

# Drivers of sustainability practices and contributions to sustainable development evident in sustainability reports of European mining companies

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## Research Article

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# Abstract

Mining activities cause negative environmental impacts, and social conflicts, but also provide economic benefits to communities and secure minerals necessary for low-carbon technology. The aim of this multiple case study is to analyze, compare and critically evaluate sustainability reports of 10 European mining companies for the 2016–2018 period to determine the drivers for implementation of sustainability practices and their contribution to the Sustainable Development Goals (SDGs). The findings suggest that European mining companies act under pressures from international initiatives and industry associations, the European Union, governments, stakeholders, and partnerships. The companies report on the core subjects of corporate governance, employees, the environment, stakeholders' engagement and occupational health and safety. Positive trends were observed in stakeholder's engagement, and health and safety, while air emissions, water and energy usage increased for most companies. Furthermore, there was an absence of improvement in gender diversity, utilization of renewable energy, and waste recycling. Even though all analyzed companies mentioned SDGs in the reports, the reports lacked a comprehensive explanation of mining activities' contribution to the SDGs. This study addresses a gap in the existing literature on the European mining context of sustainable development and SDGs relevant for researchers, policymakers, and other impacted stakeholders and adds new theoretical knowledge on the external drivers for CSR activities based on institutional theory.

## 1 Introduction

Mining is one of the oldest documented human activities, and has advanced the economic, cultural, and technical development of societies and countries throughout human history [1]. In Europe, mining and quarrying the stone has a very long tradition dating to the Neolithic era with extraction sites found in Portugal, Sicily, south of Russia, and north of Norway [2]. The European mining industry is an important part of its economy with an almost self-sufficient production of industrial minerals and aggregates for European requirements [4], being a major international producer of many industrial minerals, of natural stone with around 35% global production and the biggest producer of extracted gypsum in the world [3]. The European Union (EU) metal production is only about 3% of the world production while consuming around 30% of global metal production [5]. However, metal processing, including reuse and recycling, account for 46% of total manufacturing value in the EU, and 11% of gross domestic product (GDP) [6].

Mining is considered to conflict with sustainable development due to its use of non-renewable natural resources and significant impact on the environment [7]. Due to these negative impacts, the mining industry has been under intensified pressure from stakeholders over the last few decades, especially from non-profit organizations (NGOs), to improve their performance [8]. Moreover, the negative impact has intensified due to the rising demand for materials, increased production, and ore grades decline [9], causing higher waste rock production and greenhouse gas emissions per ton of product [10]. As a result, the mining industry has begun to develop strategies to address sustainable development.

The transition to a low-carbon future, based on the Paris Agreement, indicates a potentially increased demand for certain minerals needed for low-carbon technologies, meaning that the extractive industry has an essential role to play towards sustainable development [11]. Furthermore, by providing revenues to countries, driving economic growth, creating jobs, and enabling infrastructural development it contributes to the economic dimension of sustainable development [12]. The EU's Green Deal developed in 2019 by European Commission is a roadmap for sustainable development executed through resource efficiency, circular economy, biodiversity conservation, carbon neutrality and pollution reduction [13]. Utilizing waste from mining operations in Europe, consequently, could solve the limited mineral supply, reduce environmental footprint, and generate profit [14, 15].

The most widespread approach to communicate on the progress toward sustainable development is the issuing of annual sustainability reports through which companies report on the non-financial aspects of their business, including environmental and social impacts, and corporate governance issues. The Global Reporting Initiative (GRI) Standards are the most

commonly used framework in the mining industry where in 2011, 95% of the 102 global mining companies publishing reports used the GRI [19].

The study aims to examine the sustainability activities of mining companies that operate in Europe by carrying out a content analysis of their sustainability reports. The following research questions were investigated:

1. What are the institutional drivers of sustainability practices as detailed in the sustainability reports of European mining companies?
2. What efforts are the European mining companies taking to contribute to sustainable development as detailed in their sustainability reports?
3. How well integrated are the SDGs in the companies' sustainability reports?

The paper is structured as follows: Sect. 2 discusses the relationship between mining and sustainable development, the challenges of using reported data to analyze performance, and the use of institutional theory as a theoretical lens for the analysis of drivers of sustainability practices. Section 3 introduces the method including the selected criteria for the qualitative content analysis. Section 4 presents the results while Sect. 5 comprises the discussion. Implications and limitations of the study are addressed in Sect. 6.

## 2 Mining And Sustainable Development

The conciliation of mining and sustainable development does not imply the end of mining, but the rational consumption of limited resources. Sustainable mining involves the implementation of activities in mining operations to reduce negative impacts, and addresses stakeholders' interests and concerns [20]. Therefore, mining companies need to identify stakeholders and key sustainability issues, actions to tackle these issues, and develop sustainability indicators to measure and monitor performance [21].

Even though mining results in considerable economic gains [22], the extractive industry is associated with a range of damaging environmental and social impacts (Table 1).

**Table 1. Previous research on environmental and social impacts of mining**

Environmental impact	Previous research	Scale of the study
Greenhouse gas emissions (GHG)	McLellan et al., 2012 [23]	World
Air emissions	Asif & Chen, 2016 [24]	North America
Water consumption and pollution	Mudd, 2008 [25]	World
Negative impact on biodiversity	Sonter et al., 2018 [26]	World
Waste generation	Lottermoser, (2011) [15] Lèbre et al, 2017 [27]	World
Significant use of energy	Nasirov & Agostini, 2018 [28]	Chile
Renewable energy; GHG emissions	Ranängen and Zobel (2014) [17]	Sweden
SDGs contribution	Endl et al., (2019) [16]	Europe
Social impact	Previous research	
High risk for employees	Hebblewhite, 2009 [29]	Australia
Attracting and retaining high skill workers	Loow & Nygen, 2019 [30]	Sweden
Low share of female employees	Lahiri -Dutt & Macintyre, 2006 [31]; Botha, 2016 [32]	Developing countries; South Africa
Health and safety; human and labor rights issues, conflicts	Mancini & Sala, (2018) [33]	World
Social license to operate	Ranängen and Lindman (2017) [18]	Nordic countries

Few studies have explored the sustainability challenges of the mining sector within Europe, as evident in Table 1. Endl et al. [16] explored the European mining innovation's contribution to the SDGs including autonomous equipment and operations, better mine design, enhanced transparency and traceability, renewable energy solutions, and occupational safety. Ranängen and Zobel [17], in a case study of the Swedish mining company Boliden AB, revealed that implementation of international standards does not lead to the increased use of renewable energy or result in greenhouse gas emission reductions. Ranängen and Lindman [18] studied the Corporate Social Responsibility (CSR) activities of Nordic mining companies showing that they mostly complied with stakeholders' interests such as labor practices, risk management and sustainable water use. However, to gain the crucial social license to operate anti-corruption, energy and the recycling topics could have been covered more thoroughly. Social license to operate comprises the community's intangible consent of the company's operations and extends beyond legal rights [34, 35].

## 2.1 Challenges in using sustainability reports to analyze sustainability performance

Due to intensified stakeholder pressure in the previous decades and mandatory reporting among the members of mineral associations, sustainability reporting has significantly increased among the mining companies. The EU directive mandating non-financial disclosures by the largest companies, further highlights that the trend towards more mandatory reporting schemes will continue [36]. In a comparability analysis of 12 GRI reports from mining companies, Boiral and Henri [37] revealed that due to the qualitative characteristics of many GRI indicators, general information, use of different scales, and the lack of data it was difficult to compare sustainability performance between the reports. Additionally, contribution to SDGs included in sustainability reports is often limited with general descriptions, while lacking in implementation in terms of business models and the development of indicators related to the SDGs [38, 39]. However, to reach higher level of maturity in sustainability reporting, organizations require more time [40].

## 2.2 Institutional theory

Institutional theory takes a broad view in explaining why an organization adopts a particular structure or reporting practice. Companies whose core business is associated with higher environmental impact, like the mining industry, are under more pressure to act responsibly in the way they conduct their business, than companies with lesser environmental impact [41]. Institutional theory was used in this study to explain the motivations for the engagement in sustainability practices among mining companies through an analysis of their sustainability reports.

Institutional theory clarifies the pressures organizations experience, forcing them to adopt social and institutional norms and rules for the purpose of increasing legitimacy to maintain access to resources causing organizations within the same organizational field to become more similar to another [42]. The concept describing this process of homogenization is called isomorphism, and according to DiMaggio and Powell [42], and it can be categorized as coercive (regulatory), mimetic (competitive), and normative (market) isomorphism.

Coercive isomorphism occurs due to the pressure from external factors like shareholder or employee influence, and government policy and legislation/regulations to change an organization's institutional practices [43, 44], e.g., policies or taxes on companies to reduce their businesses' environmental impact. Mimetic isomorphism is the process by which an organization attempts to imitate or copy other organizations' practices, often to gain a competitive advantage regarding legitimacy, such as by implementing CSR reporting [45, 46]. Normative isomorphism relates to the pressures to adopt institutional practices arising from common values, usually from customers or suppliers to compel them to comply with environmental and social standards [43, 47], alike the increased use of the GRI Standards [36] for sustainability disclosure by companies worldwide [48].

## 3 Sustainability Reports' Content Analysis

The method employed in this multi-case study is based on the content analysis of the sustainability reports from 10 mining companies operating in Europe. A case study is a research method that simplifies the research of trends within its context using a variety of data sources to understand various aspects of a phenomenon [49], including the connections and differences between many cases in a multiple case study [50]. In addition, to gain a broader view of sustainability standards used in the mining industry, a review of the scientific literature and sustainability initiatives was carried out.

### 3.1 Data collection

The main criteria for choosing companies' sustainability reports for the analysis were the following:

1. Mining companies with a mine or an ore processing plant within Europe.
2. A sustainability framework or standards used for the sustainability reports.
3. Sustainability reports publicly published in English.
4. Sustainability reports annually published for the years 2016, 2017, and 2018.

To gather information about mining companies in Europe the GRI Database, several recent academic papers which analyzed Nordic mining industry, and database of the major European mining associations were used [51, 52]. Businesses with headquarters in European countries operating only in other parts of the world, were not included in the analysis. The final number of companies studied was 10 (see Fig. 1).

The literature review was conducted through Science Direct and Google Scholar using keywords as "mining," "sustainability," "report", "SDGs," "CSR," "GRI" and "Europe." Additionally, several papers were found in the reference list of the previously gathered academic papers using the snowball technique, a method of data collection through the primary data sources to collect potential additional sources [53].

### 3.2 Content analysis

A content analysis of 30 sustainability reports from 10 mining companies published from 2016 to 2018 was carried out, see Appendix A. This is a common method applied to define large amounts of quantitative and qualitative data of documents through systematic coding and categorization to group information around concepts or themes [54]. It was performed manually using an Excel document for collecting data by company and year of publishing of the reports. The coding process for the content analysis was based on an inductive approach, where the categories are developed from the raw data into a model with key themes [55]. During this process, disclosed materiality topics were observed as a key theme, each marked with a different color, data was sorted in separate sheets according to the key topic, and common data for all studied companies were gathered to answer the research questions.

A qualitative content analysis [56] of the policies, actions, and indicators presented in the sustainability reports was conducted to examine their contribution to sustainable development. A quantitative content analysis of the reported indicators' data was carried out to determine whether the implemented actions resulted in the improvement or reduction of impacts. In addition, contribution to the SDGs was determined through an examination of whether the SDGs were part of the reports, at which level the content was linked to the SDGs, and which Goals were the most reported upon.

## 4 Sustainability Practices By European Mining Companies

The list of companies included in the study and the sustainability frameworks used by analyzed companies are presented in Table 2. In the sustainability reports for 2016, all the mining companies, used the GRI G4 Guidelines: Core option with the majority applying the Mining and Metals Sector Supplement. There is a transition towards GRI Standards due to the change

from GRI G4 Guidelines to GRI Standards in 2016. Three of the companies as members of the International Council on Mining and Metals (ICMM) are obligated to report using the GRI Standards annually. A notable trend was observed in the use of the UN Global Compact (UNGC) principles, with nine out of 10 UNGC signatories by 2018. Similar improvements were visible in the commitment to the SDGs from only four mining companies in 2016 to the integration of the SDGs into the sustainability strategy and reporting by all companies in 2018.

The companies reported on the following topics: governance, stakeholders' engagement, occupational health and safety, and environment. Each of these topics are discussed in the following section, in addition to how the SDGs relate to the core business of the mining companies.

Table 2  
Sustainability reporting frameworks used by analyzed companies

Company	Reporting framework		
2016	2017	2018	
Agnico Eagle	In accordance with GRI G4 Guidelines/ Mining and Metals Sector Supplement	In accordance with GRI G4 Guidelines/Mining and Metals Sector Supplement; SDGs	In accordance with GRI G4 Guidelines/Mining and Metals Sector Supplement; SDGs
Boliden	In accordance with GRI G4 Guidelines: Core option/Mining and Metals Sector Supplement	In accordance with GRI Standards: Core Option/Mining and Metal Sector Supplement	In accordance with GRI Standards: Core Option/Mining and Metal Sector Supplement;  UNGC; SDGs
Eldorado Gold	In accordance with GRI G4 Guidelines: Core Option;  UNGC	In accordance with GRI G4 Guidelines: Core Option;  UNGC; SDGs	In accordance with GRI Standards: Core Option;  UNGC; SDGs
Elkem	In accordance with GRI G4 Guidelines: Core Option;  UNGC	In accordance with the GRI Standards: Core option;  UNGC; SDGs	In accordance with GRI Standards;  UNGC; SDGs
Glencore	In accordance with GRI G4 Guidelines: Core Option/Mining and Metals Sector Supplement; UNGC; SDGs; ICMM	In accordance with GRI Standards: Core Option/Mining and Metals Sector Supplement;  UNGC; SDGs; ICMM	In accordance with GRI Standards: Core Option/Mining and Metal Sector Supplement;  UNGC; SDGs; ICMM
Hydro	In accordance with GRI Standards;  UNGC; SDGs;	In accordance with GRI Standards: Core option;  UNGC; SDGs; ICMM;	In accordance with GRI Standards: Core option;  UNGC; SDGs; ICMM
Imerys	Citing GRI G4 Guidelines: Core option; UNGC	Citing GRI Standards: Core option; UNGC; SDGs;	Citing GRI Standards: Core Option;  UN Global Compact; SDGs;
LKAB	In accordance with GRI G4 Guidelines: Core Option/Mining and Metals Sector Supplement; UNGC	In accordance with GRI G4 Guidelines: Core option/Mining and Metals Sector Supplement; UNGC; SDGs	In accordance with GRI Standards: Core option/Mining and Metals Sector Supplement;  UNGC; SDGs
Lundin	In accordance with GRI G4 Guidelines/Mining and Metals Sector Supplement; UNGC; SDGs	In accordance with GRI Standard: Core option/Mining and Metals Sector Supplement;  UNGC; SDGs	In accordance with GRI Standards: Core option/Mining and Metals Sector Supplement;  UNGC; SDGs
Rio Tinto	In accordance with GRI G4 Guidelines: Core option/Mining and Metal Sector Supplement;  UNGC; SDGs; ICMM	In accordance with GRI Standards: Core option/Mining and Metals Sector Supplement.  UNGC; SDGs; ICMM	In accordance with GRI Standards: Core option/Mining and Metals Sector Supplement;  UNGC; SDGs; ICMM
Synthesized by the authors based on the analysis of the data.			

## 4.1 Corporate Governance

Code of Conduct was the primary document for the analyzed firms on which the business strategy and ethical behavior of a company were based. Furthermore, companies had developed additional policies in terms of health and safety, human rights, anti-corruption, environment, and employees. Companies stated that sustainability was an integral part of their business strategy which was aligned with international standards and commitments such as the UNGC, the SDGs, and the GRI Standards.

## 4.2 Stakeholder engagement

Building a strong relationship and maintaining an open and inclusive dialogue with stakeholders was the main objective for the analyzed companies as part of their social responsibility. Stakeholders' engagement was recognized as a critical area to maintain the social license to operate and was based on extensive stakeholder mapping, where the priority stakeholder groups were defined. Each company identified its important group of stakeholders (see Table 3).

Table 3  
Stakeholders' list

<b>Agnico Eagle</b>	<b>Employees, local communities, governments, Indigenous people, partners, shareholders</b>
<b>Boliden</b>	Employees, neighbors, owners, capital market, business partners, authorities, media, Sami villages, consumers, universities/research, environment
<b>Eldorado Gold</b>	Employees, contractors, suppliers, shareholders, local community, governments, NGOs, industry groups
<b>Elkem</b>	Employees, authorities, suppliers, customers, shareholders, local community, unions, research institutions, NGOs
<b>Glencore</b>	Employees, suppliers and contractors, local communities, local and national governments, NGOs, unions, investors, customers
<b>Hydro</b>	Society, media, authorities, NGOs, industry associations, customers, partners, suppliers, employees, unions, shareholders, banks, Norwegian state
<b>Imerys</b>	Employees, business partners, shareholders, investors, suppliers, customers, governments, industry associations, local communities, media
<b>LKAB</b>	Employees, owner, communities, customers, suppliers, society
<b>Lundin</b>	Employees, local communities, government, customers, labor unions, NGOs, shareholders, financial institutions, suppliers
<b>Rio Tinto</b>	Employees, host communities, suppliers and contractors, customers, governments, shareholders and investors, NGOs, industry associations, media
Synthesized by the authors based on the analysis of the data.	

Local communities were identified as one of the most important stakeholders of the mining companies due to the impact on communities by providing direct employment and indirect jobs carried out by the mining companies' suppliers. Community investments were mostly philanthropic donations to community development, infrastructure, health and well-being, and education. Mining companies provided scholarships and internships to attract skilled personnel and cooperated with universities and research institutions on various projects.

In the reports, employees were described as key stakeholders, driving forces, and the best ambassadors to attract new employees. The personnel's competence building was done by mandatory in-house training programs and regular performance reviews for further skills and talent development. Mining companies aim to achieve better gender balance through a workplace without gender-based discrimination or harassment. However, several companies reported on incidents



of discrimination or harassment occurred in the studied period (Boliden, Hydro, LKAB). During the three years, the share of women in companies remained the same or increased slightly (Fig. 2).

## 4.3 Occupational health and safety

Health and safety are among the main concerns for the analyzed mining companies whose aim is to operate without injuries. Their safety performance was frequently monitored using several indicators, like Total Recordable Injury Rate (TRIFR), Lost-Time Injury Frequency (LTIFR), and fatalities (Table 4). Safety has improved over the analyzed period, according to the data presented in the reports. Only few mining firms monitored employees' health by tracking the number of new cases of occupational disease which indicated a reducing trend in new cases of occupational disease.

Table 4. Health and safety performance of analyzed mining companies for 2016-2018 period

Health and safety	TRIFR			LTIFR			Fatalities			New cases of occupational illnesses		
	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Agnico Eagle	↑	↑	↓	↑	↑	↓	↓	↑	↑	n/r	n/r	n/r
Boliden	↑	↑	↑	↑	↑	↑	↑	↑	↑	n/a	n/a	n/a
Eldorado Gold	↓	↑	↓	↑	↑	↑	↓	↓	↑	n/r	n/r	n/r
Elkem	↑	↑	↑	n/r	n/r	n/r	↓	↑	↑	n/a	n/a	n/a
Glencore	↑	↑	↓	↓	↑	↓	↓	↓	↓	↑	↑	↑
Hydro	↑	↓	↓	n/r	n/r	n/r	↑	↓	↓	↑	↑	↓
Imerys	↑	↓	↓	↑	↓	↑	↓	↑	↓	↑	↑	↑
LKAB	↑	↓	↓	n/r	n/r	n/r	↑	↑	↓	n/r	n/r	n/r
Lundin	↑	↑	↓	↑	↓	↑	↑	↑	↑	n/a	n/a	n/a
Rio Tinto	↑	↑	↓	↑	↑	↓	↑	↑	↓	↑	↑	↓

Note: ↓ refers to “negative trends”; ↑ refers to “positive trends”; n/a refers to “not applicable”, n/r to “not reported”.

Created by the authors based on the analysis of the data.

## 4.4 Environmental issues

The main environmental material topics in the sustainability reports are energy, and greenhouse gas emissions, water management, waste, and air emissions (Tables 5 and 6.). Energy consumption represents one of the significant environmental impacts with fossil fuels as a highly represented energy source within mining operations, while the share of renewable energy in the energy mix is above average just for few companies, such as Hydro, Elkem, and Lundin ( $\geq 50\%$ ). Only Hydro and Rio Tinto had reduced total energy use in the period from 2016 to 2018.

Decreasing trends in total GHG emissions were noticeable in the data for five companies, due to implementation of energy recovery from excess heat, and the replacement of fossil fuels with renewable energy sources. Some companies, however, did not report on air emissions at all. Despite the efforts, most of the companies had increased SO<sub>2</sub> emissions from boosted production or higher sulfur content in the raw material. The dust emissions were lower for the companies which included dust emissions in their reports.

Vast amounts of water are utilized in mineral production, thus, to reduce the impact, companies implement, reuse, and recycling of water, and the usage of closed systems in the production. Compared with the year 2016, most of companies had increased amounts of withdrawn water. The share of the reused/recycled water was from 10 percent (Hydro), to around 200 percent (Lundin), while other companies were above 50 percent.

Table 5. Environmental performance in energy, GHG emission and air emissions of analyzed mining companies for the 2016 – 2018 period.

Environment	Energy						GHG emission			Air emissions								
	Consumption			Renewables						SO <sub>2</sub>			NO <sub>x</sub>			Dust		
	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Agnico Eagle	↓	↓	↓	n/r	n/r	n/r	↑	↓	↑	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Boliden	↓	↓	↓	↑	↑	↑	↑	↑	↑	↑	↓	↓	↑	↓	→	↑	↓	↑
Eldorado Gold	↓	↓	↓	n/r	n/r	n/r	↑	↓	↑	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Elkem	↓	↓	↓	↑	↑	↑	↓	↓	↓	↓	↓	↓	↑	↓	↑	↑	↓	↑
Glencore	↑	↑	↓	↑	↑	↑	↑	↑	↑	↓	↓	↓	n/r	n/r	n/r	n/r	n/r	n/r
Hydro	↓	↑	↑	↑	↑	↑	↓	→	↑	↑	↑	↑	↓	↓	↑	↑	↑	↑
Imerys	↓	↓	↓	↑	→	→	↓	↓	↓	↓	↓	↓	↓	↓	↓	n/r	n/r	n/r
LKAB	↓	↓	↑	↓	↓	↓	↓	↓	↓	↑	↓	→	↑	↑	↑	↓	↑	→
Lundin	↓	↓	↓	↑	↑	↑	↑	↓	↓	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Rio Tinto	↓	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↓	↑	↑	↑	↑	↑

Note: ↓ refers to “negative trends”; ↑ refers to “positive trends”; → refers to “no change”; n/a refers to “not applicable”, n/r to “not reported”. Created by the authors based on the analysis of the data.

Table 6. Environmental performance in water, waste, and land use of analyzed mining companies for the 2016 – 2018 period.

Environment	Water						Waste						Land use					
	Withdrawal			Recycled/reused			Generated			Recycled/reused			Disturbed			Rehabilitated		
	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Agnico Eagle	↓	↓	↓	n/r	n/r	n/r	↑	↓	↑	↑	↑	↑	n/r	n/r	n/r	n/r	n/r	n/r
Boliden	↓	→	→	↑	↓	↑	↓	↓	↓	↑	↑	↑	↓	↑	↓	↑	↓	↑
Eldorado Gold	↑	↑	↑	↑	↑	↑	n/r	n/r	n/a	n/r	n/r	n/r	n/a	n/a	↑	n/a	n/a	↑
Elkem	n/a	n/a	n/a	n/r	n/r	n/r	n/a	n/a	n/a	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Glencore	↓	↑	↓	↑	↓	↑	↓	↓	↓	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Hydro	↓	↓	↓	↓	↓	↓	↑	↑	↑	↑	↑	↑	↓	↓	↓	↑	↑	↑
Imerys	↓	↓	↓	↑	↑	↑	↓	↓	↓	↑	↑	↓	↑	↑	↑	↓	↓	↓
LKAB	n/r	n/r	n/r	n/r	n/r	n/r	↓	↓	↓	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
Lundin	↑	↑	↑	↑	↑	↑	↑	↓	↓	↑	↑	↑	↓	↓	↓	↓	↓	↓
Rio Tinto	↓	↓	↑	↑	↑	↓	↑	↑	↑	n/r	n/r	n/r	↓	↑	↓	↓	↑	↑

Note: ↓ refers to “negative trends”; ↑ refers to “positive trends”; → refers to “no change”; n/a refers to “not applicable”, n/r to “not reported”. Created by the authors based on the analysis of the data.

Generation of waste from the mining operations increased for the majority of companies, while half of them did not presented data for reused or recycled waste. Barren rock and partially tailings were used as backfill in underground mines, as a construction material, and in cement production. Elkem uses collected micro silica as a by-product, while Hydro and Boliden recover metals from process waste.

Mining uses large land areas for mining, exploration, and the construction of the mining infrastructure. Boliden, Imerys, Hydro and Rio Tinto used two land-use indicators, namely total disturbed surface area and total rehabilitated area. Despite the restoration activities, rehabilitated area per year is much lower than the affected area.

## 4.6 Integration of the SDGs into the core business

Mining companies' sustainability work is based on their own established norms and values, as well as on the UN Global Compact principles and the SDGs. Implementation of the SDGs into the sustainability reports considerably improved over the three-year study period. In 2016 only Glencore, Hydro, Lundin, and Rio Tinto had begun to align their sustainability strategies with the SDGs. By the 2018 reporting year, all the mining companies adopted SDGs as a part of their business strategy. Their contribution to the SDGs is explained in special sections within the report or directly linked to the materiality topics. However, the explanations were too general without profounder relation to the SDGs and defined objectives linked to the SDGs targets.

The results from all referred SDGs from the reports are presented in the Table 7. The only mutual SDG for all companies was Goal number 8, Decent work, and economic growth, followed by SDG 3 Good health and well-being and SDG 13 Climate action. Other relevant SDGs within the studied reports were SDG 16 Peace, justice, and strong institutions, SDG 5 Gender equality, SDG 6 Clean water and sanitation, SDG 9 Industry, innovation and infrastructure, SDG 10 reduced inequalities, SDG 12 responsible consumption and production, and SDG 15 Life on land. SDG 1 No poverty and SDG 2 Zero hunger were not well represented in the analyzed sustainability reports.

Table 7. Sustainable Development Goal referred in the analyzed reports.

SDG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Agnico Eagle	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
Boliden	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+
Eldorado Gold			+		+	+		+	+			+					
Elkem			+				+	+	+				+			+	
Glencore			+			+		+		+		+	+	+	+	+	+
Hydro				+				+	+			+	+	+	+	+	
Imerys			+	+	+	+		+				+	+		+	+	
LKAB					+		+	+	+		+		+		+		+
Lundin			+		+		+	+	+	+		+	+			+	
Rio Tinto				+	+	+		+		+	+		+				+

Created by the authors based on the analysis of the data.

## 4.7 Institutional drivers of sustainability of European mining companies

The findings suggest that European mining companies act under pressures from international initiatives like UNGC, industry associations, the European Union, governments, stakeholders, and partnerships. Stakeholders like local communities were a highly influential force requiring that mining companies implement actions to mitigate negative impacts like dust, noise, and heavy traffic. Partnerships with external stakeholders such as NGOs, universities, and research institutes act as a normative driver for sustainability activities in fields of biodiversity, education, and research and development (R&D). Figure 2 synthesizes the key findings on the study showing how institutional drivers influence the sustainability practices among European mining companies and their contribution to sustainable development as presented in their sustainability reports. The figure also suggests an additional pressure, in the form of community acceptance, namely the social license to operate. In addition, the figure shows how reporting on sustainability issues may lead to additional improvements in terms of

contributions to sustainable development, such as increased emphasis on the SDGs and in the sustainability practices of European mining companies. These improvements can, in turn, further alter institutional drivers, such as through peer pressure among companies in the same sector. All these aspects are discussed further in what follows.

## **5 Discussion**

The overall aim of this research was to analyze, compare and critically evaluate sustainability reports of European mining companies for the 2016–2018 period to determine the drivers for implementation of sustainability practices, to assess performance based on their reported data and the integration of SDGs.

### **5.1 Institutional drivers for implementation of sustainability practices in European mining**

As analyzed companies had been publishing sustainability reports prior to the period included in this study, it can be argued that the pressures for such disclosure relates to normative isomorphism [48]. However, the EU Directive on non-financial reporting can be a coercive force by obligating large enterprises, including the studied companies, to report on environmental and social issues [36]. The positive trend of mining companies joining the UNGC was likely influenced by mimetic pressures from industry peers [46], as the UNGC is a voluntary initiative, therefore no regulation obliges companies to join it.

The mining industry has been under pressure to act responsibly regarding the environment and social issues by several external drivers [41]. Participation in internationally recognized sustainability initiatives determines the company's commitment to the implementation of CSR practices [48] and can be identified as one of the main isomorphic pressures to institutionalize CSR in business. Furthermore, membership in industry associations encourages companies to apply and share best practices in the industry, while through these networks companies also tend to mimic the behavior of competitors [46].

National governments and legislation are another coercive factor as governments issue the mining permits to operate on which companies must comply. Likewise, governments force changes in sustainability activities through the environmental and social laws, taxation systems, labor practices, and corporate governance regulations [44]. The EU legislations are also recognized as one of the regulatory forces influencing mining companies in Europe to align their operations and policies to new regulations, such as the REACH Directive on Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals, the EU Directive on non-financial disclosure and various other regulations [36]. The EU strong commitment to the SDGs and the Paris Agreement through the Green Deal puts additional pressure on mining companies operating in Europe to implement strategies and actions in terms of decarbonization, energy efficiency and biodiversity conservation [13].

In general, stakeholders impose coercive and normative pressures on companies [44] by forcing them to improve their performance to maintain their social license to operate [18].

### **5.2. Mining contribution to sustainable development and the assessment of the performance**

The findings support the results of a previous review of sustainability practices in the mining industry [17] i.e., that the Code of Conduct, together with sustainability reports and community engagement, predominantly characterize sustainability management. Maintaining a strong and open dialogue with stakeholders and their engagement is an important objective for mining companies to secure a social license to operate [35]. Local communities were recognized as one of the most crucial stakeholders [44] represented in the specially developed protocols, community monitoring programs, and community relations teams [17]. Among the key stakeholder classification, only Boliden identified the environment as the priority stakeholder. Considering the significant negative environmental impact of mining operations (Table 1.), it should arguably also be recognized as a key stakeholder by other companies [55]. Following the concept of sustainable development [57]

future generations are important stakeholders, as they are affected by the present decisions of companies or society, but they cannot influence those [56].

Most important stakeholders for the mining companies are their employees; therefore, great efforts are made to attract skilled new employees and to retain existing ones. Due to operations in the remote areas, high risk for employees and often the negative image of mining [30], they struggle to attract high-qualified and locally available skilled people [33]. Even though diversity is highlighted in the reports, especially gender equality, the results show that the mining industry is still male dominated [31] with a steady low share of women employees. Also, cases of harassment and discrimination evidenced in this research, confirm other studies' outcomes [32] that women workers in the mining industry still experience discrimination. These issues could be mitigated through an increased emphasis on sustainability [58].

The results in health and safety performance suggest that progress is evident in reduced injuries in the workplace due to safety training, programs, risk assessment and implemented technology [29, 33]. However, due to fatalities there is a necessity for stronger safety culture combined with the best technologies to prevent accidents [30], including safety culture programs and certification.

Energy presents a huge part of mining impact [28], and most of the analyzed companies had increased their energy consumption during the study period. Mining companies should not just be the providers of minerals for a low-carbon future, but be leaders in efficient renewable energy use, energy saving in the production and use of secondary raw materials [4]. The inclusion of these considerations would ensure a more genuine mining contribution to sustainable development based on enabling a renewable energy transition while mitigating the negative impacts of current mining operations.

Half of the studied companies decreased their GHG emissions by using excess heat, recycling, renewable energy sources and improved energy efficiency [23]. Still, targets for reducing carbon emissions were not ambitious, and, moreover, 40 percent of the companies did not have any targets to reduce GHG emissions. The findings indicate that the companies are far from meeting the Paris Agreement goals [11], and the EU's objective of becoming climate neutral by decarbonizing the energy sector [13]. Despite that air pollution from mining has a great impact on the environment [24], this impact is not thoroughly covered by most of the companies.

Even though most of the water was recycled and reused in the operations, not all the companies disclosed data on recycled water [25]. To contribute to the SDGs [12], the EU's Green Deal, and the sustainable supply of raw materials [4], European mining companies could pay more attention to utilizing the generated waste to extract valuable secondary minerals as they have a great potential to solve the limited mineral supply and generate profit [14], while reducing their energy input, environmental risks, and overall environmental footprint [15]. The results demonstrate that the efforts to restore disturbed land area are significantly low, therefore implementation of integrated mine closure during the operation phase would result in better environment protection and transparent stakeholder engagement [59]. Furthermore, biodiversity issues should be addressed through more holistic approach due to the European Commission [13] recognition of biodiversity conservation as one of the essential activities to achieve a climate-neutral EU, and companies' commitment to SDGs.

### **5.3. Integration of the SDGs based on the companies' sustainability reports analysis**

From the results related to the SDGs, mining companies made considerable progress in supporting and linking their sustainability activities to the SDGs from several firms in 2016, to citing the SDGs in all analyzed sustainability reports two years later. Only one Goal, SDG 8 on decent work and economic growth, was common for all companies which demonstrates that these companies recognize their economic contributions as one of the most crucial segments of their impacts on sustainable development [38]. Most of the companies associated one or more SDGs to the report's materiality topic or indicators, while some had separate sections related to the identified SDGs. What is lacking in some reports is an evident explanation of the contribution of the associated SDGs and activities [38, 39]. To enhance the SDGs integration, companies could set and align their short-term and long-term objectives to the SDGs targets and indicators. Likewise, contribution to the

SDGs could be more comprehensive with exact activities connected to the Goals instead of general explanations. However, considering that SDGs are relatively new topic, and that the results suggest most of the analyzed companies started aligning their business strategies to the SDGs in 2017 or 2018, longer period is required for mining companies to implement SDGs into business strategy and sustainability disclosures [40].

## 6 Conclusions

The results of this research offer a unique contribution to understanding the sustainability activities of mining companies in Europe, the external drivers that motivate them to engage in these activities and their contribution to the SDGs. This study addressed a research gap of a limited academic research conducted on the sustainable development regarding the European mining industry. International initiatives, industry associations, the EU, national governments, and external stakeholders are recognized as the forces pushing the mining industry in Europe to implement sustainability practices. Therefore, this research provides new insight into institutional theory and the external drivers for sustainability practices. Since the EU recognized the extractive industry as one of the key partners in the realization of The Green Deal, the findings are relevant to European policymakers responsible for the sustainable development regulations and benchmark for policymakers in other regions. Importance for the EU Directive on the Disclosure of Non-financial Information and its implementation is demonstrated as all the analyzed companies are in the category of mandatory non-financial reporting. Outcomes are also applicable to the mining companies, to learn from their peers, to reduce negative impact, and implement the best practices.

Mining companies in Europe implement various actions to reduce their impact ranging from stakeholder engagement, to training, and skill development of the employees. However, there is a lack of progress in renewable energy, generated waste utilization, and higher gender equality. Despite the progress in the implementation of SDGs regarding sustainability reporting, disclosed contributions were too general without detailed explanation and set objectives lacked relation with the SDGs' key performance indicators.

Perhaps the most important limitation of the study is that the analysis is based on self-reported data which are used as a measure of company performance. Lack of previous studies in the field of sustainability reporting within the European mining industry was also a limiting factor in conducting the research. Regardless of the uniform use of similar sustainable reporting standards, there are some obstacles to the studied reports' comparability. Due to different materiality assessments some materiality topics were not disclosed, such as biodiversity, and the GRI Content Index was missing in some reports. The performance indicators on which companies report differ from using one to several indicators related to the same subject or different measuring units for the same indicators, like either joules (GJ, TJ) or watthour (kWh, GWh) for the energy consumption. While some companies presented exact numbers in forms of tables and graphs, data for different geographical locations and periods, other disclosed numbers only for the reporting year; hence, the reader cannot get the overall view of whether the company improved or not.

Future studies on this topic should explore further implementation of SDGs among mining companies in Europe, as the analyzed period might be too short to detect significant progress. Furthermore, different research methods or data sources could be used, such as interviews with sustainability committees or key stakeholders, to provide a broader view and better understanding of the effectiveness of the implemented sustainability activities and practices. Finally, this research offers a model for further studies, not just for Europe and can serve as a comparative tool for future research on the progress towards sustainable development.

## Appendix

Appendix A - List of analyzed reports used in the research

Company	Sustainability reports		
	2016	2017	2018
Agnico Eagle	2016 sustainable development report: Proud Of Our Past, Engaged In Our Future	Sustainable development summary report 2017: Working Together For A Sustainable Future	2018 sustainable development report: Mine. Yours. Ours.
Boliden	GRI Report 2016: Sustainable metal production for the future	GRI Report 2017: Metals for sustainable value creation	2018 Annual and Sustainability Report: Metals for a sustainable society
Eldorado Gold	Eldorado Gold Year in review 2016: Focus on the future	Eldorado Gold Year in review 2017: Tomorrow, Together	Eldorado Gold Year in Review 2018: Opportunity
Elkem	Sustainability report 2016	Elkem GRI report 2017: Global Presence.	Sustainability report 2018: Delivering your potential
Glencore	Sustainability report 2016	Sustainability report 2017	Sustainability report 2018: Responsibly sourcing the commodities for everyday life
Hydro	Annual report 2016	Annual report 2017	Annual report 2018
Imerys	Mineral solutions to create tomorrow's world.2016 registration document. Annual financial report	2017 corporate social responsibility report	Corporate social responsibility report 2018
LKAB	2016 Annual and Sustainability report	2017 Annual and sustainability report	2018 Annual and sustainability report
Lundin	2016 Sustainability report	2017 Sustainability report	2018 Sustainability report
Rio Tinto	Partnering for progress: 2016 Sustainable development report	Partnering for progress: 2017 Sustainable development report	Pioneering progress: 2018 Sustainable development progress

## Abbreviations

<b>EU</b>	European Union
<b>NGO</b>	Non-governmental organization
<b>ICMM</b>	International Council on Mining and Metals
<b>GRI</b>	Global Reporting Initiative
<b>SDGs</b>	Sustainable Development Goals
<b>CSR</b>	Corporate Social Responsibility
<b>UNGC</b>	United Nations Global Compact
<b>GHG</b>	Greenhouse gas emissions
<b>SO<sub>2</sub></b>	Sulphur dioxide
<b>NO<sub>x</sub></b>	Nitrogen oxides
<b>REACH</b>	Regulation, evaluation, and authorization of chemicals
<b>EMS</b>	Environment management systems
<b>TRIFR</b>	Total Recordable Injury Rate
<b>LTIFR</b>	Lost-Time Injury Frequency
<b>GDP</b>	Gross Domestic Product

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