SUMEX DELIVERABLE D1.2

SD CRITERIA
SUMEX SUSTAINABILITY FRAMEWORK

Summary:
This report describes a sustainability framework for the European extractive industry established by the SUMEX project.

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1 EXECUTIVE SUMMARY

In this report we analyse the current debate regarding sustainability and the extractive industry in order to develop a sustainability framework suitable for the European extractive industry and to be used for the SUMEX project going forward. We conclude, that a holistic and integrated view on sustainability (i.e. considering ecological boundaries, interdependencies among dimensions and looking into wider societal paradigms beyond the framing of an industry sector) is needed. Given that the scope of the project is the European extractive sector, we do not engage in any sourcing and supply chain or resource justice issues concerning non-European extraction.

Using in-depth interviews and together with earlier results from the project, we were able to draw up the SUMEX Sustainability Framework, consisting of a narrative description of our approach, sustainability aspects relevant for the extractive industry in Europe and an evaluative scheme (with three different models suggested at this stage).

SUMEX sees legal compliance with all applicable legislation as the baseline and as a minimum requirement for companies in the extractive sector. But even in the EU legal compliance does by no means equal sustainable management of the sector. We suggest one common standard to describe what responsible extraction should mean in the EU: We suggest to use the IRMA (Initiative for Responsible Mining Assurance) Standard to describe the criteria that a responsible extractive operation should fulfil today. But once again, and as IRMA itself admits, responsible management does not mean sustainable management. In order to meet this criterion, we suggest for the industry to transition, aligned with the European Green Deal, from responsible extraction towards a future state of sustainable management, as expressed through our sustainability aspects below, over a time period up to 2050, via the milestone of contributing towards achieving the Sustainable Development Goals (SDGs) in 2030.

In addition to describing sustainability aspects, the SUMEX Sustainability Framework (see Figure 1) also includes evaluation or decision-making criteria in order to assess a policy's, project's or operation's, etc. sustainability. In SUMEX we assessed three very different schemes: i) Leverage Points, ii) The Seven Questions to Sustainability and iii) the Institutional Resource Regime. They all serve different purposes and hence we decided to include all three of them in our framework.

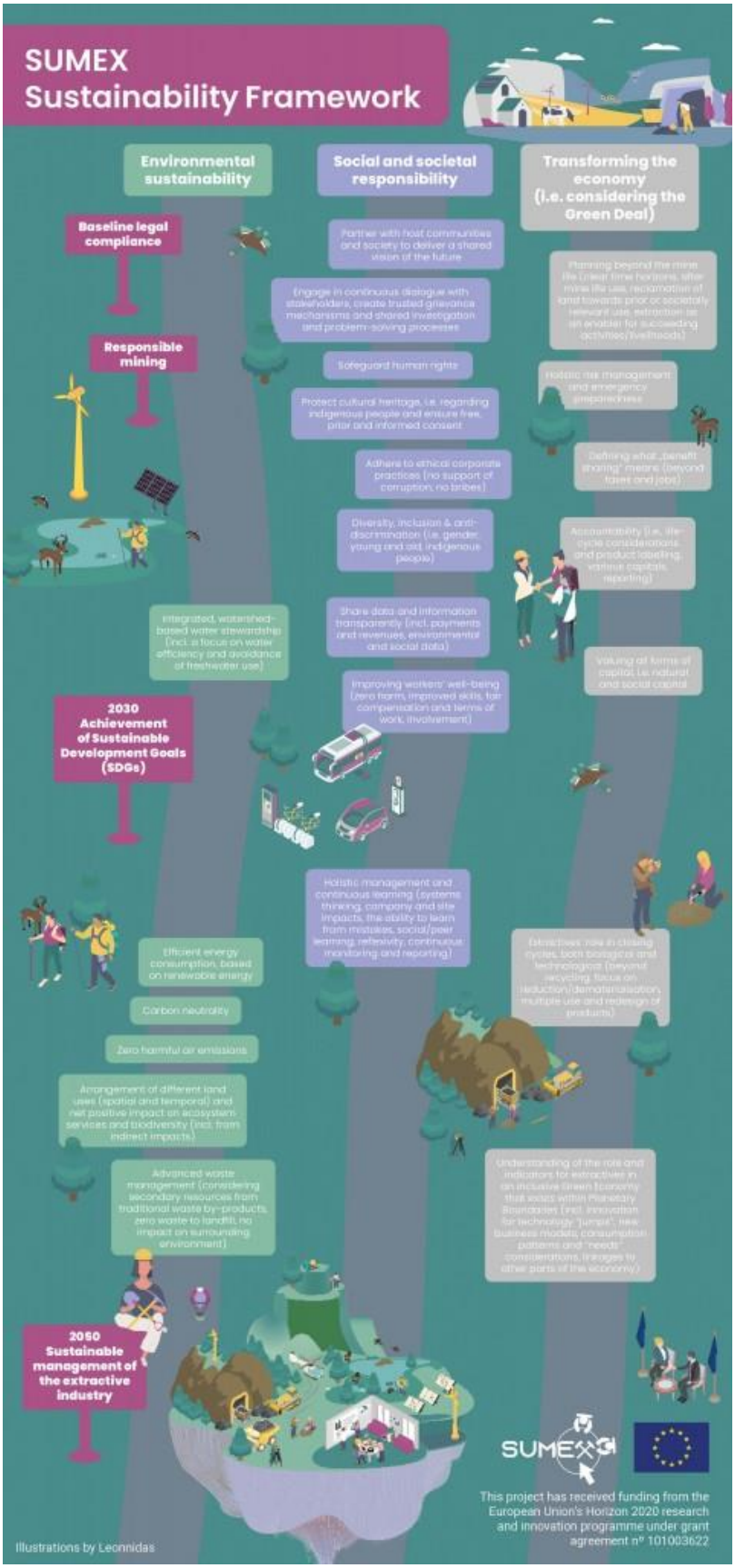

Figure 1: SUMEX Sustainability Framework. Please click here for a larger version of the image.

2 INTRODUCTION

The Horizon 2020 project SUMEX (**Su**stainable **M**anagement in **Ex**tractive industries; for more detailed information check the project background section at the end of this document or the project webpage: www.sumexproject.eu) supports the set-up of a European sustainability framework for the extractive industry. The project started in November 2020 and in February 2021 an interim report "D1.1 - European Sustainable Development Framework", describing the key principles of this framework and the process how we derived them, was published.

This report builds on the mentioned interim report. It includes a description of what sustainability and sustainable development (SD) in extractive industries (see chapter 3) means. Through in-depth interviews with stakeholders and further desktop research we validated and developed further the initial sustainability aspects as well as the areas considered to be most relevant for sustainable management of the extractive industries in the European context. Subsequently these were put into the recent context of legal requirements, responsible extraction and the United Nation's Sustainable Development Goals (SDGs). In addition, we investigated three different multi-variable decision-making models, that can be used to assess sustainability, i.e. inform the relative influence and/or impact in processes.
In chapter 4 of this report, we describe three models we consider most relevant for the SUMEX project. Together, these form the SUMEX Sustainability Framework. In chapter 5 and 6 we test it on three real life examples in Austria, Greece and Finland to see if it indeed "fits the purpose", and describe how the SUMEX Sustainability Framework links to the five focus areas of the SUMEX project: permitting, environmental and social impact assessments, land use, health & safety and reporting.

Within the SUMEX project, the sustainability framework will be used as criteria to identify and contextualise good practice examples within policies of the European Union (EU) and projects along SUMEX's five focus areas. These will be synthesised and structured for an open access toolkit, which will be utilised for capacity building, learning and awareness raising actions in a SUMEX Community of Practise (CoP) in later stages of the project.
For the European extractive industry, the SUMEX Sustainability Framework acts as a roadmap towards sustainability, as it brings together and maps current and future priorities of how the extractive sector can transform towards sustainability. In addition, it includes evaluative criteria that stakeholders can use to assess the sustainability of projects, extractive operations or mineral raw material products.

The way we conceptualised and developed the SUMEX Sustainability Framework takes into consideration:

- The geographical and institutional focus of the SUMEX project is the European Union, hence the SUMEX Sustainability Framework focuses on aspects relevant for the extraction of mineral raw materials (excluding energy raw materials) within the EU. For extraction activities outside of the EU, other sustainability aspects might also be relevant, e.g. poverty reduction. Also, aspects of intra-generational resource justice ("Global North vs. Global South") with regards to sourcing practices, due diligence and supply chain need to be considered. Only then could the framework also be relevant for raw material producers outside the EU and raw material importers sourcing outside the EU.
- Deep sea mining is outside the scope of the SUMEX project. The illustrated sustainability framework focuses on terrestrial aspects - the extraction on land. Whilst in theory the framework could be utilised for deep sea mining, the application of its sustainability aspects would certainly be very different. The current scientific and societal discourse indicates a lack of data and regulations for deep sea mining practice to be done sustainably. Some of the recently defined challenges are not well understood or ill-defined [1, 2, 3] and knowledge from terrestrial extraction is not necessarily transferrable to deep sea mining. It should therefore be governed as a distinct extractive industry type [4].

- Given that especially the extraction of construction materials in Europe is dominated by small and medium sized companies (SMEs), concerns were raised whether the SUMEX Sustainability Framework should also be applicable to SMEs specifically. The current layout is generic to a degree that it does not differentiate between different companies or size of operations. However, future capacity building, learning and awareness raising actions might more prominently support SMEs in their journey towards sustainable management.

2.1 IN-DEPTH INTERVIEWS

From February to June 2021, we conducted in-depth interviews with 30 stakeholders (40% female and 60% male respondents), from 13 different EU countries, as well as Canada and Switzerland. Interviewees were selected to illustrate a broad diversity and an appropriate cross section of the different stakeholder groups engaged in the extractive industries in Europe, starting with all members of the SUMEX advisory board. Figure 3 summarizes the country distribution of the interviewees, Figure 3 the stakeholder group distribution.

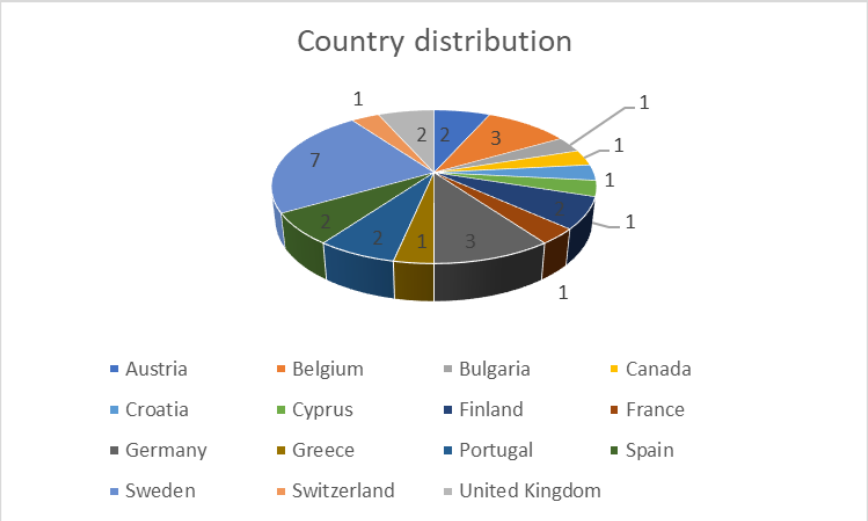

Figure 2: Country distribution of the interviewees

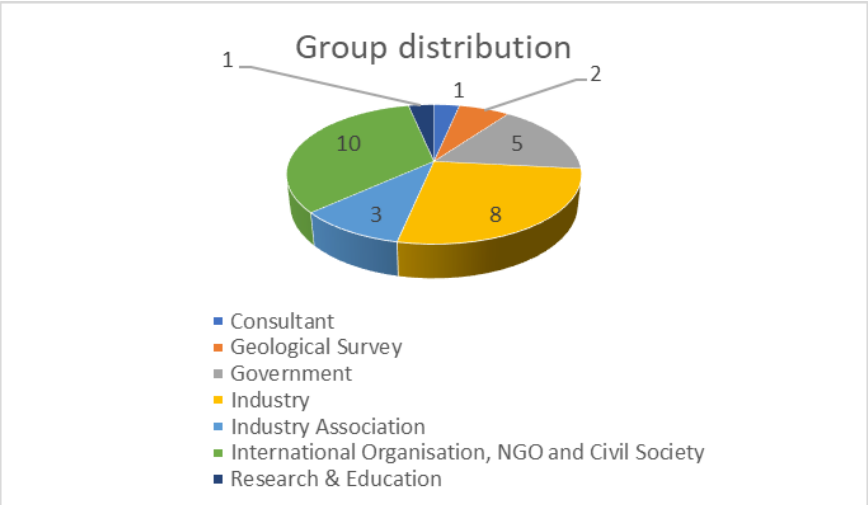

Figure 3: Stakeholder group distribution of the interviewees

We used a semi-structured approach to these interviews; the guiding questions can be found in Annex 1.
In summary, we discussed with the interviewees what sustainability means for them generically and for the extractive industry specifically, what they see as key sustainability aspects, asked them for examples regarding tensions and good practices, before in a final step bringing their responses back to the SUMEX project by comparing their responses with the list of the preliminary sustainability aspects from the D 1.1 report. The interviews, all done online via videoconference, lasted on average one hour (45 mins to 1.5 hours). All of them were recorded and transcribed for analysis. In this content analysis, we mainly looked at people`s approaches towards sustainability, examples of good practises and tensions and views on the sustainability aspects.

3 SUSTAINABILITY AND SUSTAINABLE MANAGEMENT IN THE EXTRACTIVE INDUSTRY

There is now global consensus about the dire need and importance of the concept of sustainable development to provide quality of life that is equitably shared and achieved under conditions not deteriorating the world's ecological functioning [5, 6, 7]. Despite progress in academic circles on how to define, operationalise and implement SD and its decades of implementation in the world of practitioners, there is widespread evidence [8, 9, 10] it did not deliver on solving humankinds most pressing challenges. Against this background, Drummond and Marsden, explain that sustainable development is "seemingly simple, intuitively rational, and self-evidently expedient" which leads to its immediate attraction in the world of public policy and business alike [11].

3.1 A BRIEF DISCOURSE ON THE EMERGENCE OF SUSTAINABLE DEVELOPMENT

In scholarly debates sustainable development has come a long way over the last three decades and has been the focus of discussion along different aspects of 1) its definitional and conceptual nature [12, 13, 14, 15], and 2) its implementation frameworks and application by practitioners in business and policy alike [16, 17, 18, 10].
Despite a myriad of academic research and since its first application in the world of practitioners, scholars argue that the concept has been repeatedly miss-interpreted or -used due to its normative nature and the different backgrounds of professionals dealing with the concept [19, 20]. Some even go further by claiming that due to its vagueness the concept stands on 'shaky grounds' [21]and due to its normative nature camouflages underlying worldviews and paradigms, and, thereby hinders progress on revealing agendas for effectively delivering outcomes [13, 22].
Therefore, the next section briefly outlines key principles and underlying assumptions following of what most recent scholarly debates consider a sustainable development approach.

3.1.1 THE INTEGRATION OF HUMAN SOCIETY & ENVIRONMENT DIMENSIONS

Most commonly reported in research and practice [14, 23, 15, 24], a conceptualisation of sustainable development often represents isolated aspects or dimensions of what constitutes environment, society, and economy. Such a separation distracts from underlying fundamental connections between economy, society and the environment and leads to the assumptions that trade-offs can be easily made across these dimensions. Instead this approach indicates a continued conceptual divide between the environment and humanity [25, 14]. While part of the debate in sustainability science tries to accommodate this dichotomy by describing these interdependencies ("integration frameworks" [26, 27, 28]; nexus research [29, 30]), others argue to abandon

system dichotomies of human and nature entirely, and, instead, subsume them under new concepts such as "a safe and just space for humanity" [31] or "a good life for all within planetary boundaries" [32] or relational thinking and values of human nature relations [33, 25]. As a consequence, to better inform decision-making for sustainable development fundamentally relies on understanding human-environment interactions with regards to both trade-offs and synergies [26, 34] as well as integrating human society and environment perspectives into implementation approaches [6].

3.1.2 ECOLOGICAL BOUNDARIES – AN APPROACH WITHIN LIMITS

Since the Club of Rome emerged with the idea of absolute limits to societal and, in particular economic growth [35, 36], the debate was reemphasised by a new paradigm of planetary boundaries for maintaining the global bio-physical system [37, 7, 31]. This discourse has been reinforced by the adoption of global Sustainable Development Goals and the "isolationist view" or "cockpit-ism" these individual goals and their targets impose on the concept of sustainable development. The current discourse is heavily criticised for not taking account of these limits, and the need to redefine sustainable development therein [6, 29]. Hence, SD frameworks do not only need to make transparent these transgressions of limits, but also apply solutions that rectify transgressions.

3.1.3 PARTICIPATORY AND DELIBERATIVE ENGAGEMENT

Due to its normative nature of what "development" in sustainable development encompasses, SD as a concept has the potential to "hide" or "camouflage" underlying values of its advocates [13, 24, 19, 22, 38]. To overcome the challenge of normativity, for example, some suggest "to engage in deliberative learning processes with societal actors, with a view to jointly reflecting on existing development visions and creating new, contextualized ones" [19]. Therefore, SD approaches should comprise of deliberative and participatory approaches: Examples such as transition arenas or Labs [39, 40]; the 'energetic society' suggested by Hajer et al. [41], or 'spaces of hope' by David Harvey [42] are new governance arrangements for actors to develop a common approach for SD.

3.2 NEW APPROACHES FOR GOVERNING THE TRANSITION TOWARDS SUSTAINABLE DEVELOPMENT

Abovementioned conceptual considerations – integration of human-environment perspectives, absolute ecological boundaries, deliberative approaches - coupled with the complexity as well as uncertainty for understanding human-environment relations requires new approaches for implementing SD. Most importantly, one needs to investigate what are the necessary intervention and management requirements for both public and private sector [38, 17].

There exist a set of core characteristics for the governance for or management of SD. These characteristics respond to several inherent challenges of the concept such as manifold and diverging actor's interests, its complexity, institutional inflexibility to address uncertainty with regards to, for example, global ecological boundaries, and fragmentation in political and institutional systems [26, 43]. In order to account for the abovementioned challenges, several approaches to understand and analyse societal transition or transformation processes have been developed (e.g. Multi-level perspective approaches [44], clumsy solution approaches [45] or leverage points [46].

Moreover, there are shortcomings in current international SD frameworks to enable a sustainability transformation (the Sustainable Development Goals), which amount to a lack of an adequate and effective

framework for implementation and governance [16, 26, 47, 48, 49, 50]. In parallel, there is now fundamental critique and concern from sustainability science that the dominant global paradigm of quantitative economic growth in the form of increasing material and energy use, even in a green or circular economy [51, 52] is not able to resolve the sustainability crisis of, for example, failing ecosystems and increasing global inequality [53, 54, 55].
Considering both requirements for SD management and inadequacy of current implementation frameworks, there is a need for more systematically and holistically changing interventions addressing society's underlying worldviews and paradigms that address the root causes of today's sustainability crisis [25, 56].

3.3 STAKEHOLDER PERSPECTIVES FROM A PRACTISE POINT OF VIEW: AN UNDERSTANDING OF SUSTAINABILITY & BALANCING TENSIONS

The "what" and "how" of a sustainable development or sustainability approach (often these two wordings are used simultaneously and often are interpreted differently) in the extractives sector gathered widespread attention over the last three decades. Generally, according to, for example, Han Onn & Woodley [51] there are different levels of "depth" of how the extractive industry applies sustainability. They distinguish sustainability according to the benefits provided by extractive activity: 1) benefits limited to shareholders; 2) benefits for society and the environment at large; and 3) benefits focusing on intergenerational aspects for society and environment even after extraction ceased. Today most extractive sector activities engage in an approach that moved beyond a narrow view of only needing to maintain operations in a sustainable manner [58, 59, 60, 61]. In the below mentioned part, we reflect on the perspectives and views of different European stakeholders by looking into i) what is their general understanding of sustainability relating to the different conceptual underpinnings in section 3, and ii) what is their view on different tensions and trade-offs across the social, environmental and economic aspects being part of an integrative concept of sustainability.

3.3.1 THE GENERAL UNDERSTANDING OF SUSTAINABILITY

The different abovementioned view points and applications are very much reflected in the perspectives of different European stakeholders as expressed in the interviews we conducted, of what sustainability and implementation thereof means for the extractives sector. Against this background and as outlined in the previous paragraphs on conceptual considerations of SD and sustainability, the normative perspective and views of practitioners (worldviews and values forming different paradigms underlying ways of thinking of how sustainability should be framed and implemented) form the baseline for engaging in sustainability endeavours (i.e. why certain practices are developed and applied and what is the underlying assumption). SUMEX interviews with European stakeholders in the extractives sector represent this diversity of viewpoints and interpretations of what and how a sustainability approach for the extractives at the current stage is interpreted.
Concerning societal benefits interviewees responded in a way that can be considered as the 'social' or the local context of sustainable development which either relates to 1) corporate internal operations such as workers health & safety or 2) corporate external impact on society which mostly referred to social licence to operate (SLO; although its understanding even varied strongly). Against this background, some interviewees referred to what SLO means as a common journey among the many stakeholders involved in the local context of an extractive operation or also what has been coined by Schneider [38] that "finding common ground on what sustainability and implementation of the 2030 Agenda means in specific contexts" and jointly reflect with societal actors on existing development visions.
Beyond the scope of corporate management and community benefits, some argued extractives' benefits extend to society beyond the local scale with regards to their contribution to the transition to a more environmentally

friendly and renewable energy provision (critical mineral raw materials for renewable energy technologies) as well as mobility (e.g. rare-earth elements for e-mobility). Contrasting this view, very few understood the extractive sector sustainability perspectives as what Han Onn and Woodley [40] labelled as 'Transitional Sustainability' focusing on intergenerational benefits for society and environment (e.g. taking into consideration planetary boundaries). Scholarly debates perceive this as an upcoming trend indicating intergenerational equity of extractive sector issues with regards to both benefits and impacts [62, 63, 58], in an industry where most of the debate of sustainability is focused on the local context of community. None of the interviewees depicted a view of extractives activities beyond the re-definition of an understanding of SLO and community benefits such as outlined by, for example, a shared value paradigm, which could both re-define and secure a social licence to operate [64, 65, 66] as well as support implementation of SDGs [67].
A view beyond extraction and integration of the extractive sector in value chains and into the broader architecture of society's production and consumption patterns was very rare among interviewee perspectives. Value chain perspectives where the emphasis on responsibility is shifting towards down-stream players and other parts of the mineral value chain or focus shifted from the local to the global with a view to unequal distribution of ecological impacts between "producer" and "consumer" countries are a representation of a more systemic view on minerals. These views have been hardly addressed by practitioners and remain a "side-walk" for the sustainability discourse in the extractives. Instead, more integrated and holistic approaches towards resource governance and sustainability as addressed by the UN and the International Resources Panel [62] as well as recent academic discourse [69, 70, 71] were mentioned.

3.3.2 INTEGRATIVE VIEWS ON SUSTAINABILITY: TENSION AMONG HUMAN SOCIETY & ENVIRONMENT DIMENSIONS

Conceptualisation of sustainable development or sustainability often represents isolated aspects or spheres of what constitutes environment, society, and economy [14, 34, 23]. Non-integrative conceptualisations and applications or a separation distracts from underlying fundamental connections between economy, society and the environment and leads to the assumptions that trade-offs can be easily made across these dimensions and, thus, balancing becomes important for sustainability approaches.

Generally, balancing takes place on different levels:

1. companies and the extractive industries are balancing those aspects within their business approaches and sustainable management of their operations;
2. public policy and decision making is balancing within the public domain different policy domains, negotiating and balancing different public interests and aspects of the common good; and
3. balancing between public and private interests (e.g. permitting procedures) and thus balancing sustainability.

Pursuing sustainability and balancing those sustainability aspects inevitably triggers and illustrates tensions in different parts of the broader extractive system. Here, tensions are identified based on current policy- and extractive practises: this approach shows (a) where extractive industry requires support and capacity building to achieve more sustainable management practises, (b) provides insights for policy makers on national and EU level where additional measures are required to pursue the transition to sustainable Europe, and (c) it informs the IRR- and policy analysis as well as required needs and questions for capacity building and the Community of Practise.

Tension between the Economic and Environmental Dimension

The interview data illustrate various tensions attempting balancing private (extractive development) and environmental aspects as public interest. While in the MINLAND project (www.minland.eu) biodiversity and

nature protection were addressed as the most pivotal competitive and conflicting land-use, the interviewees emphasized on water availability, current and future water supply as a notable tension. Water supply was particularly addressed in the context to climate change and a related increasing number of droughts and the relevance of a stable water supply for other sectors such as agriculture. Particular tensions between extractive operations or mineral development and biodiversity conservation/nature protection were identified. This tension manifests in particular in designated Natura 2000 areas, which provide a network of protected areas in the European Union. There are several attempts to implement extractive activities in Natura 2000 areas in Europe [45, 46] and open the discussion about mineral extraction in Natura 2000 Sites. These developments are perceived critically: *"(…) so Natura 2000 habitats by law are not able to enter, but it's there are conversations on that by states to actually dig that in. And this is obviously a huge concern for us. So that's something I would never call sustainable, even not responsible, right."* (International organisation, NGO and civil society representative). Tensions between economic competitiveness and climate change were identified, pointing towards European emission certificates that from a stakeholder's industry perspective lower the economic competitiveness of the European extractive sector. This perspective can be contrasted with the perception that the European extractive industry transfers sustainability costs to citizens of the producing countries: *"So we think it's a double externalisation here, for the first to have been there probably forever where in particularly legacy issues and closure issues haven't been taken seriously and responsibly by mining operators (…) externalisation of costs to other economies (…)."* (International organisation, NGO and civil society representative).

Tensions between Environmental and Social Dimension

These tensions were the least addressed ones: respondents addressed possible tensions in fringe areas, where a strong focus on nature protection and environmental considerations might result in the decline of local jobs and cause unemployment and social hardship in areas with limited options to change into other sectors than mineral extraction (Geological survey representative). Another tension addresses the growing demand for battery materials and metals for green energy technologies that are required to meet climate policies and pursue a societal transition towards more sustainability. While there is a general commitment that this transition is required, less agreement is perceived regarding the sourcing of the required materials and low social acceptance of extractive operations: *"There are many communities that say, okay, you're saying that you need lithium for this transition, for your batteries, for your renewable energies, but we just don't want it here, no matter how well it's done, and that's playing out all over the world. I think the big tension is, how do you increase extraction while honouring what communities want, which is in many cases simply no extraction."* (International organisation, NGO and civil society representative).

Tensions between Economic and Social (Equity, Justice) Dimensions

Tensions between economic and social dimensions of sustainability are broadly discussed in the extractive sector, mainly in discourses and practises of social acceptance and the Social Licence to Operate, e.g. by MIREU [47]. The SUMEX data collection illustrates additional tensions such as the quality of life and local liveability that is considered threatened and/or lowered by extractive operations. In this context characteristics such as general liveability, increased emissions (dust, noise), decreasing property values and possible damages, and the possible loss of their landscape and surrounding environment are mentioned: *"(..) 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. It's an issue also that they will not be able to graze their cows there, that the water might be polluted. But also, the purer landscape ideas was an issue."* (International organisation, NGO and civil society representative).

The data show the need to balance community interests and those of extractive industries, stressing the need to consider *"stakeholder rights and stakeholders rights and needs to use land, I think those are becoming more and more extreme issues, especially in Europe because we're quite densely populated in a way. (…) So you are always in the neighbourhood of somebody (…) And I think the one thing that to me is hasn't really evolved as*

much in Europe is the whole social aspects of mining. But so land-use and right to use land and then maybe in the Northern European context, it goes into the indigenous issues as well as for me and who has the right to choose and who has the right to use the land and power – so that's the one conflict." (Industry representative). Hence, considering traditional land-use practises and embracing its cultural aspects is another pivotal tension (International organisation, NGO and civil society representative). These tensions on social and community acceptance are not perceived unique to the extractive sector, but are considered the case for any major industry (Industry association representative).
Another central tension identified is that of a dignified life and decent employment for workers. The feedback provided addressed that in the extractive industries social aspects of sustainability are limited to health and safety issues and fail to cover a comprehensive understanding of social sustainability, including decent working conditions, right to organise, continuous education (not limited to the middle management and above) and to live a dignified life.

Tensions related to changes of the intent of the system

The interview data shows that tensions are emerging due to changes of the intent of the system, mainly low carbon transitions and the shift to a so-called green economy. Changes and alterations of the system's intent are on the level of deep leverage points and cause a re-alignment of all subsequent leverage points on the design-, feedback- and material level. Those tensions address several issues, such as the sourcing of metals and materials required to pursue that transition amid rising societal and community resistance against mineral extraction and exploration. This tension is related to the longstanding practice to *"pushing dirty industries like industries like the extractive sector to parts of the world where we don't have to see it first-hand, there is now increasing pressure that we actually need to do it in our countries."* (International organisation, NGO and civil society representative). Hence, whilst a general commitment for sustainability transitions, such as low carbon transitions or the energy transition and the sourcing of such transitions, seem to exist, the broader societal discourse on resource injustice and the uneven (re)distribution of benefits and burdens of the extractive sector has only recently been moving from academia and civil society to become a global debate due to the press coverage on critical minerals. Taking a broader perspective on extractive industries, that also includes the consideration of emissions of the products in use: *"And so I think you probably need to have that more holistic look, not just a local level benefit, but broader societal benefit or cost."* (International organisation, NGO and civil society representative). Another respondent stresses that a more profound debate is required, deliberating which degree of (social and environmental) impacts of extractives industries is acceptable.

Perceived challenges in balancing sustainability dimensions on the company level

Modest knowledge and skills regarding sustainability and climate issues on company level were mentioned as possible challenges that might aggravate sustainable management. In parallel, frontrunner companies appear to be increasing their efforts regarding capacity building on the company level and the importance to gain top-down commitment to implement sustainability aspect on all company levels: *"Do you have the expertise? (…) It's been noticeable, certainly in most of the bigger players (…) they're recruiting more people from sustainability backgrounds, it's just more a focus and getting expertise, or getting their executive team to focus more on this area – one or two members of the executive team. (…) So, it's not really about cost. It's more about how they're prioritizing their high achieving executives to go on that area, more than perhaps other areas (…) So yes, there's not so much cost, but definitely more about who is being put in place to look at this within the bigger players."* (International organisation, NGO and civil society representative). Regarding balancing social sustainability aspects, the lack of conversations between extractive industries and communities is considered an obstacle for the sustainable management: *"And I think a lot of conversations have been by the mining industry, especially also in Europe as an obstacle to getting conversation with communities, but they don't see the risks, the risk are way higher than the obstacles they have to overcome (…) So if they don't know the landscape they are working in, if they don't get in contact with the communities, it's a huge risk for them.*" (International organisation, NGO and civil society representative).

Perceived challenges in balancing sustainability dimensions on policy level

The fragmented and/or incomplete transposition and/or implementation of European Directives were mentioned. The interview data let assume that there might be particular implementation challenges in EU member states located in Eastern Europe, who are also facing additional challenges: limited resources, weak institutions and possible propensity for corruption were mentioned. From a policy perspective, modest alignment, policy coordination, modesty or lack of horizontal integration, and fragmented information flow and distribution of information were identified as challenges for the sustainable management of extractives.

3.4 ENGAGING AND FRAMING SUSTAINABILITY WITHIN THE EUROPEAN EXTRACTIVES SECTOR: THE NEED FOR A HOLISTIC AND SYSTEMIC APPROACH

Current progress on sustainability and its perception by the industry is under heavy critique and considered as partly ineffective from a reporting and business model perspective, [65, 75, 76] if not unethical with regards to some practices and their impacts and benefits to society [40, 59, 77]. The current academic discourse on extractive sector practices [69, 78, 79] argues that industry stakeholders should take a more holistic as well as more pro-active approach of sustainable development. Therefore, many studies indicate that the extractives sector concept and approach of benefits to society should go beyond the local scale and address it on more general societal terms [62, 63, 58, 80].

Following work of Han Onn & Woodley [40] on transitional sustainability at corporate level, despite the prominence of studies on mining and SDGs [81] Segura-Salazar & Tavares [82] depicted the discourse on sector level and indicated that there is little evidence about holistic and integrated views on sustainable development (i.e. considering ecological boundaries and interdependencies among dimension). Segura-Salazar & Tavares [82] supported by earlier work [75, 78, 83] outlies several shortcomings of existing extractive sector sustainability frameworks: 1) the need to explore the sustainability of the sector beyond the frontiers of the organization (e.g. a recent development is that some extractive companies are now looking at themselves as material providers, allowing them to think more about recycling and beyond extraction alone), 2) underestimation of synergies and trade-offs between the sustainability dimensions, as well as 3) Intra- and intergenerational equity, aiming at the sustainability of mineral resources in a long-term horizon. Against this background, system transcending as well as paradigm changing concepts in the extractives sector can act as important leverage point for both re-defining and securing a Social Licence to Operate [64, 65, 66], as well as the current discourse on Sustainable Development Goals [67]. However, the current application of standards, tools and frameworks [84] in the extractives sector as well as stakeholder perspectives investigated in the context of SUMEX reveal the absence of a comprehensive approach and framework for understanding sustainability and its complexities in Europe.

At the same time, efforts for international resource governance and sustainability in raw material management approaches during the last decade are on the rise [69, 68, 85], while also governments adopted new strategies suggesting a sustainability approach [86, 87, 88, 89]. However, recent studies indicate [71, 82, 90] a lack of understanding within these approaches in how far the extractive sector contributes and has a significant impact on the sustainability and SDGs and what could be potential interdependencies (creating tensions & trade-offs across different sustainability aspects).

Against the background of beforementioned conceptual considerations, thus, SUMEX engages in a sustainability approach by addressing the concept both holistically with regards to its underlying assumptions (see paragraphs above):

- A sustainability framework that builds on conceptual considerations of sustainability and is applied and reflected in the context of the extractive sector (giving substance to the concept in terms of sustainability aspects along major topical areas relevant to the extractive sector and reflecting major conceptual dimensions of sustainability).
- A holistic approach for assessing the extractive sector practices for potential to bring about sustainability transformation (systematically looking into wider societal paradigms) beyond the narrow framing of an industry sector, by applying a systems perspective (leverage point analysis) that is able to fundamentally address the root causes of a sustainability crisis.

Taking a systemic perspective, we recognise the fact that there is an unequal distribution of impacts and benefits between highly industrialised economies and developing or emerging economies with regards to extraction. However, the project's scope and framework exclusively address the European extractive sector, and, therefore, do not engage in conceptualisation or assessment of practices with regards to sourcing practices, due diligence and supply chain considerations targeting non-European extraction.

4 SUMEX SUSTAINABILITY FRAMEWORK

As described in the sections above, this report builds on a previous report of the SUMEX project, D1.1 "European Sustainable Development Framework", where we explored definitions and frameworks for sustainability and sustainable development and their implications for the extractive industry in Europe in order to develop initial, preliminary priorities and attributes for sustainability. We conducted in-depth interviews with extractive industry stakeholders (see chapter 2.1) to inform the final framework which will serve as a guide for the SUMEX project to identify good practise examples, concentrating on the five focus areas of SUMEX: permitting, environmental and social impact assessments, land use, health & safety and reporting.
In addition to the interviews, we also looked for evaluative criteria to be used for assessing and/or decision making in the sustainability context. As a result, we found three evaluation schemes, described in chapter 4.3 and started to explore them further as described in chapter 6 to see which would best fit the later stages of the SUMEX project.

Together with the results from the previous work described in D1.1 "European Sustainable Development Framework", we were able to draw up the SUMEX sustainability framework, consisting of a narrative description of our approach, sustainability aspects relevant for the extractive industry in Europe and an evaluative scheme (with three different models suggested at this stage).
From the interviews it became clear very early on that stakeholders had very different views on what sustainability actually means (see chapter 3), "how far this framework should go" and how quickly things would have to change. The first part of our framework is therefore in response to these differences a narrative description of the approach.

4.1 FROM LEGAL COMPLIANCE TO SUSTAINABLE EXTRACTION

SUMEX sees legal compliance with all applicable legislation (local, regional, national and international) as the baseline and as a minimum requirement for companies in the extractive sector. But even in the EU, with member states with advanced economies, more or less well-developed democratic systems and strong governance of the extractive sector (i.e. through mining and environmental legislation), legal compliance does by no means equal sustainable management of the sector. In fact, governance systems are very diverse across Europe [91, 92] and hence we suggest one common standard to describe what responsible extraction should

mean in the EU: We suggest to use the IRMA (Initiative for Responsible Mining Assurance) Standard [93] to describe the criteria that a responsible extractive operation should fulfil today. In addition, we suggest for the industry to transition (which is mostly aligned with the European Green Deal) from responsible extraction towards a future state of sustainable management, as expressed through our sustainability aspects below, over a time period up to 2050, via the milestone of contributing towards achieving the Sustainable Development Goals (SDGs) in 2030. Some of the goal descriptions contained in our aspects might be relevant earlier than in 2050 and there, action should not be pushed backwards.

4.2 SUSTAINABILITY ASPECTS

These 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. The sustainability aspects consider the European Green Deal and its aspiration to transform the European economy to an inclusive, circular and carbon neutral economy in 2050. As already stated above they are a mixture of topics which should be considered as part of responsible mineral extraction in the present (e.g. emergency preparedness and risk management, diversity and anti-discrimination) and future aspirations (e.g. defining the role of extractives in a green economy, carbon neutrality) which the sector needs to move towards going forward. Figure 4 gives an overview of the sustainability aspects in a temporal context.

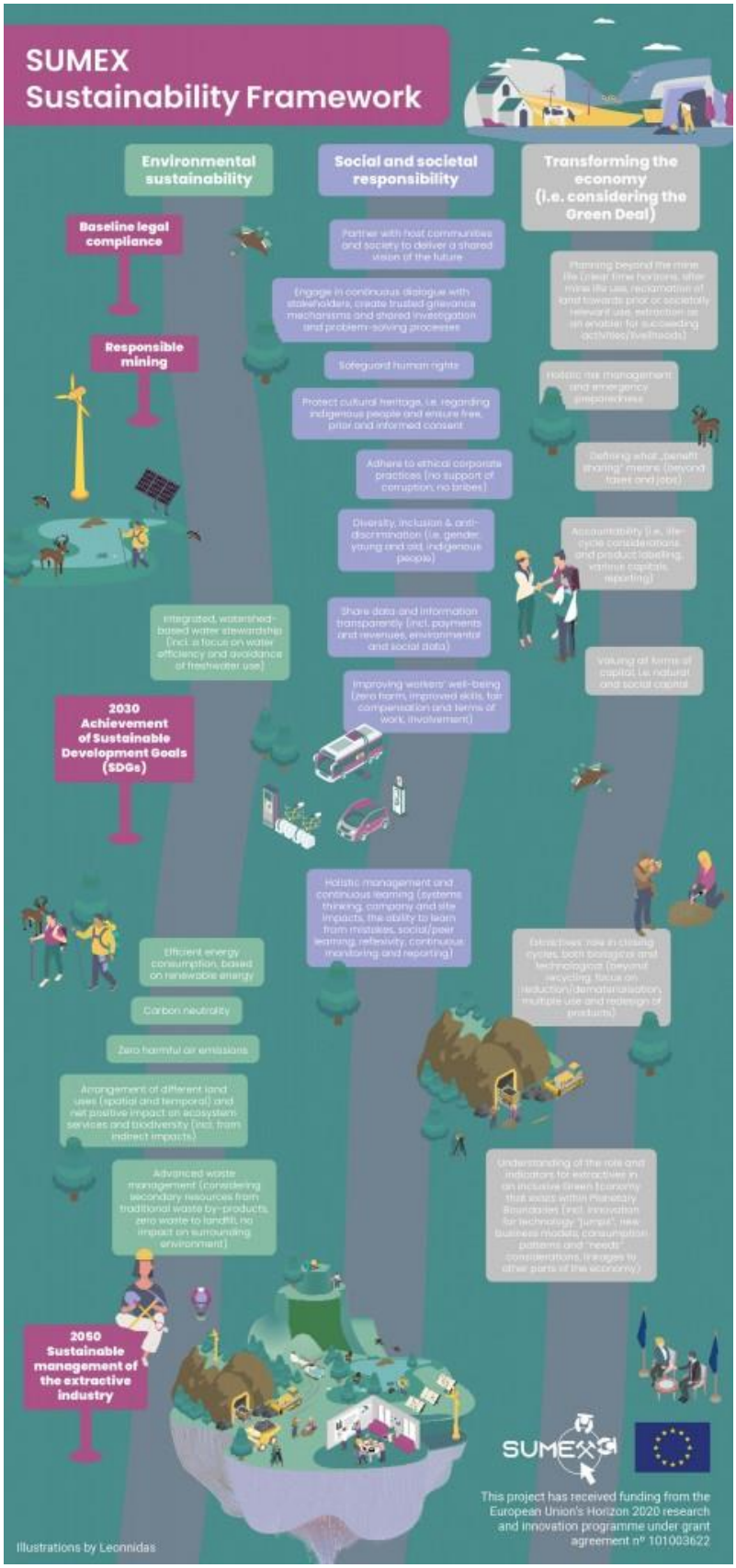

Figure 4: SUMEX Sustainability Framework. Please click here for a larger version of the image.

4.2.1 WHAT DO THESE ASPECTS MEAN IN MORE DETAIL

Environmental sustainability

As discussed in previous sections, our planet has biophysical boundaries, which are e.g. expressed in the concept of the Planetary Boundaries [37]. These boundaries describe limits which mankind and its (economic) activities should not trespass. The extraction of minerals has many impacts on the environment of which we evaluated the main ones (in the context of Planetary Boundaries) and for which the sector will need to find ways on how to significantly reduce its impact, often towards zero or even a positive impact.

Mineral extraction and processing often require large amounts of water. Integrated, watershed-based water stewardship means comprehensive and jointly planned management of all water systems, company internal and external ones, where all waters are used as valued resources and water efficiency and avoidance of freshwater use are key [97]. Thus, a flexible, resilient water infrastructure that can respond to various scenarios can be achieved. Equally, the extraction of minerals and processing is energy intensive. Companies need to continuously optimise and innovate their processes to improve energy efficiency. With the aim of carbon neutrality, energy consumption needs to be predominantly based on renewable energy. Other harmful air emissions also need to be reduced to zero.

The use of land for mineral extraction and its impact on biodiversity and ecosystem services is another important aspect. Land use stakeholders, including the extractive industry, need to work together to find collaborative ways on how to use the land both spatially but also temporally; before, during and, considering especially the finite nature of mineral extraction (see above), after the extraction phase. Of particular concern in the context of land use are impacts on biodiversity and ecosystem services, where the sector will need to find ways on how to turn these from being negative towards net positive. This should also include the consideration of potential indirect impacts, caused by related industry activities (e.g. additional economic activities due to better transport infrastructure or renewable energy provision). Lastly, and also due to the transformation to a circular economy, advanced waste management systems will be required. These comprise secondary resources from traditional waste by-products (e.g. waste rock and tailings), the continuous reduction of waste generated and the treatment and/or storage of waste without the need for landfilling and any impacts on the surrounding environment.

Social and societal responsibility

Different views (locally and globally) can potentially influence the progress of an extractive project. The lack of social acceptance or SLO (social license to operate) can even lead to the project being hindered or failing. Engaging with stakeholders, ranging from the community affected by the extractive operation to broader society, helps to achieve active collaboration between the company and society in order to define and deliver a shared vision of the future [54]. Part of this is the continuous engagement with stakeholders to give them the opportunity to actively participate in the process, deliver procedural and deliberative justice and take an active role in decision-making. Trusted grievance mechanisms and shared investigation and problem-solving processes enable all parties involved to raise critical questions, concerns and complaints without hesitation. It also ensures that the issues raised are addressed in the best possible way. Data and information are shared with stakeholders in a transparent and timely fashion, where required at a site and not the company level. This includes payments and revenues, as well as data from environmental, health and safety.

Extractive companies adhere to ethical corporate practices, including for example that corruption and bribery must neither be supported nor tolerated. Human rights (e.g. free and prior informed consent, and participation) and cultural heritage have to be respected and safeguarded. This, in particular, includes also special consideration of indigenous people like the Sami in Sweden and Finland. Also, diversity and inclusion are supported on the one hand and discrimination is eliminated on the other. This refers to factors such as gender, age, skin colour and origin of the people involved in the extraction project, as well as indigenous people and different cultural or religious groups.

The workers well-being in a company is fundamental. To ensure and improve the objective and subjective well-being of workers, ongoing efforts are made. The basis is a zero-harm culture, health and safety, as well as fair compensation. Continuous improvement of skills and the involvement of workers in the company processes are to be analysed.
As already stated in the Mining, Minerals and Sustainable Development (MMSD) process 20 years ago, the extractive sector needs a culture of continuous learning and engagement with societal actors in order to see the bigger picture of how a site, a company, the sector or its products are embedded in an ever-changing society and environment (see also chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**). It also requires reflexivity and deliberation of a form of learning in the sense of a jointly developed vision and values that guide a theory of action for certain practises [19, 96].

Transforming the economy (i.e. considering the Green Deal)

The European Green Deal [94] intends to transform the European Union's economy towards a green, circular and inclusive one ("leaving no person behind"). Extractives play, and will continue to do so, an essential role in achieving the goals of the European Green Deal, as they are a basic requirement for the transition. However, the extractive sector needs to understand its role in this transition (e.g. which raw materials will be required and which will not be), how to measure this role with indicators as well as what types of improved and innovative technologies and new/modified business models will be required. It also needs to deal with changing consumption patterns (usage instead of ownership) and considerations of "needs" (e.g. what is the role of mineral raw materials for producing luxury items like jewellery in such an economy). A key part of such a green economy will be closed cycles with highly increased material efficiencies, reduced dependency on imports of minerals overall and from irresponsible sourcing practices, and a demand that can be partly covered by secondary sources. Different loops such as sharing, prolonging, remanufacturing and recycling (see Circular Economy System Diagram of the Ellen Macarthur Foundation) will be crucial. Therefore, circularity will significantly impact the extractive sector well beyond recycling, with a focus on reduction/dematerialisation, multiple use and redesign of products. Waste products can be re-used as a secondary product for other industrial processes (e.g. full value extraction), which means also closer linkages to other parts of the economy/avoiding enclaves. The sector will need to examine life-cycle considerations regarding its products and product labelling and will be accountable for them.
Natural capital that needs to be considered by the extractive sector are for instance biodiversity and ecosystem services. Social capital refers to relationships and networks between individuals and groups, as well as the resulting ability to secure or maintain resources, knowledge or information. Knowledge of their value, which is not only monetary, but also includes ethical, moral or cultural ("values") dimensions, facilitates their inclusion in accounting and reporting systems and decision-making processes and enables natural and social capital to be reflected accordingly. For natural capital in particular, this knowledge is important for conducting an appropriate appraisal of services and benefits to ensure either its restoration or its continuation and sustainable use. As the extractive industry has the potential to generate huge benefits, it is important to define what benefit sharing in the context of a shared vision of the future (see below) means, considering all dimensions of value and i.e. beyond paying taxes and creating jobs. The question is how these benefits can and should be shared between stakeholders, i.e. since the current "social contract - jobs vs. environmental impacts" will change with ongoing automatisation in the near future[1].
All of the above is also relevant for planning beyond the life of the mine or quarry right from the start when planning for the operation begins, to ensure that the extractive company has budgeted the financial resources for the phase after mineral extraction has been completed and considered the full variety of social and environmental aspects. This includes the closure of an operation, required socio-economic transitions to enable

[1] In SUMEX value or benefit do not only refer to financial value, but we use these terms to refer to stakeholder values broadly. This is aligned for example with the OECD, see https://www.oecd.org/dev/Framework_Public-Private_Collaboration_FINAL.pdf

succeeding activities/livelihoods and the subsequent land-use. The same goes for risk management, where the extractive sector needs to exert a holistic approach towards risks and opportunities in the context of this transformation, but also needs to do better concerning emergency preparedness in order to prevent events with catastrophic consequences going forward.

4.3 EVALUATIVE CRITERIA

In addition to describing sustainability aspects the framework also includes evaluation or decision-making criteria in order to assess a policy's, project's or operation's, etc. sustainability. In SUMEX we assessed three very different schemes: i) Leverage Points; ii) The Seven Questions to Sustainability; and iii) the Institutional resource regime.
They all serve different purposes, as described below, and hence we decided to include all three of them in our framework. In chapter 5, we tested these three schemes for application on real life operational examples.

4.3.1 LEVERAGE POINTS

Approaches, such as the Leverage Points (LP) [98, 46] or Social Tipping Elements [99] 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). Both, tipping points and leverage points are points in the respective system at which even small changes can lead to significant change; hence they are referring to systems' change processes, in which a system is reorganising (e.g. towards sustainability) and enters a new state. Previous work has identified two specific processes in which LPs are emerging: (i) regime shifts, which are large-scale changes in structure and function of entire systems; and (ii) transformations, such as sustainability transformations, which are fundamental reorganisations of a system [100]. Such change processes involve technologies, rules and structural change, attitudes, values and behaviour or knowledge- and information flows [101]. Critics stress, that severe sustainability issues such as climate change or the exhaustive exploitation of non-renewable mineral resources, are only fragmentedly targeted and thus unfold only limited impact [101]. This limited impact might be related to the way sustainability interventions are identified and/or at which points possible measures are placed in a system. Hence, many actions remain on the level of mitigation and alleviating symptoms of unsustainable management. The LP approach provides a tool and lens to assess sustainability interventions and 'sustainable management' measures regarding their potential to initiate change on different levels in a (sub-)system (see Figure 3).

Leverage points can occur individually or as chains or cascades, operating at different points in the system individually and/or sequentially, simultaneously or across different scales, policy sectors and time periods. Meadows [46] suggests a hierarchy of 12 LPs subdivided in shallow and deep leverage points: shallow leverage points cover items such as buffers, stock and flows or feedback loops; deep leverage points cover information flow, institutions and structural components, the goal of a system and its underpinning paradigm and values. The twelve LPs can be shelved into four main system's characteristics [98]: parameters, feedbacks, design and intent. Those four categories resemble core system's characteristics (see Table 1).
Interventions at different LPs should not be considered competitively but rather complementary with one another. While interventions and measures across 'shallow' LPs are quite popular among policy makers and managers [60] 'deep' LP are difficult to target, hard to change and reach beyond traditional political election cycles. Figure 3 shows the leverage points approach adopted for the extractive industries. Different examples show potential interventions at different deep and shallow leverage points of the system.

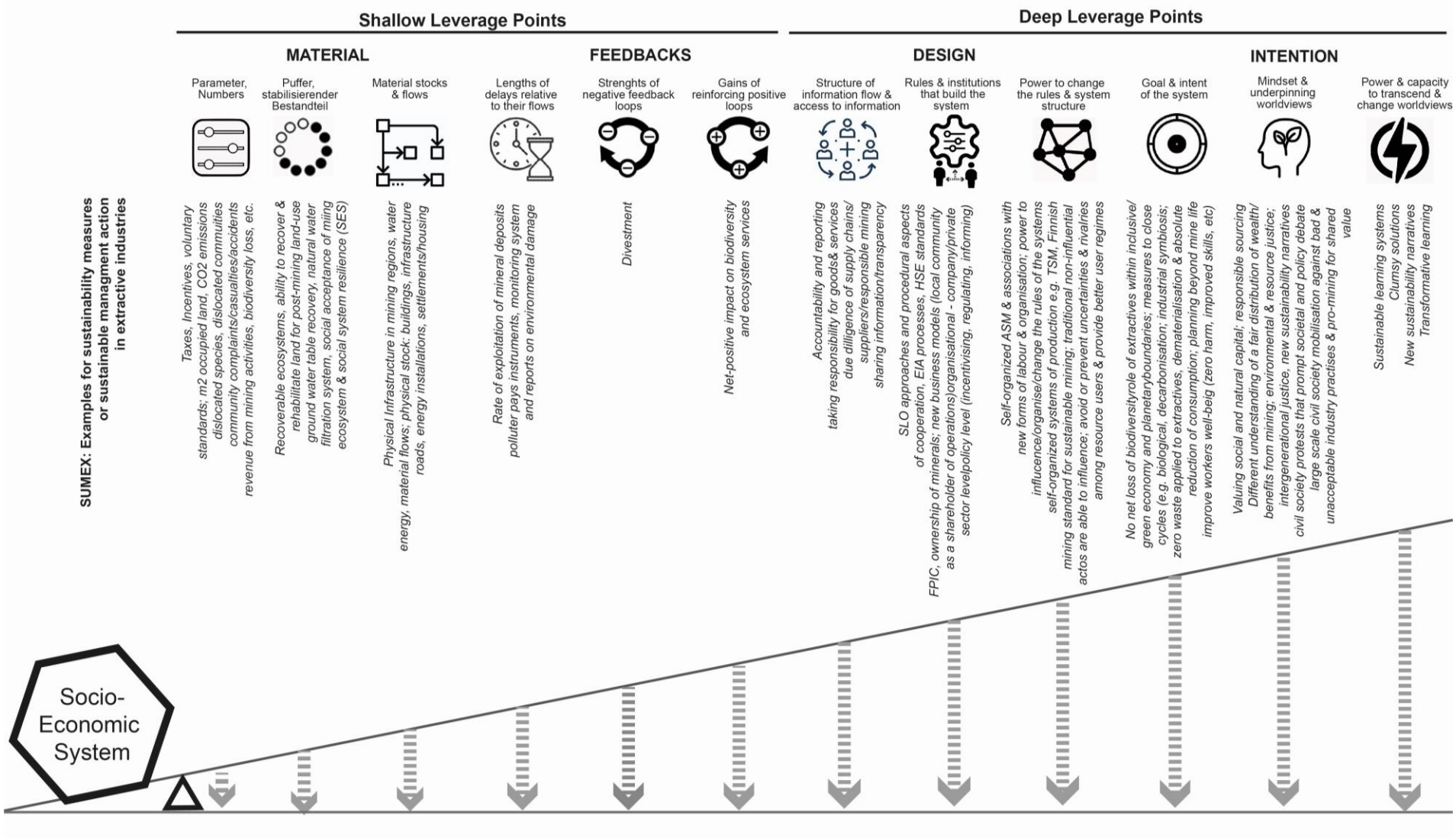

Figure 5: Leverage Points Perspective adapted to the subsystem of the extractive industries.

Table 1: 12 different types of leverage points that describe 4 main characteristics of a system

System Characteristics		Leverage Points		
Parameter	Modifiable, mechanistic characteristic (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	**Shallow Leverage Points**
		11	Size of buffer stocks, relative to their flows	
		10	Material stocks and flows, e.g., transport and infrastructure	
Feedback	Interactions between elements that impact the internal dynamics of a system or that provide information regarding desired outcomes	9	Lengths of delays, relative to the rate of a system change	
		8	Strengths of balancing feedback loops, relative to the impacts they are trying to correct against	
		7	Gain around positive, reinforcing feedback loops	
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 flows and the access to information (who does and does not have access to information)	**Deep Leverage Points**
		5	Rules and institutions that build the structure of the system	
		4	Power to add, change or self-organise the system structure	
Intent	Underpinning value, attitudes, goals and/or worldviews of actors and stakeholders that shape the direction of a system, the other 3 characteristics are directed towards the intent	3	Goals of the system	
		2	Mindset, paradigms and underpinning worldviews in which the system is rooting	
		1	Power to transcend paradigms	

Advantages for taking a leverage points perspective are:

1. Bridging causal/system dynamics and normative/value-based dimensions of system change, allows to shelf different types of interventions into a joint framework;
2. it acknowledges the complementarity of different LP interventions and recognises the importance of the interplay of both; while 'shallow' ones might pave the way for deeper and more fundamental transformative 'deep' Leverage Points, they are acknowledged as similarly important where interventions have a longer time-frame and are much more difficult to launch;
3. providing a boundary object that serves as joint basis for different stakeholder and disciplines [103].

With regards to society, over the past decades, the issue of sustainability was dealt with under the umbrella of a global, socio-cultural paradigm that equated "sustainable" with "economic growth" [56]. In parallel, there is now fundamental critique and concern from sustainability science that the dominant global paradigm of quantitative economic growth in the form of increasing material and energy use, even in a green or circular economy [52] is not able to resolve the sustainability crisis of, for example, failing ecosystems and increasing inequality [54, 55]. A change of paradigm would require actions changing its most radical manifestation, following a dramatic shift of perception that involves a fundamentally new way of seeing and thinking, of relating to the world and to ourselves [56]. Several scholars argue that next to leverage point targeting techno-scientific approaches, sustainability transformations need to be complemented by cultural, psychological as well as spiritual dimensions of the individual and human society – reflected in values, worldviews and beliefs manifested in paradigms [96, 104]

As regards the study of leverage points in any system (i.e. the extractive sector) it becomes clear, that LP higher on the scale (i.e. intent-transforming) are going beyond what can be considered a singular system or sector rather taking a nested or holistic system's perspective (e.g. economic system & global biophysical system):

essentially engaging only in a extractives sector perspective without considering the wider societal implications of values, worldviews and beliefs that influence a sub-system (i.e. extractives) is an important question of framing the LP perspective. In addition, for sustainability transitions to become truly transformative, altering the system's dominant paradigm ultimately shapes the rules on which it operates and designs interventions that address the root cause rather than symptoms of societal challenges (such as climate change or distributional justice).

The leverage points approach has been used as analytical lens in different policy sectors, such as food, food waste and food security, [105, 106] energy systems [101] and environmental management [105]. Thus, the approach appears feasible for various policy sectors to assess and evaluate different measures and interventions regarding their potential to improve or transform a system towards sustainability. The assessment of different interventions through the lens of leverage points allows the identification of the mix of different measures including 'deep' leverage points, such as measures that target resource justice or the (re-)distribution of benefits and burdens; the assessment of alignment and coordination of LPs on the policy and operations level; and the appraisal of chains of LPs: while some interventions might alleviate impacts from the extractive industry and focuses on sustainable management of extractives they might be paving the way for more profound and systemic transitions.

4.3.2 THE SEVEN QUESTIONS TO SUSTAINABILITY

As part of the Global Mining Initiative's (GMI) analytical process called Mining, Minerals and Sustainable Development (MMSD), the North American stream of the MMSD in 2002 published "The Seven Questions to Sustainability - How to Assess the Contribution of Mining and Minerals Activities" [107]. This report "*set out to develop an approach to assessing how a mining/mineral project or operation contributes to sustainability*". The initiative led to the design of a framework to guide the assessment of whether or not a project or operation's net contribution to sustainability is positive over the long term. For each of seven components, a question is posed as a means of assessing whether the net contribution to sustainability over the long term of a mining/mineral project or operation will be positive or negative.

Figure 6 shows the original seven questions from the MMSD North America project.
For each of the questions, the report includes more detailed descriptions, as well as "ideal answers" on how this issue can be resolved, including sample indicators and metrics. They are intended for all stages of an extractive operation, from exploration to post-closure and are applicable for small and large sites and companies.
The main reasons why this evaluative framework is considered in SUMEX are its mining origin and the underlying definition of sustainability, based on a value set that is stated as "*parallel care and respect for the ecosystem and for the people within. From this value set emerges the goal of sustainability: to achieve human and ecosystem well-being together.* "

When reviewing the seven Questions, it was nevertheless decided to update them – basically to "make them European", i.e. consider the Green Deal, circular economy and Planetary Boundaries. Because of this, we replaced the fifth question with one concerning the circular economy and made the original question, which is about traditional and non-market activities, an optional question to be used e.g. in the Nordic countries when dealing with the Sami people.
Figure 7 shows the updated questions.

Figure 6: Seven Questions to Sustainability [107]

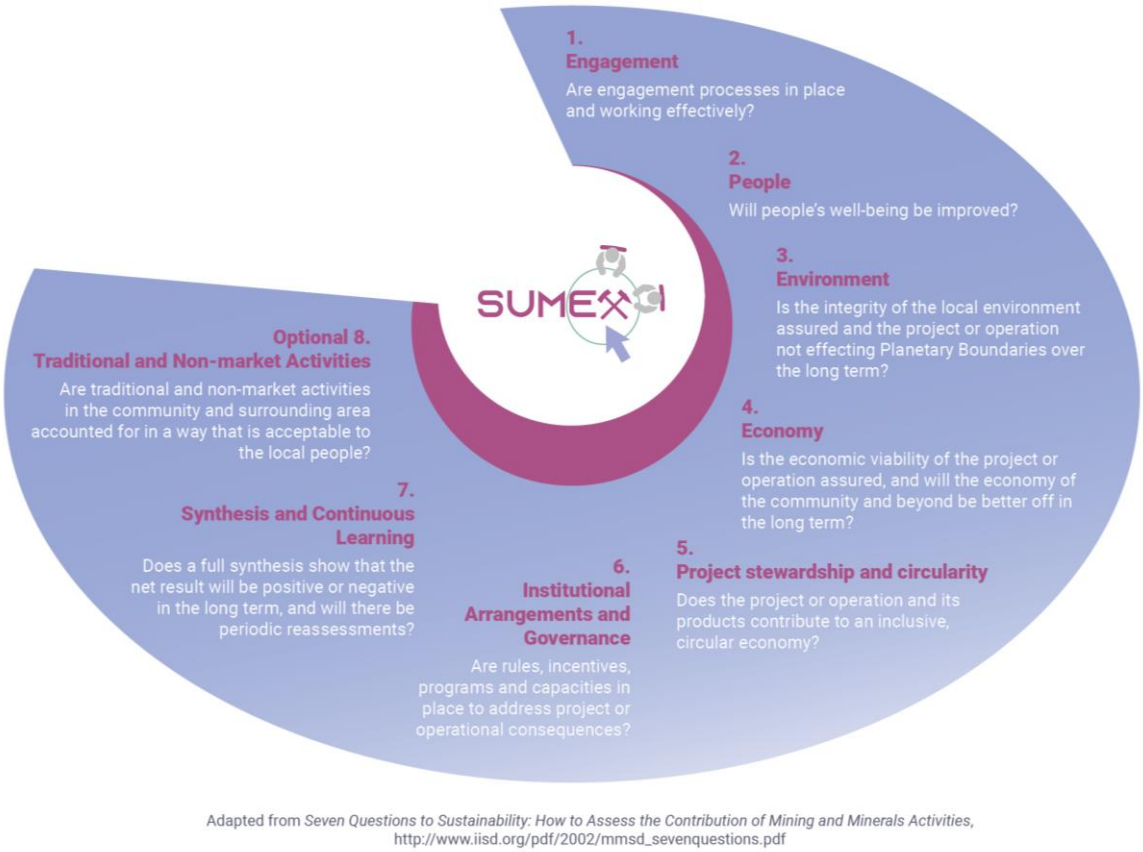

Figure 7: SUMEX's Seven Questions to Sustainability, adopted from MMSD [107]

The approach is feasible for sustainability assessments of extractive projects and operations (see chapter 5.3) but it is not aimed at assessing and evaluating different measures and interventions regarding their potential to improve or transform a system towards sustainability, e.g. to assess the good practise aspects of a Horizon 2020 project focused on improving energy efficiency in a quarry.

4.3.3 INSTITUTIONAL RESOURCE REGIME FRAMEWORK

Most resources are likely to be subject to a large number of different, and often simultaneous uses that compete with each other, sometimes resulting in conflicts. Conflicts arise from rivalries between different users for the same resource (homogeneous rivalry), i.e. different extractive companies competing for access to mineral resources, or between different users for access to different resources in a resource system (heterogeneous rivalry), i.e. competition to access land for extractive purposes vs. construction purposes vs. farming/animal husbandry purposes vs. recreation/ tourism purposes. Sustainable management of a resource entails the management of such rivalries as a condition sine qua non for sustainability. Hence, the identification of institutional conditions that facilitate their sustainable management is of crucial interest. Institutional Resource Regime (IRR) is a proposed framework for the analyses of institutional arrangements that regulate individual and/or collective uses of resources [108, 109].

The attribution and regulation of uses of a resource, such as mineral raw materials, is implemented through management use rights. Use rights commonly derive from measures defined through public policies, formal property rights or, most frequently, a combination of the two [110]. As pointed out in our interviews, challenges in extractive industries often arise from a lack of coherence amongst different public policies such as land use planning (land reserved for urban expansion, nature conservation, recreation and other uses) vs. mineral extraction (land required for expansion of the extraction site), fragmentation of resources as a result of numerous property rights holders, and/or a mismatch between public policy target groups and property right holders.
Precisely due to this double foundation of use rights (in public policy and property rights) the IRR framework combines policy analyses (including resources, actors, institutional rules) with property rights theory to enable the identification of the most important regulatory dimensions which can explain and help tackle the unsustainable uses of resources. IRR is preoccupied with use rights:

- their definition (i.e. How are mineral extraction rights defined?),
- their allocation (i.e. Who owns these rights? How is access to such rights secured? Who is excluded from such rights? How do mineral extraction rights affect access to other rights, such as building rights, farming rights, air rights, etc and vice versa?) and
- their redistribution (i.e. How can these rights be distributed to create conditions for a sustainable management of the resource?).

Figure 8 is a graphical representation of different elements that make up IRR, while it indicates four main different ways of regulating uses of a resource:

1. Through policies that do not affect the content of property rights (i.e. subsidies or tax relief)
2. Through policies that affect the value and content of property rights (i.e. restrictions on developments in buffer areas of extraction sites)
3. Through re-definition of the institution of property rights (i.e. changes in the civil code)
4. Through the re-definition of the structure of the distribution of property rights (i.e. privatisation/ nationalisation of water, forest, land, raw material, etc)

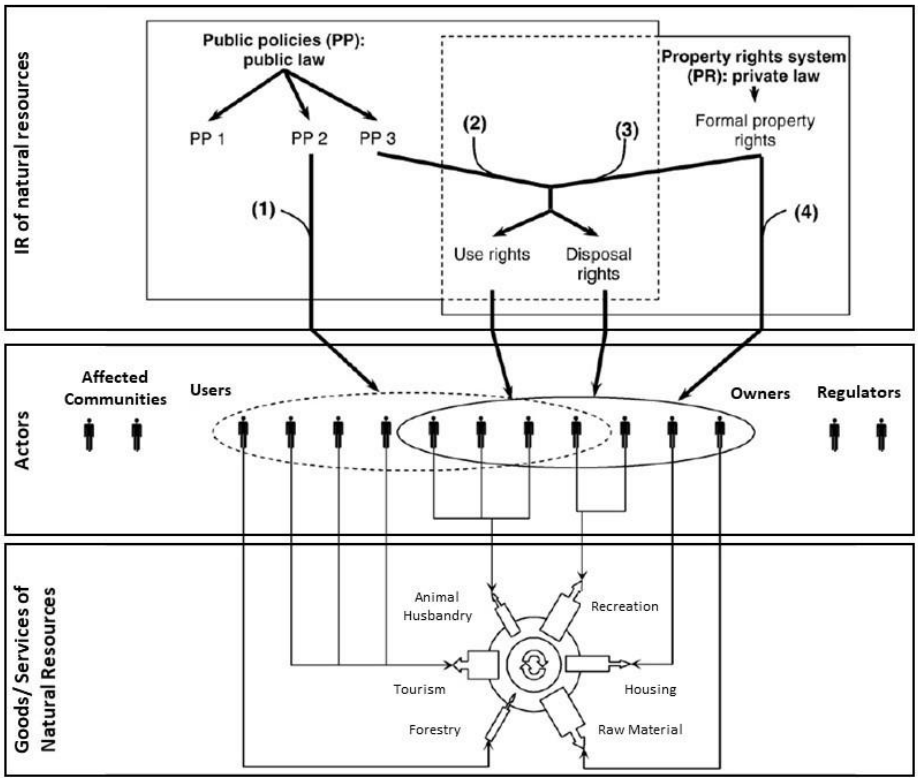

Figure 8: IRR adopted from Gerber et al. [108]

IRR focuses on users and owners as main actors with use rights in the system [108]. Nevertheless, we suggest the inclusion of regulators and affected communities in the analysis framework, as key stakeholders with influence in shaping the institutional conditions within which resources are managed.

IRR framework facilitates the analysis of the resource management practices and the regulatory measures associated with competitive (and sometimes conflicting) heterogeneous use situations, defining preconditions that support the sustainable management of a resource. Institutional Resource Regimes can be defined and categorised based on two dimensions: extent and coherence. *Extent* refers to whether or not all goods used from a resource are regulated, throughout the whole resource exploitation lifecycle. The use goods in one resource can affect the goods of other resources, hence they should comprehensively be included in this part of the analyses (as shown in Goods/Services of Natural Resources part of Figure 8). The importance of the extent of regulation is based on the idea that lack of regulation of the behaviour of users can result in over-exploitation of the scarce resource [108, 109]. The extent to which a resource is regulated is also closely linked to *global resource quota* and how quotas are translated into limitations on individual use rights of a resource [109]. Here, global resource quotas are in line with the concept of Planetary Boundary [37]: quotas are defined to acknowledge the thresholds within which humanity can operate safely (Earth's "Rules of the game"). In the case of mineral extraction, this also refers to considerations around the impact on other resources consumed during the extraction process such as water and land, and also the impact that this use has on other Earth System processes such as biodiversity loss, chemical pollution and so on. Thresholds are defined globally, regionally and/or sub-regionally and in some cases such thresholds have not been defined yet. The translation of limitations of defined thresholds into quantifiable quotas for the use of resources constitutes a central political issue to the extent that it expresses society's conception of sustainability. The quota attributed to a specific use, in the context of SUMEX the land reserved for extraction, will directly affect the total amount of extraction user rights and their distribution. However, it also affects the user rights of groups that are excluded from this use or other potential uses of the same land. Altogether, regulations that qualitatively and quantitatively

operationalise the use rights based on agreed quotas constitute *the extent* to which a resource is regulated. The higher the extent of regulations, the more likely conditions of sustainable use are to emerge.
Coherence refers to the content and connection of different regulations established by the regime and is evaluated in three main realms:

- Internal coherence of the property rights system: i.e. entitled claimants for a single good vs. resource units available
- 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. mineral extraction policy vs. water policy vs. land use policy)
- External coherence, which refers to the two components of IRR (public policy and property rights regime). It particularly refers to 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.

The more coherent the regulations, the more likely conditions of sustainable use are to emerge.

One of the contributions of IRR is the ability to identify and describe configurations of different resource regimes, based on these two dimensions: extent and coherence [108, 109] (see Figure 9). The central hypothesis of 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.* Lack of regulation of user behaviour (extent), through specific use rights emerging from policies and/or property rights, the higher the risk of overexploitation. Similarly, incoherence or gaps in policies and property-rights system, as well as between these two components, also constitutes a major cause for over-exploitation of resources (albeit there could also be a case for over-regulation).

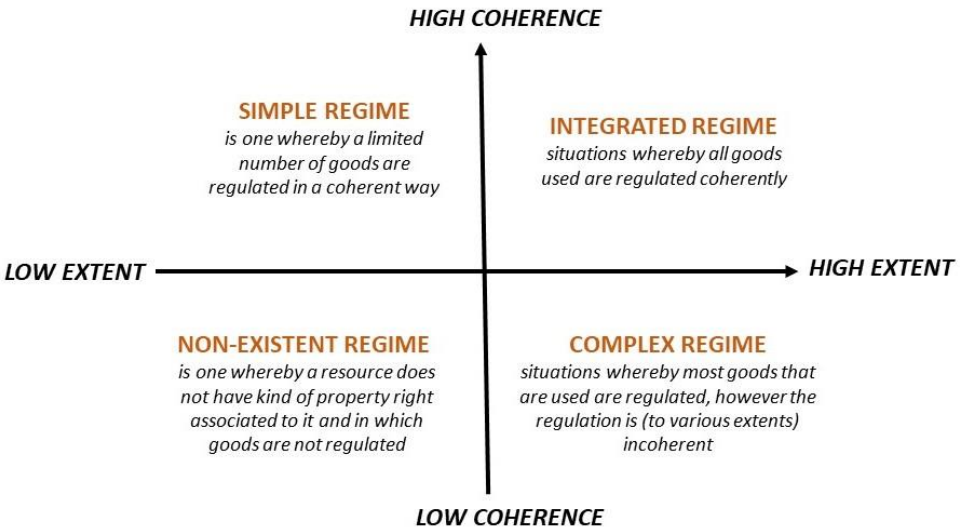

Figure 9: Four typologies of IRR according to extent and coherence, adapted from Gerber et al. [108]

By working simultaneously with use rights emerging from private law (i.e. Civil Code) and public policies (i.e. Mining Act), IRR observes the limits of policy analyses approaches which often tend to group them all into the fuzzy category of "property rights". In reality, in many cases, there are user rights with greater or lesser degrees of resistance, the modification of which can affect policy implementation in various degrees, as well as the sustainability of the resource regime.

Use of the IRR in SUMEX

IRR provides a conceptual framework for in-depth analyses and explanation of key elements depicting the degree of sustainability of natural resource uses in a given institutional setting. One advantage that the framework provides is that it is both analytical and normative (prescriptive) in nature. Hence, it is a guide for carrying out analyses of existing regulations around extractive resources, whilst providing a usable framework for proposing new institutional regimes that enable more sustainable management of such resources. Figure 10 provides a simplified guide for such an analysis whereas Table 2 introduces some analytical questions which operationalise IRR in the context of extractive industries. As an in-depth analysis framework, the detailed operationalisation of IRR is context bound, hence questions in Table 2 are by no means exhaustive but rather indicative of the nature of empirical evidence required for such an analysis.

Table 2: Operationalisation of IRR in the context of extractive industries with illustrative analytical questions

IRR dimensions	Categories	Illustrative Questions
EXTENT	Goods and Services	• *What are all goods used in the resource(s) analysed?* • *Are all goods that are being used regulated?* • *Are there areas of overregulation/ overexploitation?*
	Quotas	• *Are there identified quotas for the goods being used?* • *Have regional/ local quotas been identified?*
COHERENCE	Internal Coherence of Property Rights system	• *Are there clear titles and use rights?* • *How are mineral extraction rights defined and managed?* • *Is there a mismatch between property rights and identified quotas?* • *Are there challenges arising from the distribution of property rights? (fragmentation of ownership)*
	Internal Coherence of Public Policies	• *Vertical coherence: Is there coherence between policies/legislation deriving from EU/ national mineral extraction legislation/ regional and local legislation?* • *Horizontal coherence: Is there coherence between mineral extraction legislation and other types of legislation affecting/ being affected by mineral extraction?*
	External Coherence	• *Are there use rights deriving from public policies conflicting with use rights deriving from Property Rights?* • *Do public policy target groups correspond with property rights holders?*

IRR facilitates in-depth analyses of institutional regimes and supports their evaluation in terms of existing preconditions that facilitate the sustainable management of a resource. As it approaches the regime as a whole, IRR is less suitable for examining specific interventions and their ability to transform the system towards sustainability. IRR is embedded in the analyses of contextual factors that support (or constrain) the progress of institutional regimes towards integration. As such, this scheme will be applied for in-depth analyses of the institutional resource regime of two use cases.

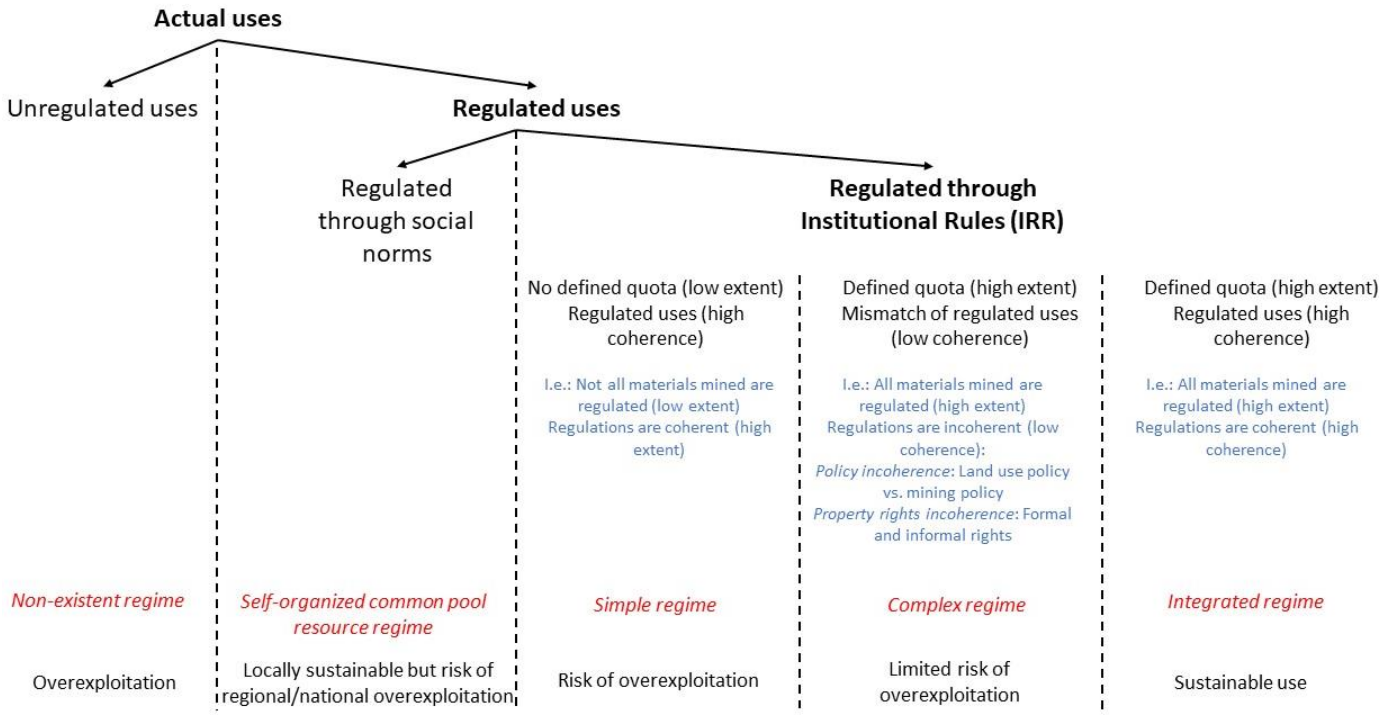

Figure 10: Guide for the analyses of existing regulations from the perspective of institutional regimes, adapted from Knoepfel, Nahrath and Varone [109]

5 FRAMEWORK TESTING

As part of our work, we tested the SUMEX Sustainability Framework on three operational examples, as well as on practices (including e.g. from other Horizon 2020 projects) and policies (e.g. mineral extraction legislation at a member state level) to find out, if they work for our project going forward (we were not interested in how they work, i.e. the results of the test).

Mineral extraction site examples

- LafargeHolcim's Mannersdorf operation in Austria
- Eldorado Gold's Olympias operations in Greece and
- Agnico Eagle's Kittila Mine in Finland,

Practice example

SLO Guidelines from the MIREU project

Policy example

The Swedish Mining Act

5.1 OPERATIONAL EXAMPLES

For all three examples, we used publicly available information, i.e. the companies' sustainability or annual reports. Based on these, we assessed if and how the companies currently consider the sustainability aspects from our framework, and applied the three evaluative schemes to try and assess their status. Assessing the validity of the information, including a verification of the information with stakeholders (e.g. controversies in Greece concerning Eldorado Gold`s operations), was not part of our testing.

5.1.1 LAFARGE HOLCIM MANNERSDORF

Mannersdorf is not only Austria's largest cement operation (it produces around 1.1 million tons of cement per year), it is also one of the oldest. Despite its 127-year history, the plant sees itself as a model company in the industry with regard to ecological production, mainly due to efficient fuel usage. After the plant had undergone a comprehensive environmental impact assessment in 2010, the first denitrification system in the Lafarge Group was installed in 2012 with a catalytic converter system to reduce nitrogen oxides. Last year, they have announced plans to build a CO2 capture system by 2030 together with industrial partners that would allow to capture and re-use almost 100% of its 700,000 tonnes of annual CO2 emissions [69].

Being part of the Swiss group LafargeHolcim, it has to adhere to the Group's sustainability and related policies, as well as to their goals and targets. Community engagement, human rights, climate change, circular economy and recycling, water use and health & safety were key focus areas in 2020. Figure 11 shows their four strategy pillars and the lead metric and targets [70, 71].

Sustainability pillars	CLIMATE AND ENERGY	CIRCULAR ECONOMY	ENVIRONMENT	COMMUNITY
Objective	Reduction of CO_2 emissions	Increased reuse of waste-derived resources	Reduction of freshwater withdrawal	Creation of shared value
Lead metric	CO_2 emitted ($kgCO_2$/t cementitious)	Quantity of waste recycled (million tons)	Freshwater withdrawn (liters freshwater/ ton cementitious)	Number of beneficiaries per year (million)
Performance 2020	Scope 1: 555 Scope 2: 36	46*	273**	6.2
% change from 2019	Scope 1: -1.1% Scope 2: -2.2%	-3.1%	-8.6%	+5.2%
Target 2022	550	60	291	7
Target 2030	475	100	262	10

Figure 11: Lafarge Holcim`s sustainability pillars, performance and targets [71]

5.1.2 ELDORADO GOLD OLYMPIAS

Olympias (which together with other Greek operations forms Hellas Gold, as subsidiary of Canadian company Eldorado Gold) is a gold-silver-lead-zinc mine located in the Halkidiki Peninsula in northern Greece. Starting as an open pit mine in the 1970s it is now an underground mine with annual production of about 58,000 oz of Gold, 1 million oz of Silver and about 10,000 tonnes to each of lead and zinc. It has only moved underground some years ago and is now in the process of re-mining old tailings and rehabilitating previously mined areas [36].

Olympias has to adhere to Eldorado Gold`s sustainability framework, which the company formalised in 2020. This framework is the foundation for how they approach responsible mining. It articulates four key pillars that express their commitments across environment, social and governance as follows: i) safe, inclusive and innovative operations; ii) engaged and prosperous communities; iii) responsibly produced products; and iv) healthy environment, now and for the future [37]. Part of the framework is a Sustainability Integrated Management System (SIMS) through which they set minimum standards and measure performance. Eldorado Gold adheres to Mining Association of Canada's Towards Sustainable Mining (TSM) and the World Gold Council's Responsible Gold Mining Principles. Using the Global Reporting Initiative (GRI), Eldorado has identified a number of material aspects (Figure 12), however, their current sustainability goals are not aligned with them (Figure 13).

Figure 12: Eldorado Gold`s 2020 material aspects [73]

Goal	Achievement level	Target
Develop Eldorado's Sustainability Integrated Management System ("SIMS")	●	In 2020, we developed and began planning the implementation of our SIMS. See page 8 for more information
Reduce LTIFR by 10%	●	Our 2020 LTIFR was 0.85, a reduction of 43% from 2019
Reduce TRIFR by 10%	●	Our 2020 TRIFR was 5.95, a reduction of 27% from 2019
Zero fatalities	●	Eldorado recorded zero fatalities in 2020. Eldorado has not recorded a fatality since Q3 2017
Zero environmental and regulatory non-compliance	●	Eldorado recorded zero material environmental or regulatory non-compliances

Significant efforts by Health, Safety and Sustainability teams across all operating regions led to the successful development of SIMS, and our continued focus on workforce engagement helped us achieve our health and safety targets. Placing an emphasis on sustainability in our corporate scorecard is an important indication of our commitment to responsible mining, and reinforces our values to all of our stakeholders.

2021 Sustainability Goals

In 2021, we are focused on integrating sustainability across Eldorado through the implementation of SIMS, advancing alignment to the RGMPs, developing energy and GHG-reduction targets, and focusing on leading health and safety indicators.

Goal	Target
Reduce LTIFR and TRIFR by 10%	LTIFR: 0.77 TRIFR: 5.35
Establish common health and safety leading indicators	Enhance corrective-action performance following preventative inspections
Sustainability systems and strategy	Progress on multi-year sustainability programs including: • SIMS implementation and site self-assessments • Advance alignment to the Responsible Gold Mining Principles • Develop a Climate Change Strategy and set climate-related targets
Zero fatalities	Zero fatalities
Zero major environmental or social incidents	Zero major environmental or social incidents

Figure 13: Eldorado Gold's 2020 and 2021 sustainability goals [73]

5.1.3 AGNICO EAGLE KITTILÄ

The Kittila mine in Lapland (northern Finland) is the largest primary gold producer in Europe. Kittila started commercial production in 2009. Since open-pit mining was completed in 2012, Kittila has been an underground-only operation. In 2020, it produced about 208,000 oz of Gold, with the operation currently being expanded (delayed due to Covid 19 restrictions [116]).

As with the other two examples, the mine follows the sustainability approach of the parent company, Canadian Agnico Eagle. It uses a Risk Management and Monitoring System (RMMS) as the foundation for managing the commitments made in their Sustainable Development Policy and under international initiatives, principles, codes, and programs such as TSM and the SDGs. The report does not include a materiality assessment, but a list of performance metrics, based on their focus areas (Figure 14), as well as a list of objectives and targets (Figure 15). These show especially that the company has yet to figure out its climate change response.

Health, Safety and Wellness	2018	2019	2020	3-Year Trend[1]
Combined Lost-time Accident and Restricted Work Frequency[2]	1.28	0.99	1.02	+
Fatalities	0	0	0	+

→ *See page 22 for more details*

Environmental Stewardship	2018	2019	2020	3-Year Trend
Total tonnes CO_2 Equivalent	411k	521k	578k	−
CO_2 Equivalent/Oz	0.32	0.36	0.40	−
Total Water Recycled	64%	62%	67%	=
Significant Spills	0	0	0	+

→ *See page 30 for more details*

Our People	2018	2019	2020	3-Year Trend
Proportion of Women in the Workforce	16%	16%	15%	=
Local Employment	64%	59%	61%	=
Inuit Employees	398	442	410	=

→ *See page 46 for more details*

Our Communities	2018	2019	2020	3-Year Trend
Number of Significant Disputes	0	0	0	+
Operations Payments to Local Suppliers	$900M	$865M	$876M	=

→ *See page 58 for more details*

1. Performance is based on targets or where targets are absent three-year trends.
2. Per 200,000 hours worked by employees and contractors.

Figure 14: Agnico Eagle`s sustainability performance metrics [117]

Our 2020 Objective and Targets

Achieved | On Track | Delayed | Not Achieved

Topic	2020 Target	2020 Status	2021 Objective
Health and Safety We aim to operate a safe and healthy workplace that is injury and fatality free.			
Injury Frequency	Achieve a Global Combined Lost-time Accident and Restricted Work Frequency below 1.05.	Achieved	Achieve a combined Global Combined Lost-time Accident and Restricted Work Frequency 1.00.
Fatalities	Zero fatalities.	Achieved	Zero fatalities.
Environmental Stewardship We aim to eliminate, minimize, and mitigate impacts of our operations on the environment.			
Environmental Compliance	Finalize Environmental Incident Management Standard.	Delayed	Finalize Environmental Incident Management Standard.
	Achieve zero major or critical/extreme environmental incidents.	Achieved	Achieve zero major or critical/extreme environmental incidents.
Water Stewardship	Present Corporate Standard for Water Management to senior management, project teams and operations for implementation across the Company.	Delayed	All our operating sites have a water management strategy captured by a water management plan and supported by robust water balances.
Integrated Closure	Continue reclamation of orphan site "Manitou" with Quebec Ministry of Energy and Natural Resources.	On Track	Continue to focus on progressive reclamation of active mine sites while reducing risks at legacy sites.
	Continue dismantling of surface infrastructure and rehabilitation work at Lapa mine, transportation of waste rock to the LaRonde mine.	Achieved	Continue closure activities and earthworks at the former Lapa mine site following successful removal of site infrastructure.
Tailings and Waste Management	Update risk assessment of critical infrastructure (2019–2020).	Achieved	Ensure operations have functioning and sustainable critical infrastructure governance oversight. Develop a communication plan for our operations to make sure the process is understood.
Climate Change	Prepare first Climate Action Plan Strategy and initiate risk assessment in line with TFCD.	Delayed	Finalize first Climate Action Plan Strategy and initiate risk assessment in line with TCFD.
Our People We aim to maintain a work environment that is based on mutual respect, fairness and integrity.			
Employment / Jobs	Implement workforce management process to ensure all reasonable steps are taken to provide long-term sustainable jobs for our people.	On Track	Regions to develop workforce productivity and workforce plans to continue providing long-term sustainable jobs for our people.
Diversity and Inclusion	Implement actions to increase diversity in the workplace.	Delayed	Achieve the 2021 Diversity and Inclusion Action Plan.
Our Communities We aim to contribute to the social and economic development of sustainable communities associated with our operations.			
Community Relations and Satisfaction	Implement the Good Neighbour Guide for operations in Abitibi.	Achieved	
	Audit stakeholder mapping process.	Delayed	Audit stakeholder mapping process.
Indigenous Rights and Relationships	Continue to negotiate relevant agreements with Indigenous groups for projects in Ontario and Quebec.	On Track	Continue to negotiate relevant agreements with Indigenous groups for projects in Ontario and Quebec.
	Enhance our process in order to align expectations between Indigenous groups, government, and Agnico Eagle.	On Track	Enhance our process in order to align expectations between Indigenous groups, government, and Agnico Eagle.

Figure 15: Agnico Eagle`s 2020 objectives and targets [117]

5.2 COMPARISON TO THE SUMEX SUSTAINABILITY ASPECTS

Next, we compared our sustainability aspects with the priorities of the companies in order to see how far they consider these aspects. At this stage, we only looked if the "spirit of the aspect" was broadly incorporated. We did not look at the status or quality of any actions (see below). Table 3 lists the results, showing that the large majority of aspects (all but valuing all forms of capital and holistic management) are already under some sort of consideration by these companies.

Table 3: Consideration of sustainability aspects at the three example companies

Sustainability aspects			
	LafargeHolcim	Eldorado Gold	Agnico Eagle
Transforming the economy			
Understanding of the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries	+	-	-
Extractives' role in closing cycles	+	-	-
Valuing all forms of capital	-	-	-
Defining what "benefit sharing" means	+	+	+
Accountability	+	+	+
Planning beyond the mine life	+	+	+
Holistic risk management and emergency preparedness	+	+	+
Social and societal responsibility			
Partner with host communities and society to deliver a shared vision of the future	+	+	+
Engage in continuous dialogue with stakeholders, create trusted grievance mechanisms and shared investigation and problem-solving processes	+	+	+
Safeguard human rights	+	+	+
Protect cultural heritage	-	+	+
Adhere to ethical corporate practices	+	+	+
Share data and information transparently	+	+	+
Diversity, inclusion& anti-discrimination	+	+	+
Improving workers' well-being	+	+	+
Holistic management and continuous learning	-	-	-
Environmental sustainability			
Integrated, watershed-based water stewardship	?	?	+
Efficient energy consumption, based on renewable energy	+	+	+
Carbon neutrality	+	-	+
Zero harmful air emissions	Reduction only	-	Reduction only
Arrangement of different land uses and biodiversity net positive impact	?	Land, biodiversity reduction only	Land, biodiversity reduction only
Advanced waste management	+	-	-

5.3 TESTING THE EVALUATION CRITERIA

In a last step, we tested the evaluation schemes (LPs, Seven Questions and IRR) on the company examples, as well as on an example practice from another Horizon 2020 project, the SLO Guidelines from the MIREU project [47] and the Swedish Minerals Act (No. 45 of 1991) [75] in order to assess the usefulness of the evaluation schemes in the SUMEX project, i.e. the analysis of good practices and the policy analysis and use cases. Table 4 summarises the results:

Table 4: Feasibility of the evaluation schemes for different levels of sustainability

	Leverage Points	Seven Questions	IRR
Operational examples	+/-	+	-
SLO Guidelines	+	-	-
Swedish Minerals Act	+	-	+

LP can be used for all three examples, with limitations concerning the assessment of the overall sustainability of an operation or project. However, its advantage is the possibility to assess specific practices or actions on a scale from shallow to deep, which in SUMEX will also give us the opportunity to avoid the "black and white" classification of what constitutes a good practise. It is important to notice that 'shallow' does not equate with unimportant or common or of limited value; deep and shallow mainly refer to an intervention's capacity to trigger transformative, systemic change. The IRR will be used to assess the two use cases, which as deep dives will support the policy analysis. The effort to adopt and use the scheme for the broader policy analysis was however deemed as beyond the resources of this project.

The Seven Questions as adopted by SUMEX will not be used any further within the project, as our focus will not be on the assessment of extractive operations. However, they are expected to be useful for all stakeholders to assess the sustainability of an extractive project or operation in the context of the SUMEX Sustainability Framework described in this report.

6 THE SUMEX SUSTAINABILITY FRAMEWORK, STAGES OF DEVELOPMENT AND SUMEX'S FIVE FOCUS AREAS

The SUMEX Sustainability Framework acts as a roadmap towards sustainability, bringing together current and future expectations. The aspects presented in chapter 4 are composed of a mixture of themes or processes that are of different relevance at each mining stage and for each focus area.
In this section, the relevance of the identified sustainability aspects is assessed against SUMEX's five focus areas: socio-economic and environmental impact assessments, land-use planning, health and safety, reporting official statistics, and permitting processes/policy integration. Similarly, the relevance of the aspects is assessed for the different development stages of extraction: pre- exploration and development, operation, closure / post-closure.
The matrix in
Table 5 depicts the relevance of each aspect on a three-tiered qualitative basis. Two major elements are considered for the evaluation: the importance of a sustainability aspect for a focus area or extraction stage and

the influence these areas and stages have on achieving the aspect's goals. While all sustainability aspects are relevant to some degree (■□□), some aspects are more linked and have a stronger relation than others to the extraction stages and SUMEX focus areas. These more relevant aspects (■■□) can be tangibly influenced at the focus area or extraction stage. Very relevant (■■■) sustainability aspects are crucial elements that can be significantly influenced.

For instance, the sustainability aspect of improving workers wellbeing is only of little relevance in the exploration phase, while it becomes crucial at the operation phase and can be directly influenced. Similarly, this sustainability aspect is at the core of the focus area Health and Safety but only of limited relevance for land-use planning.

Table 5: Matrix of the sustainability aspects, mapped against extraction stages and SUMEX focus areas

Qualitative relevance of the Sustainability Aspects with the Mining Stages and Focus Areas ■□□: relevant ■■□: more relevant ■■■: very relevant	Extraction Stages			SUMEX Focus Areas				
Sustainability Aspects	Exploration and development	Operation	Closure / Post-closure	Socio-economic and environ-mental impact assessments	Land-use planning	Health and safety	Reporting official statistics	Permitting processes/ policy integration
Transforming the economy								
Understanding of the role and indicators for extractives in an inclusive Green Economy that exists within Planetary Boundaries	■□□	■□□	■□□	■□□	■■□	■□□	■■□	■■■
Extractives' role in closing cycles, both biological and technological	■□□	■□□	■□□	■■□	■■□	■□□	■□□	■■■
Valuing all forms of capital, i.e. natural and social capital	■■□	■■■	■■■	■■■	■■■	■■■	■□□	■■□
Defining what "benefit sharing" means	■□□	■■■	■■□	■■□	■■■	■□□	■□□	■■□
Accountability	■■□	■■■	■■□	■■□	■□□	■■□	■■■	■■□
Planning beyond the mine life	■■□	■■■	■■■	■■■	■■□	■□□	■□□	■■□
Holistic risk management and emergency preparedness	■□□	■■■	■■■	■■■	■■□	■■□	■■□	■■□
Social and societal responsibility								
Partner with host communities and society to deliver a shared vision of the future	■□□	■■■	■■□	■■□	■■□	■■□	■□□	■■□
Engage in continuous dialogue with stakeholders, create trusted grievance mechanisms, shared problem-solving processes	■■□	■■■	■■□	■□□	■□□	■□□	■■□	■■■
Safeguard human rights	■■■	■■■	■■■	■■□	■□□	■□□	■□□	■■□
Protect cultural heritage	■■■	■■■	■■■	■■□	■■■	■■■	■□□	■■■
Adhere to ethical corporate practices	■■■	■■■	■■■	■■□	■□□	■□□	■■□	■□□
Share data and information transparently	■□□	■■■	■■□	■■■	■■□	■■□	■■■	■■■
Diversity, inclusion & anti-discrimination	■□□	■■■	■□□	■■■	■□□	■■■	■□□	■■□

Qualitative relevance of the Sustainability Aspects with the Mining Stages and Focus Areas ■□□: relevant ■■□: more relevant ■■■: very relevant	Extraction Stages			SUMEX Focus Areas				
Sustainability Aspects	Exploration and development	Operation	Closure / Post-closure	Socio-economic and environ-mental impact assessments	Land-use planning	Health and safety	Reporting official statistics	Permitting processes/ policy integration
Improve workers' well-being	■□□	■■■	■□□	■□□	■□□	■■■	■□□	■□□
Holistic management and continuous learning	■□□	■■■	■■■	■□□	■■□	■■□	■■■	■□□
Environmental sustainability								
Integrated, watershed-based water stewardship	■■□	■■■	■■■	■■□	■■■	■■■	■□□	■■■
Efficient energy consumption, based on renewable energy	■□□	■■■	■□□	■■□	■□□	■□□	■■■	■■□
Carbon neutrality	■□□	■■■	■□□	■■□	■■□	■■□	■■■	■■□
Zero harmful air emissions	■□□	■■■	■■□	■■□	■□□	■□□	■■■	■■□
Arrangement of different land uses and net positive impact on ecosystem services and biodiversity	■■□	■■■	■■■	■■□	■■■	■□□	■□□	■■■
Advanced waste management	■□□	■■■	■■■	■□□	■□□	■■□	■■□	■■□

6.1 EXTRACTION STAGES

Pre- Exploration and development

A sustainable and integrated view on extractives management requires investigating pre-exploration including the 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 [119]:

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 enhances the steering capacity for the preparation and implementation of sustainable land-use plans that include minerals development.

Before the production at a specific site begins, exploration and afterwards the construction of the infrastructure need to take place. At this stage, the foundation for a sustainable approach is set. The sustainability aspects of

transforming the economy, valuing social and natural capital, and benefit sharing need to be considered. But most importantly, every project needs to always incorporate into the planning what happens after the operation is closed and what options there are for remediation. From a social and societal responsibility standpoint, the exploration and potential construction of a mine needs to obtain the social license to operate (SLO). This is of crucial importance in a European context. In contrast to other well-regulated mining regions, such as Australia or Canada, the EU is much more densely populated. Therefore, SLO is even more important. Stakeholders need to be engaged and included from the exploration phase. Human rights and cultural heritages need to be considered, and of course ethical corporate practices must be applied while continuously promoting anti-discrimination practices. Data and information on exploration and construction plans need to be made publicly available to ensure affected communities receive all information. Although environmental sustainability is crucial for the long-term success of a project, many aspects only become relevant once the project is operating. Nonetheless, positive impacts on ecosystem services and biodiversity need to be included in exploration efforts before planning and constructing a mine or quarry.

Operation

Operation includes the active extraction and processing of raw materials on site. Accordingly, environmental, and social impacts during the operation phase are most direct. Compared to all other extraction stages and SUMEX focus areas the largest number of sustainability aspects are highly relevant at this stage.
Except for larger transformational sustainability aspects all economic, social and environmental aspects should be fulfilled during the operational phase. Looking at the other stages it is evident that some aspects can only be appropriately addressed during operation. The improvement of workers' well-being or the coordination of an advanced waste management system are best addressed in this phase.

Closure / post-closure

After the exploitation of a deposit, the site has to be decommissioned, infrastructure removed, the landscape remediated and the economic impacts of closure need to be managed. If such rehabilitation of the site and its surroundings is not performed, the location remains vulnerable to further environmental degradations with social and socio-economic impacts. Around the world, abandoned or orphaned mines that have not been remediated pose significant threats. Acid Mine Drainage (AMD) is only one major issue that can cause perpetual environmental harm when waste management and remediation is not taken care of adequately [120]. In the post-closure period, cultural heritage needs to be safeguarded and, most importantly, monitoring needs to take place to ensure that no harm results from the remediated areas.

6.2 SUMEX FOCUS AREAS

Socio-economic and environmental impact assessments

Transparently sharing the methods and results from impact assessments investigating the socio-economic as well as the environmental effects of mineral extraction is fundamental to concluding an impact assessment. Through such transparency, an impact assessment can contribute toward stronger social and societal responsibility by revealing the impacts on human rights and cultural heritage and by rating anti-discrimination practices. Encouraging these socio-economic and environmental impact assessments can assist in economic transformations as part of the EU's Green Deal. In particular, the analyses from such assessments can substantiate the value given to certain natural or social capital. This value is useful for planning at an extraction site, also after the site is closed. Impact assessments, in particular where risks are identified, enlighten risk management and preparations for emergencies.

Land-use planning

As extraction projects are planned, the land-use intended for areas surrounding the mine or quarry and, after closure, at the site itself impacts the economic potential and the environmental sustainability in the area. Including land-use planning in all stages of mineral extraction projects can promote the value of the natural and social capital. As part of the plans, it is important to have a clear understanding of how benefits could and should be shared. This can include aspects relating to environmental sustainability, for example by promoting awareness of the need to care for water sources. Managing land use must aim at only allowing positive impacts on the ecosystem and biodiversity.

Health and safety

Mineral extraction can impact human health and safety through all extraction stages, affecting workers as well as inhabitants near a site. As part of an economic transformation, considerations for health and safety indicate that natural and social capital are valued. In particular, protecting human rights and diverse cultural heritages boosts the health of impacted populations and reduces risks to their physical wellbeing. Encouraging environmental stability through e.g. watershed-based water stewardship allows people to have access to clean water for their daily needs and agriculture. Overall, health and safety regulations are one of the key instruments to ensure social and societal responsibility.

Reporting official statistics

The collection and reporting of data are critical to monitoring and setting tangible targets for improvement. By looking at different sectors on the EU level like batteries or packaging waste many lessons can be learned. Since the introduction of collection targets for portable batteries in 2012 (increased targets from 2016) the collection rates in the EU increased significantly. Similarly recycling targets for packaging waste streams such as plastic or paper waste can only be monitored because constantly improving statistics are collected. Similarly, the extractive sector could benefit from more data collection and monitoring. Improvement needs to be measured against something, therefore collecting as much information as possible can ensure a meaningful monitoring. Sharing official statistics about extraction activities and their impacts can support accountability by helping to identify, monitor and mitigate potential economic, social, and environmental risks. This not only ensures learning and monitoring, but also opens dialogue between stakeholders and the extraction industry and allows grievance mechanisms to be put into place. Transparency also supports trust building between the producing company, residents and civil society.

Permitting processes/ policy integration

All areas belonging to 'Transforming the economy' have a stronger link to setting up permitting processes and integrating policies. Large scale transformations like a Green Economy existing within Planetary Boundaries or the definition of the extractive's role in closing biological and technological cycles need to be addressed on a policy level. Therefore, the focus area should address rather macro than micro-scale sustainability aspects. Permitting procedures of course need to consider social and environmental aspects prior to the authorisation of a new mine. Firstly, information needs to be shared transparently to ensure prior and informed consent of affected communities. From an environmental standpoint, water related impacts and consequences for biodiversity and ecosystem services need to be considered.

Overall, the analysis clearly shows that in each focus area and at each developmental stage of an extractive project, a different set of sustainability aspects needs to be considered. Bearing in mind that there is also a temporal dimension included in the sustainability aspects (see chapter 4), some aspects might be more relevant in the shorter time frame while others will only become relevant in the future.

7 CONCLUSIONS – TAKEAWAY LESSONS

The SUMEX Sustainability Framework presented in this report lays out a roadmap for the extractive industry in Europe to move from legal compliance and responsible extraction to sustainable extraction in 2050, aligned with i) the current scientific debate regarding sustainability except for the intra- and intergenerational justice perspective and ii) the current European political debate, i.e. regarding the SDGs, the Green Deal and the transition towards an inclusive, green and circular economy. The sustainability aspects describe the topics and to some extent high level goals that the industry will need to consider most as part of the transformation required. The stakeholder interviews and desk research indicate the need for addressing extractive sector approaches from a systems perspective (leverage point analysis) in order to conquer root causes of the sustainability crisis, and making transparent and tackling tensions & trade-offs among different sustainability dimensions. The SUMEX framework tries to address these shortcomings - the three very different assessment schemes can be useful in describing effectiveness of policy measures and actions (Leverage Points, Institutional Resource Regime), but also the overall sustainability of an extractive project or operation (Seven Questions).

For the SUMEX project internally, the initial testing of the sustainability framework showed that its components - aspects and two of the assessment schemes (Leverage Points, Institutional Resource Regime) – can be used as a 'funnel' for i) delineating and mapping good practices from other projects from programmes such as Horizon 2020 or EIT Raw Materials (work package 2) and ii) for analysing European policies targeting the extractive industry with regards to sustainability (work package 3), as summarised in Figure 16. These practices will then be presented in a digital toolkit, which will the basis for establishing a Community of Practise (CoP) for engagement and peer learning amongst extractive industry stakeholders across Europe.

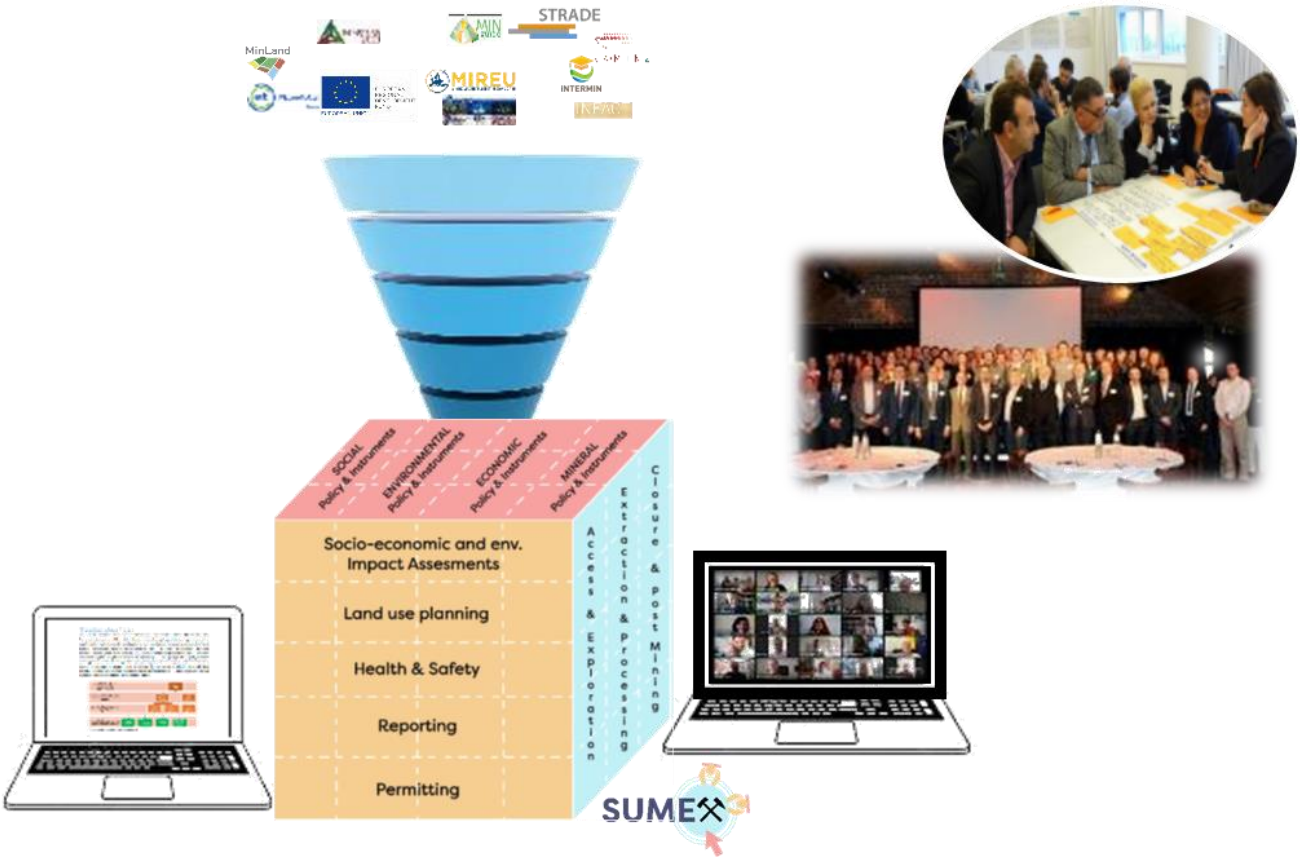

Figure 16: Within SUMEX, the sustainability framework acts as a 'funnel' to analyse European projects and policies for good practices to be included in a digital toolkit to establish a Community of Practise

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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.

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ANNEX 1 – INTERVIEW GUIDE

Introduction

- Create an easy, trustworthy atmosphere
- Thanks for doing this; we need your help
- Short Info concerning SUMEX
- Mention data protection and get ok to record the interview

Research question

How does European Extractive industry conceptualise (understand and operationalise) sustainability and its aspects?
To which degree do mining practitioners perceive sustainability-tensions (trade-offs) within the current practises of/in extractive industries?

Method

In depth, semi-structured interview

Interview questions

(1) To start with, perhaps you can introduce yourself and your professional background in relation to the extractive sector?

(2) How do you understand sustainability? What does it mean for extractive industries?

(3) What are sustainability aspects in the European context? (follow up, if it stays very generic and abstract: Can you illustrate that with a practise example?)

(4) What are tensions and conflicts (trade-offs) (Social & societal, Environmental & ecological, Economic, other?) involved in sustainability practises in the European extractive sector?

(5) What are ways to resolve these tensions or conflicts (trade-offs) (follow up, if it stays very generic and abstract: Can you give an example?)

(6) What needs to change in the extractive sector for sustainability to be operationalised in Europe?

(7) *Follow up from 6:* When you think about practises, can you identify ones where operationalisation has already been achieved appropriately?)

(8) In the SUMEX project, the following aspects were identified in addition to the ones you mentioned *(Interviewer to name – we expect that these will be the ones concerning the green economy / planetary boundaries, circular economy, natural and social capital valuation, etc.*). How important are these in your opinion? (follow up, if it stays very generic and abstract: Can you give an example of operationalisation?)