
Leverage Point	Interplay of SD Aspects & leverage point
4 Power to change the rules & structure of the system (here structure means the structure of rules)	Advanced waste management (in the context of stewardship, integrating companies and at a regional level)
10 Material Stock and flows	Considering secondary resources from traditional waste by-products
12 Parameters, metrics, numbers	No impact on surrounding environment, zero waste to landfill

TABLE 7: EXAMPLES OF SD ASPECT & LEVERAGE POINT INTERPLAY IN THE SD DIMENSION OF 'ENVIRONMENTAL SUSTAINABILITY'

5.4 INSTITUTIONAL RESOURCE REGIME APPROACH

As highlighted in the SUMEX European Sustainable Development Framework report, the discourse around sustainability over the past 30 years recognizes the limits of traditional environmental policies, which tend to address only the use of environment as a sink for pollution and therefore regulate only the emission of pollutants. In response to that, the Institutional Resource Regime (IRR) approach offers a resource-based method to sustainability. In the IRR the focus shifts from pollution restriction to the management of "stocks" used from a resource in a way that will safeguard the reproductive capacity[4] of the resource systems (Knoepfel et al., 2007).

Against this background, IRR sustainability approach encompasses the SUMEX approach on planetary boundaries and sustainability since the IRR framework facilitates the analysis of the resource management practices and the regulatory measures associated with competitive (and sometimes conflicting) heterogeneous use situations. More specifically, the IRR explores the causal relation between the Institutional Regime in place (a combination of public policies and property rights), user constellation and their appropriation strategies on one hand and the condition of the resource on the other. The underlying hypothesis of the IRR is that the closer the resource regime moves towards an Integrated Regime, the higher the likelihood for the creation of conditions for the sustainable management of the resource.

One of the main reasons for selecting the Institutional Resource Regime (IRR) as a guiding framework for the in-depth analyses of the two use cases is its ability to conceptualize the complex institutional frameworks that regulate the use of resources in a way that echoes real-life arrangements. An institutional regime refers to all the formal rights and regulations governing the rival (competing) uses of a resource in a given area (Gerber et al., 2020). Such regulations derive from public policy, such as land use planning regulations, socio-economic and environmental impact assessment frameworks, permitting regulations (along SUMEX focus areas) and property rights legislation. As explained more at length in the SUMEX sustainability framework report, the IRR framework facilitates the analyses of Institutional Regimes which regulate use rights for the extraction of battery and construction raw materials, by combining analyses of public policies (public law) with the analyses of property rights (deriving from private law).

The IRR framework supports the investigation of the interplay between institutions and actors in terms of natural resource management, overcoming the limits of traditional public policy analysis. Public policy analysis explores the institutional complexity of public management of resources without capturing the importance of property rights in resource regulation. Property rights holders are usually in a strong position to interfere with the implementation of public policies that have a spatial manifestation (i.e. land use change for a mine site expansion) as a result of the constitutional guarantee of property. By including non-environmental policies in the analyses, and by aligning the analyses of use rights deriving from public policies with use rights deriving from property rights, the IRR framework helps the identification and analyses of "implementation deficits".

The application of the IRR framework for the analyses of the two use cases starts with the delineation of the boundary relevant to the management of the mining site, including the affected infrastructure and buffer zones. An inventory of the existing and planned uses of land is carried out, using Geographic Information System (GIS) whenever possible. This inventory serves as a basis for the identification of the user regime of the respective land uses, based on a comprehensive stakeholder analysis. Stakeholders include public and private entities with use rights deriving from property rights, or their representatives (owners, tenants, lease holders, housing associations, mining permit holders and/or concessionaires, associations of miners, farmers/ farmers associations, etc) and public authorities responsible for the elaboration and implementation of the policy

[4] In the case of extractive industries for battery and construction materials, the reproduction capacity safeguarded refers to land- and water-based systems affected by the mining sector.

instruments that regulate every land use included within the boundary of the use case (Mining Inspectorate (Sweden), Directorate General of Energy Policy and Mines (Spain), Regional and Local Authorities responsible for Land Use Planning, Environment Protection Agencies, Water Boards, Forest Management Authorities, etc). The stakeholder analysis will be supported through semi-structured interviews with identified key stakeholders, which will help formulating the problem (scarcity, identification of rivalries between different users, etc).

Qualitative policy analysis follows, covering the main policies that regulate use rights in the use case area. Here, the qualitative policy analyses will follow the two main dimensions used to define and categorize Institutional Resource Regimes: Extent and Coherence (see SUMEX SD Criteria Report for more). In terms of extent, policy analyses will define the extent to which all services and goods used are regulated, seeking to identify policy gaps that can lead to overexploitation of certain goods. In terms of coherence, policy analyses will focus on evaluating 1) Internal coherence of the public policies, vertically (amongst different levels such as EU legislation, international conventions, National legislation, Court decisions, Regional/Local regulations) and horizontally (amongst different policies affecting the resource, i.e. mining policy vs. water policy vs. land use policy) and 2) External coherence, assessing the correspondence between the target groups of public policy on one hand and the holders of rights in accordance with the Property Rights system in place, on the other.

Additionally, policy instruments (including permitting, land-use planning, access to land, socio-environmental impact assessment) are assessed based on the evaluation criteria efficiency, effectiveness, legitimacy and justice. The way such criteria is relevant will be illustrated in an example. In the case of Institutional Regimes of the land resource for instance, strict zoning rules might be introduced to guarantee the sustainable management of the land resource or to safeguard the health and safety of residents, i.e. buffer zones/strips around mining sites. However, such land-use planning policy might lead to a reduction in the value of land, which can constitute grounds for private landowners to demand compensation from public authorities. As a result, the implementation of this policy can either be overly expensive for the public authority (inefficient) or affect stakeholders disproportionately (if fronted only by taxpayers money for instance), or be impossible to fully enforce (ineffective). Internal and external coherence between public policies and private property rights is of crucial importance for an integrated institutional resource management and it is also likely to increase the efficiency, effectiveness, perceived legitimacy and justice in the implementation of a given policy.

In this case, effectiveness refers to the level of conformance of the effects of the policy with the aims of the policy. Effectiveness is closely linked to the internal and external coherence of policies, and is evaluated to help identify and tackle the aforementioned “implementation deficits” of certain policies. Policy efficiency refers to the input with which a given policy goal is achieved, taking into consideration that public authorities are under budgetary constraints and they do not want effectiveness at all costs. Usually, efficiency and effectiveness are assessed either as predictions before a law is put in place (ex-ante) or after it has been terminated, to measure its effect (ex post). In this case, the analyses will be conducted whilst the policy instruments under investigation are in action (ex durante). The ex durante evaluation, albeit not common, can help identify gaps or incoherence amongst different policy instruments and help improve legal practices (Needham et al., 2018). However, often the evaluation of policy effectiveness and efficiency does not take into account the skewness of the distribution of the positive and negative effects stemming from the implementation of a policy and how different stakeholders are affected disproportionately. Aspects of distributive justice resulting from the implementation of relevant policies will be part of the analyses, also because it often affects the perceived legitimacy and public acceptance of such policies. Evaluating the legitimacy and justice of certain policies is much more complex, as the perception of what is legitimate and just, is contextual and intrinsically linked to how the relationship between the citizens and the state is constituted. Semi-structured interviews together with content analysis of reporting from main media outlets will provide the main data to evaluate the perceived legitimacy of the policy instruments that regulate the activities in the use case sites.

Finally, this in-depth qualitative analyses will allow for an evaluation of the Institutional Resource Regime in place in both use cases, classified as explained in more detail in the SUMEX SD Criteria Report. Recommendations based on the identified aspects of internal policy incoherence (vertical and horizontal) as well as external incoherence (mismatch between policies and property rights stipulations), will support the evolution of the Institutional Resource Regime towards an integrated one, which can stir extractive industry towards sustainable practices. Such recommendations will also include instruments of land policy and of good governance which can help public authorities to choose a legal approach which its citizens will recognise as legitimate and just. Hence the in-depth analyses of use cases using the IRR framework will be mostly useful to public authorities, whose public activity covers areas relevant to sustainable extractive industry.

5.5 QUALITATIVE POLICY ANALYSIS – THE INTERPLAY OF PUBLIC POLICY ALONG THE SUMEX SUSTAINABILITY ASPECTS

The SUMEX project will investigate areas of public policy along the SUMEX sustainability aspects with an emphasis on responding to identified challenges of the use cases and bridging gaps identified in the meta-analysis. For example, in the use case of BOLIDEN AB SUMEX will investigate water management policy such as the European Water Framework Directive which is highly relevant for achieving SUMEX sustainability aspects (i.e. integrated water management) and respective global or EU sustainability policy goals (such as water- or biodiversity protection), but are perceived as inhibiting mineral exploration and exploitation in Sweden.
Next to the IRR, the qualitative policy analysis will look into the implementation of policy instruments on the regional and local level as this is most relevant for the analysis of the two use cases. For that purpose, the analysis will specifically look into evaluation criteria of effectiveness, justice and legitimacy. Building on the IRR, the SUMEX team will apply qualitative policy analysis and investigate policy instruments (including permitting, land-use planning, access to land, socio-environmental impact assessment) based on the evaluation criteria efficiency, effectiveness, legitimacy and justice. This work will include desk research and document analysis complemented by expert interviews from public administration on national, regional and local level.
In liaison with the IRR approach, the SUMEX team will analyse the internal coherency of policy regimes such as water management, as well as external coherency towards mineral policy within the respective use case. More specifically, the analysis will look into coherence of policy goals, content and instruments & programmes within (internal) and across (external) different policy regimes (i.e. water & mineral policy). European environmental policy instruments exhibit a notable impact on national policy in EU MS (e.g. via EU Directives). The diverse combination of EU policy objectives, the multiple national level policy instruments and potentially strongly diverging national mineral policy systems results in notable challenges regarding policy coherence. The BOLIDEN use case illustrates that the transposition of EU framework directives (e.g. Water Framework Directive) and resulting policy governance regimes (e.g. River Basin Districts and new administrative authorities with regards to implementation and participation), as well as vertical integration of newly formed water policy governance into existing governance structures requires further investigation for policy coherence. Hence, also the question whether public administration has the required resources available for effective policy implementation at the responsible administrative level is crucial regarding policy coherence and successful policy implementation.
With regards to the evaluation criteria justice, the policy analysis is looking into several sub-aspects thereof: The IRR approach is specifically investigating distributional justice of ownership and its relation to benefits and burdens. Procedural justice is linked to the idea of stakeholder participation in governance regimes and the way they can support policy agenda setting, design and implementation along different policy regimes.
Next to classic policy evaluation criteria of effectiveness and justice, legitimacy is an important part since it relates to long-term goals and interests of authoritative decision makers representing society's acceptance of their legitimate claims to govern (Wallner, 2008): Both the substantive as well as procedural elements of public policies along the entire policy cycle influence (the perception of) legitimacy held by both stakeholders and the public. Along the substantive dimension policy content should reflect dominant attitudes of stakeholders and,

if possible, the general public. Along the procedural dimension, aspects such as adequate stakeholder involvement, co-design processes in policy design and implementation or policy windows (of opportunity) outlined by Kingdon (1984) or appeals to garner support for an initiative influencing the legitimacy of public policies and the public authorities promoting them.

The qualitative policy analysis results gathered during the two use cases will be subject to a Delphi study approach to consolidate the results and receive expert feedback. The results of the Delphi Study will help identifying the actual mix (which instruments are combined into a policy mix), its performance (effectiveness, justice and legitimacy) and which strategies are to be deployed given situations (political agenda making, institutional framework).

ANNEX I: **FINAL LIST OF SEARCH WORDS FOR THE SECOND SCREENING**

1. Health & Safety		
Reinventing the economy		
Social and societal responsibility	**Improving workers' well-being**	Wellbeing/Well-being
		Health & Safety
		Zero harm
		Improved skills
Environmental sustainability		
2. Land use planning		
Reinventing the economy	**Extractives' role in closing cycles**	Recycle, reuse, redesign, reduction
		Closing cycles
		Biological/technological reduction
		Dematerialisation
		Redesign
		Post-consumerism
		Post-materialism
	Planning beyond the mine life	Post-closure
		Closing
		Rehabilitation
Social and societal responsibility	**Developing value together with society**	Collaboration
		Consultation
		Cooperation
		Social License to Operate
		Social acceptability
		Social Capital
		Natural Capital
		Participation
Environmental sustainability	**Multiple, co-operative land use**	Land use / land-use
		Landscape
		Land use conflicts
		Net positive impact
		Ecosystem (services)
		Biodiversity
	Integrated water management	Integrated Water management
	Enlightened waste management	Waste management
		Circular economy
		Recycling
		Secondary waste streams
		Valorisation of waste
3. Reporting		
		International standards

Reinventing the economy	**Understanding of the role and indicators for extractives**	Good practice
Social and societal responsibility	**Sustainable learning**	Sustainable learning
		Systems thinking
		Learning feedback loops
	Share knowledge and information	Transparency
		Share/sharing
		Knowledge/information
Environmental sustainability		
4. Permitting processes and Policy integration		
Reinventing the economy	**Benefit Sharing**	Benefit sharing
		Shared value
		Accountability
		Life-cycle considerations
		Reporting
		Natural capital
Social and societal responsibility	**Share knowledge and information transparently**	Share/sharing
		Knowledge/information
	Social capital	Social capital
	Taking responsibility for goods and services	Responsibility
		Green Economy
Environmental sustainability		
5. Socio-economic and environmental impacts		
Reinventing the economy	**Valuing natural and social capital**	Natural capital
		Social capital
		Social License to Operate
		Social cohesion
	Accountability	Accountability
		Life-cycle
	Extractives' role in closing cycles	Recycle, reuse, redesign, reduction
		Closing cycles
		Biological/technological
	Planning beyond the mine life	Post-closure
		Rehabilitation
		Closing
Social and societal responsibility	**Developing value together with society**	Collaboration
		Consultation
		Cooperation
		Social License to Operate
		Social acceptability
		Social Capital
		Natural Capital
		Participation

	Community well-being	Wellbeing/Well-being
Environmental sustainability	**Integrated water management**	Integrated water management
	Efficient energy consumption	Energy consumption
		Renewable energy
		Greenhouse gas emissions (reduction)
	Multiple, co-operative land use	Land use/ land-use
		Landscape
		Land use conflicts
		Net positive impact
		Ecosystem (services)
		Biodiversity
	Enlightened waste management	Waste management
		Circular economy
		Recycling
		Secondary waste streams
		Valorisation of waste
	Community well-being	Wellbeing/Well-being

SUMEX Project background

SUMEX is a 36-months project funded by the EC that started on 01.11.2020. The project supports the set-up of a European sustainability framework to improve the permitting procedure along the extractive value chain (prospecting, exploration, extraction, processing, closure, post closure activities), to guarantee timely decisions, a transparent governmental regulatory regime, appealing financial and administrative conditions and sustainable natural environmental and social conditions. The main mission of SUMEX is to assist policymakers and other stakeholders in seizing this opportunity.

To foster more, but sustainable mineral production in the EU, SUMEX (*SUstainable Management in EXtractive industries*) will establish a sustainability framework for the extractive industry in Europe. It does so by considering the Sustainable Development Goals, the European Green Deal, as well as EU Social License to Operate considerations and will involve stakeholders from industry, government, academia and civil society backgrounds from all across the EU.

This framework is then applied across the extractive value chain to analyse the mineral, as well as relevant economic, environmental and social policy frameworks of the EU, member states and selected regions along five focus areas – socio-economic and environmental impact assessments, land use planning, health and safety, reporting official statistics and permitting processes/policy integration-to find, or build, where needed, good practices or tools for an open access toolkit, which will be embedded in a broader Community of Practise (CoP) and which forms the basis for capacity building. This CoP will consider relevant stakeholder groups, with a focus on permitting authorities, across the EU, providing a digital platform and using a series of workshops and webinars. In SUMEX, the experience from other projects builds a powerful foundation for addressing the challenge of how best to implement sustainability considerations into the whole raw materials value chain.

Challenge: No common understanding of sustainable management in extractive industries

SUMEX supports the set-up of a European sustainability framework to improve the permitting procedure along the extractive value chain (prospecting, exploration, extraction, processing, closure, post closure activities), to guarantee timely decisions, a transparent governmental regulatory regime, appealing financial and administrative conditions and sustainable natural environmental and social conditions. The main mission of SUMEX is to assist policymakers and other stakeholders in seizing this opportunity.

Objectives of SUMEX

- Strengthen policy coordination and agenda setting along the mineral extraction value chain;
- Propose a uniform EU sustainable management in extractive industries context;
- Cluster with other projects to identify good practices and good practise principles;
- Identify good practises and principles for policy strategies and strategic approaches, coordination/integration and approaches and property rights regimes for different institutional systems;
- Build a toolkit with good practises, with a focus on access to land, permitting and policy coordination and integration;
- Identify stakeholder learning needs and requirements;
- Deploy an open access toolkit for capacity building across EU and with all stakeholders.

More info on https://www.sumexproject.eu/
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BIBLIOGRAPHY

Campbell, S. (1996). "Green Cities, Growing Cities, Just Cities?: Urban Planning and the Contradictions of Sustainable Development." Journal of the American Planning Association **62**(3): 296-312.

Endl, A. (2017). "Addressing "Wicked Problems" through Governance for Sustainable Development—A Comparative Analysis of National Mineral Policy Approaches in the European Union." **9**(10): 1830.

Hartmann, T. (2012). "Wicked problems and clumsy solutions: Planning as expectation management." Planning Theory **11**(3): 242-256.

In 1973, Horst W Rittel and Malvin A Webber introduced the term 'wicked problem' in planning theory.

Head, B. W. and J. Alford (2013). "Wicked Problems: Implications for Public Policy and Management." Administration & Society **20**(10): 1-29.

Hopwood, B., et al. (2005). "Sustainable development: mapping different approaches." Sustainable Development **13**(1): 38-52.

Jordan, A. (2008). "The Governance of Sustainable Development: Taking Stock and Looking Forwards." Environment and Planning C: Government and Policy **26**(1): 17-33.

Kemp, R., et al. (2005). "Governance for sustainable development: moving from theory to practice." International Journal of Sustainable Development **8**(1-2): 12-30.

McAllister, M. L., et al. (2014). "Unstable shafts and shaky pillars: institutional capacity and sustainable mineral policy in Canada." Environmental Politics **23**(1): 77-96.

Olsson, P., et al. (2006). "Shooting the Rapids

Navigating Transitions to Adaptive Governance of Social-Ecological Systems." Ecology and Society **11**(1).

Rossi, M., et al. (2021). "Trajectories of mining territories: An integrated and interdisciplinary concept to achieve sustainability." The Extractive Industries and Society.

van Zeijl-Rozema, A., et al. (2008). "Governance for sustainable development: a framework." Sustainable Development **16**(6): 410-421.

Verweij, M., et al. (2006). "CLUMSY SOLUTIONS FOR A COMPLEX WORLD: THE CASE OF CLIMATE CHANGE." Public administration **84**(4): 817-843.

Voß, J.-P., et al. (2007). "Steering for sustainable development: A typology of problems and strategies with respect to ambivalence, uncertainty and distributed power." Journal of Environmental Policy & Planning **9**(3-4): 193-212.

Whyte, K. P. and P. B. Thompson (2012). "Ideas for how to take wicked problems seriously." Journal of Agricultural and Environmental Ethics **25**(4): 441-445.

Wallner, J. (2008). "Legitimacy and public policy: Seeing beyond effectiveness, efficiency, and performance." Policy Studies Journal **36**(3): 421-443.

Kingdon, J. W. and E. Stano (1984). Agendas, alternatives, and public policies, Little, Brown Boston.