

Perspectives on sustainable mining in Finland





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Translation of publication 2/2021 in the National Audit Office's
publication series "Perspectives"

Introduction



The economic, social, and ecological sustainability of mining is debated in Finland, in the EU and around the world. In this publication, the topic is approached from the following perspectives: the connection between sustainable mining and central government finances, objectives and implementation of Finland's mining policy, increasing the added value of battery minerals and battery industry, circular economy solutions for mining operations, local acceptance of mining operations (social licence to operate), and the management of environmental risks arising from abandoned and closed mines. We are mapping areas of sustainable mining that have or may have an impact on the sustainable management of central government finances. This publication is not an audit report.

The most recent audit by the NAOF focusing solely on the mining sector was published in 2007. It was titled 'State as a promoter of exploration and mining' (154/2007). Mining is also one of the industries that were examined in the performance audit 'Encouraging business investments – views of four sectors' (4/2017).

The NAOF has also produced audits and reports on environmental sustainability¹ and this publication supplements these reports from the perspective of mining.

Written material was used as sources and a large number of interviews with mining and mineral industry experts were carried out. Mining companies and experts also provided the NAOF with valuable information in writing. We would like to thank all partners taking part in the preparation of the publication.

Helsinki, 6 May 2021

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1 The state is involved in sustainable mining in many different ways

Mining and the industries and services related to it play a significant role in the Finnish national economy, which is reflected in central government finances. The state also plays a major role as a regulator and a permit authority. Occasionally, the state may have to assume liability for the costs and environmental problems arising from closed mines. As the owner of the Finnish Minerals Group, the state is also a major mining operator. Production of metals enhances the security of supply. Environmental protection and ecologically sustainable mining have been major themes in Government Programmes in the 2010s.



1.1 Mining and the other industries based on it play a significant role in the national economy

There are promising mineral deposits in the Finnish bedrock. Mining has been carried out in Finland for centuries. There are more than 40 metal ore and industrial mineral mines in operation in Finland. In international comparisons, Finland has a number of strengths making the country well-suited for mining activities. These include good geological knowledge and ore resources, a stable society, a high level of education and a top-class infrastructure.

The mines are often located in areas where there is little industrial activity. Thus, they have a significant impact on regional economy. Finland is also home to mining-based processing industries and services and manufacturing of technologies supporting them. Finland is one of the world's leading suppliers of mining technology.

Mining accounts for a significant proportion of the added value of Finland's gross domestic product. Mining and the other industries and services related to it also have significant employment impacts.

Finland's mining sector in figures

In 2018, there were 11 metal ore mines in Finland, in which a total of 38.5 million tonnes of ore were extracted during the year. Nine of the mines are owned by foreign companies. Thus, most of the investments in recent years have come from outside Finland. Finland also has 35 industrial mineral mines, in which 16.5 million tonnes of usable rock for industrial minerals was extracted.

Finland's mining industry has an annual turnover of about EUR 2 billion, while the annual turnover of metal processing companies totals about EUR 11.2 billion. Mining generates a total of EUR 1.2 billion in added value to the Finnish economy each year.

The direct and indirect employment impact of the mining industry in 2017 amounted to about 13,000 person years. The entire mineral sector employs about 30,000 people. Finland's metal processing sector employs more than 15,000 people. Indirectly, the activities supporting the mining industry employ a total of 35,000 people.

Mining and extraction output totalled between EUR 0.4 and 1.7 billion in the period 2000–2015, and it has doubled during those years.² It is estimated that in the long term, the need for mineral raw materials will increase, which means that there will also be demand for them in the future.

Most of the metals extracted in Finland are processed into other products. There is a substantial deficit in the trade of raw materials: imports of metal ore concentrates (EUR 1.7 billion) is higher than exports (EUR 484 million). However, there is a surplus in the trade of end products. Although domestic extraction of metals has increased substantially over the past ten years, metal processing companies mostly rely on imported concentrates.

1.2 State has many roles in mining operations

As stated above, mining and the industries and services related to it play a significant role in the Finnish national economy and this is also reflected in central government finances. The state plays a key role in mining, even though the activities are carried out on a commercial basis.

The state regulates mining operations in many ways, and a variety of different administrative permits are required for mining activities. These include the exploration and mining permits based on the Mining Act, environmental permit based on the Environmental Protection Act, water management permit based on the Water Act, mining safety permit, permits for the handling of hazardous chemicals and rescue plans, dam safety programmes, mining area redemption permit and a building permit. An environmental impact assessment procedure (EIA procedure) is required in connection with the planning of major mining projects. The state plays a major role as a regulator and permit authority in the mining sector, which requires substantial resources from central government authorities.

The EIA and permit procedures concerning the mining sector are often criticised for being work-intensive and time-consuming. However, they are usually well-suited for managing the environmental risks arising from mining. In general, mining companies also take a positive view of explicit and comprehensive legislation as it enhances their operating prerequisites.

The state also provides mining activities with funding. Through the Finnish Minerals Group, it is a major mining operator and owner of mines. The issue is also linked to the security of supply, as there have been more calls recently to boost the production of critical minerals in Europe.

The state also provides funding for research and development in the mining sector. The Geological Survey of Finland (GTK), operating under the auspices of the Ministry of Economic Affairs and Employment, plays a major role in the use of Finland's ore and mineral resources. The task of the GTK is to map geological resources and to keep the maps and information services on them up to date. It also produces geological information to support decision-making and acts as an expert in the mineral policy of Finland and the EU. The GTK also carries out applied research for business needs.

Occasionally, the state has also been forced to assume liability for the costs and environmental problems arising from closed mines.

The state has provided funding for mining research projects and mine closures

The mining industry investment programme of the state-owned Finnish Industry Investment Ltd ended in 2018 and the companies involved were transferred to the Finnish Minerals Group, a new state-owned special assignment company. A total of about EUR 46 million in unused appropriations of the mining investment programme allocated to the Finnish Industry Investment in the state budget were transferred to the new company. The state has invested more than EUR 800 million in Talvivaara and Terrafame. In the fourth supplementary budget proposal for 2020, the Government granted EUR 300 million to the recapitalisation of the Finnish Minerals Group.

The liabilities for the mining and metal industry account for about two per cent (EUR 60 million) of Finnvera's export credit and special guarantees.

Business Finland (formerly Tekes Venture Capital Ltd) has also granted substantial innovation funding to the mining and battery sector. Funding for mining research and development projects has also been provided from the Horizon 2020 project of the EU.

Mines are the most important category of companies in which environmental liabilities have been covered from the state budget. For example, a total of more than EUR 90 million has been spent on the management of the environmental damage caused by Talvivaara Sotkamo Oy, while more than EUR 20 million has been spent on the closure of the Hitura mine, which went bankrupt in 2015.

1.3 Mining must be on a sustainable basis

Mines generate economic benefits in the areas where they are located and they have positive impacts on the national economy as a whole. However, there is also a continuous debate on the need, role and sustainability of mining operations. The negative impacts of mining projects on other business activities in their areas and the environmental risks arising from mines have been highlighted in the debate. The problems caused by the Talvivaara mine prompted a lively public debate on the environmental impacts of mining in 2012. Recently, there have been concerns about ore exploration and mining projects in the Saimaa region. Mining operations require the acceptance of local residents and gaining this acceptance is not always easy. However, Finland is considered a country where mining operations can be carried out on a sustainable basis. Sustainability of mining operations is also a key consideration in Finland's policy goals.

Mining is a global business and its operating practices are often criticised, especially in developing countries. In fact, where and on what terms mining should be carried out is a key issue in the global mining debate. The sharing of the benefits and harmful impacts of mining operations between countries responsible for primary production, the processors of raw materials, and consumers also partially depends on the responsibility of the international supply chains.

Mining operations should not only be examined from the economic perspective but also from the perspective of social and ecological sustainability. These aspects of sustainability are intertwined in many different ways. Mining can contribute to the achievement of the Sustainable Development Goals of the UN, but it can also act against them. According to an international study, mining operations can promote economic development, and the creation of jobs, new business opportunities and infrastructure, but they can also generate harmful impacts. Especially in developing countries, problems include environmental destruction, health risks, forced displacement of people, widening inequalities, armed conflicts, corruption and human rights violations.³ Taking into account the different dimensions of sustainability is increasingly seen as a prerequisite for successful mining in Finland, Europe and the rest of the world.⁴

According to the principles of sustainable development, minerals should be used in such a manner that there will also be raw materials left to future generations. One way of doing this is the circular economy, which contains operating models that can be utilised in the mining industry and in the processing of metals. Mining has also become part of the development of the green economy and a carbon-free society. A broad range of different metals is required for the production of renewable energy technologies (such as batteries). The complex dimensions of sustainable mining can be illustrated with the figure below (Figure 1).

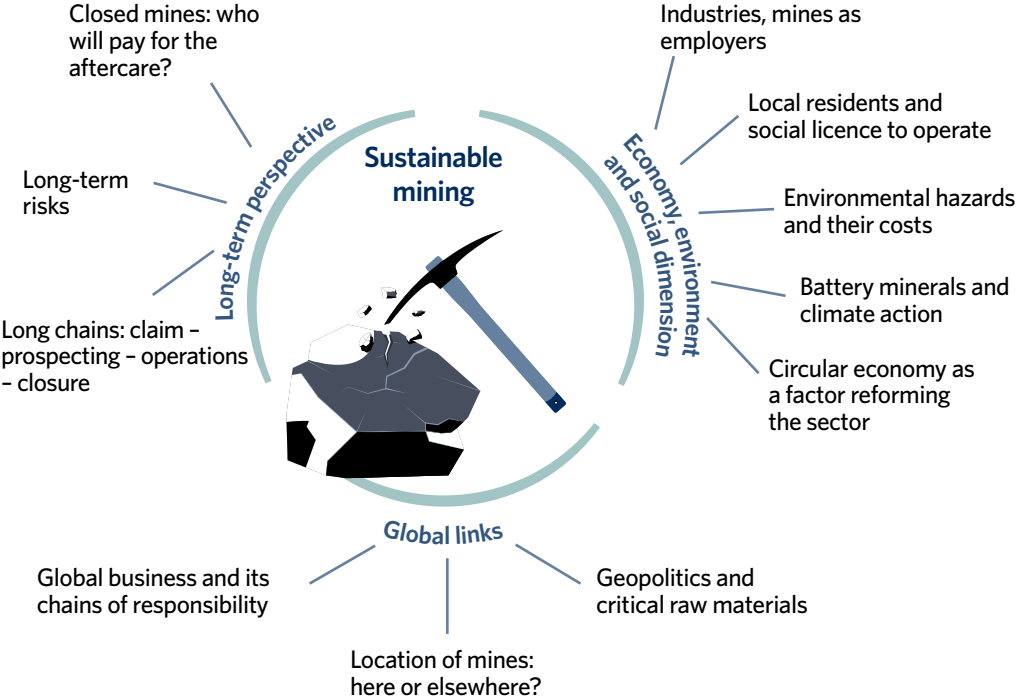


Figure 1: Dimensions of sustainable mining

1.4 Ambitious targets for sustainable mining have been set in Government Programmes in the 2010s

The mining industry became increasingly important in Finland in the early 2000s and the aim was to make the sector a new cornerstone of Finland's economy. It was also hoped that Finland would become a pioneer in the sustainable use of natural resources. These objectives are stated in Prime Minister Katainen's Government Programme (2011). On the one hand, the programme emphasised ecological sustainability and the need to respect the rights of indigenous peoples in mining and the use of natural resources in Arctic areas. On the other hand, the aim of the programme was to speed up mining projects, strengthen domestic ownership in the mining sector and to increase the processing of minerals in Finland. Finland also intended to make the mining sector the priority area of its EU policy.⁵

Mining is also given a high priority in the Programme of Prime Minister Marin's Government (2019). Under a separate objective set out in the programme, environmental protection in mines should be improved, and this would involve extensive reforms. Under the programme, mining legislation should be reformed so that environmental protection can be improved and mining operations made more acceptable at local level. The aim is to achieve coordination between mining and environmental permits and to ensure that more consideration is given to environmental impacts. Under the programme, legislative provisions on collateral should also be updated so that environmental liabilities are managed in all situations.⁶

The overhaul of the Mining Act is under way. The Government is also examining the introduction of the mining tax, as set out in the Government Programme.⁷ The topic has been widely discussed in public, and a VN TEAS review on the mining tax options and their impacts (TAXMINE) is under preparation.

Studies have already been produced on mining operations and the development of mining legislation. These include the comparative study of financing models for secondary environmental liability (TOVARAMA)⁸ and the review of the termination and aftercare measures covered by collateral under the Mining Act⁹. In addition to the objectives set out in Government Programmes, mining policy and mining operations are also guided by national and EU-level strategies.

For a summary of the strategies on mining activities, policies set out in Government Programmes and reports relevant to this publication, see [Appendix 1](#).

2 Mining and mineral policy comprises a wide range of national and EU-level strategies

The Green Mining programme carried out by Tekes between 2011 and 2016 was a key component of the Finnish Mineral Strategy published in 2010. Prompted by the problems in the Talvivaara mine, an action plan for sustainable extractive industries was prepared in 2013. Its recommendations formed the basis for the Sustainable Mining Network, which prepared the mining responsibility system and started implementing it. Numerous mining and mineral policy strategies have been drawn up at EU level in recent years. Batteries also play a key role in the achievement of EU's climate goals. The key objective of the state-owned Finnish Minerals Group is to develop a responsible electric car battery value chain in Finland. The company is also implementing Finland's National Battery Strategy adopted in 2021.



2.1 The Finnish Mineral Strategy of 2010 created a vision for Finland's minerals sector for 2050

The mineral sector comprises the extractive, mining and metal processing industries. The extractive industries comprise the aggregate industry, the natural stone industry and the mining industry. The last-mentioned sector comprises the production of metal ores and industrial minerals.¹⁰

The Finnish Mineral Strategy published in 2010¹¹ and the action plan 'Making Finland a leader in the sustainable extractive industry' (Sustainable Extractive Industries Action Plan) presented in 2013 are the two key strategies guiding Finland's mining and mineral policy. The goal of the first-mentioned strategy is to create a vision for Finland's mineral sector for the year 2050. It is based on the Raw Materials Initiative (RMI) presented by the EU in 2008, the aim of which was to draw attention to uninterrupted availability of raw materials in the EU and to reduce the dependence of EU-based industries on imported mineral raw materials.¹² A great deal of importance was attached to the 2010 Mineral Strategy in the Programme of Prime Minister Katainen's Government.

The Green Mining programme carried out by Tekes between 2011 and 2016 was part of the Finnish Mineral Strategy and its main objective was to make Finland a pioneer in eco-efficient mineral industry by 2020. The aim of the programme was to identify new raw material deposits and promote material and energy efficiency in mineral production. Minimising the negative effects on the environment and residential areas was a key feature of the Green Mining programme. Minimising the environmental impacts of mining operations is also a key consideration in European raw materials strategies.¹³

The Green Mining programme had a budget of about EUR 116 million and Tekes provided about 50% of this sum. Green Mining comprised 107 projects, and 130 companies and 20 research institutes took part in the programme.

Tekes or Business Finland have not engaged in separate mining industry programmes since the completion of Green Mining. However, Business Finland is in the process of implementing a programme focusing on export promotion, in which Finnish mining sector companies are notified of international tenders.

The action plan launched by the Ministry of Economic Affairs and Employment in 2013 resulted in the mining industry growth programme (2014–2019), which was initially funded and coordinated by Finpro. After the first years, the programme was funded by Business Finland and coordinated by the Geological Survey of Finland. The aim of the growth programme was to increase the number of exporting companies, to open new markets for companies and to boost foreign investments in Finland.

The activities outlined in the Green Mining programme and the mining industry growth programme are continued by Mining Finland, an association promoting exports by mining technology SMEs. The association does not receive funding from Business Finland. However, Business Finland cooperates with Mining Finland and disseminates information in the association's network projects.

2.2 The Sustainable Mining Network was established in the aftermath of the Talvivaara mining accident

The problems of the Talvivaara mine made responsibility a core issue in the Finnish mining debate. An occupational accident causing the death of an employee occurred in the mine in 2012. Serious gypsum waste basin leaks also occurred in the mine in 2012 and 2013, as a result of which acidic water containing metal and sulphate was released into the environment. Some of the waterways in the area became acidic and their metal content increased.

These events prompted mine stress tests and led to tighter permit conditions for mines. At the same time, there were growing calls for more responsibility from mining companies. Social acceptability of the mining sector was also questioned.¹⁴

Prompted by the events in Talvivaara, Prime Minister Katainen's Government convened a round table discussion in autumn 2012, the purpose of which was to draw up guidelines for promoting the sustainability of mining operations. The work resulted in the publication of an action plan on making Finland the leader in sustainable extractive industries in 2013. The purpose of the programme is to complement the 2010 Mineral Strategy.

The action plan contains 35 recommendations on such issues as governance, training, infrastructure, exchange of information and experience, promotion of exports and gaining social approval for the sector. Two of the recommendations relate to the establishment

of a cooperation network. The year 2014 saw the establishment of the Sustainable Mining Network, which serves as a discussion and cooperation forum for the mining industry and stakeholders. Initially, the network relied on Sitra's support, but since 2015, it has operated with the administrative support of the Finnish Mining Association.

According to the experts interviewed by the National Audit Office, the Sustainable Mining Network has worked well. The network can serve as a framework for a dialogue and a channel of communications between the actors. At the same time, such cooperation creates peer pressure among the parties encouraging them to develop their activities. The network has also led to better reporting on mining activities and made it more transparent.

The Sustainable Mining Network has developed a mining responsibility system comprising a variety of different assessment tools. In 2016, Finland adopted a self-regulatory responsibility system based on the model, the first European country to do so. Mining companies assess their progress in the field of responsibility on a regular basis.

The eight evaluation tools of the mining responsibility system cover the entire life cycle of a mine

The Finnish mining responsibility system is based on the model used in Canada (TSM; Towards Sustainable Mining). The original Canadian TSM model has been tailored to Finnish conditions and legislation and equipped with evaluation tools for water management and mine closures. The mining responsibility system consists of eight evaluation tools: stakeholder cooperation, biodiversity management, tailings management, water management, energy efficiency and greenhouse gas emissions, occupational safety and health, crisis management and mine closure. The tools cover the entire life cycle of a mine.

The responsibility system is similar to a credit rating system. National legislation is the baseline (level C) and by developing their operations, companies can gradually progress to levels B, A, AA and AAA. The overall level of a company is determined on the basis of its lowest rating. For example, in order to reach level A, a company must reach this level in all areas. The companies assess their results themselves and an external certification body must verify the results every three years.

The mining responsibility system has been adopted by the following companies: Agnico Eagle Finland Oy (Kittilä), Boliden Kevitsa Mining Oy (Sodankylä), Outokumpu Chrome Oy Kemi mine (Kemi), Terrafame Oy (Sotkamo), Pyhäsalmi Oy (Pyhäjärvi) and Yara Suomi Oy (Siilinjärvi).

The first self-evaluations of the mining companies were published in autumn 2020. Based on them, stakeholder cooperation and occupational safety and health are the best-managed areas in the companies (half of them reached level A in these categories). In the preservation of biodiversity, tailings management, energy efficiency, management of greenhouse gas emissions, and mine closures, one third of the mines reached level A. Based on the self-evaluations, water management is the area with the greatest room for improvement. Only one company reached level A in this category. Water management was also identified as the greatest challenge for mines in the mining stress tests carried out by the Ministry of the Environment in 2013.

The experts interviewed by the National Audit Office saw the mining responsibility system as a workable operating model, which can promote the sustainability of operations and harmonise the operating practices of mining companies. A mining company can also use the responsibility system as an internal management tool.

There are also challenges in the use of the mining responsibility system. Assessing responsibility on the basis of the system is a complex process. In practice, the system is best suited for relatively large mining companies. Companies with only small mines or a large number of sites may not be keen to adopt the mining responsibility system.

2.3 The EU is also interested in mining and mineral policy

The political and economic framework of the purchasing of minerals has changed over the past two decades. In addition to traditional industries, renewable technologies also require a variety of different metals, such as lithium, cobalt and platinum. The EU has become increasingly convinced in recent years that such metals must also be produced in Europe and that dependence on suppliers outside the EU must be reduced. A total of 98% of the rare earth metals used in the EU come from China. Turkey supplies 98% of the borate and South Africa 71% of the platinum used in the EU.¹⁵

In the EU, minerals are a consideration in a wide range of strategies and policy objectives. The European Green Deal prepared by the European Commission is a new strategy of the EU and it will extend to 2030. One of its aims is to make Europe climate neutral by the year 2050. In spring 2020, the European Commission also presented an industrial strategy supporting green transformation and digitalisation in the EU. The purpose of the strategy is to enhance the supply of responsibly produced raw materials and resource-efficient design and recycling of products.

In September 2020, the European Commission also published an action plan on critical raw materials, the list of critical raw materials 2020 and a foresight study on raw materials critical to strategic technologies and sectors from the perspectives of 2030 and 2050.

The number of critical raw materials has continuously increased

Critical raw materials (CRM) refer to raw materials that are of critical economic importance to the EU and the availability of which involves significant risks. They also play a crucial role in the implementation of the European Green Deal.

The EU publishes a list of critical raw materials and updates it every three years. The first list was published in 2011. In that list, 14 raw materials were defined as critical. In 2014, the total had increased to 20 raw materials, and the 2017 list already contained 26 critical raw materials. Lithium was one of the four new raw materials added to the list in 2020. At the same time, the European Commission announced that it would monitor the situation of nickel to determine whether it should be added to the list.¹⁶

There are deposits of several critical raw materials in Finland's soil, including cobalt, lithium, platinum group metals and nickel.

The European Commission has proposed ten concrete measures to achieve the objectives set out in its raw materials action plan. One of these is the European Raw Materials Alliance. It is expected to bring together all relevant stakeholders and focus on the most urgent needs of the European Union, namely improving the availability of rare earth metals and rare earth magnets.¹⁷

In various strategic approaches, the focus is on a specific raw material. The problem with this approach is that it arises from a short-term perspective as views on the importance of raw materials often change over time. The European Raw Materials Alliance, on the other hand, reflects a thinking in which all raw materials are considered important.

The EU has also adopted new legislation in recent years. Under the Conflict Minerals Regulation (EU 2017/821), companies must check that the minerals they buy are produced in a responsible manner and do not contribute to conflicts or other illegal activities. The regulation has been incorporated in the Finnish legislation through the act on the placing on the market of conflict minerals and their ores (1196/2020), which entered into force on 1 January 2021. The European Commission has also launched the Due Diligence Ready! online service. The service provides companies with information, tools and training so that they can carry out due diligence assessments of the supply chain of metals and minerals. The assessment helps companies to ensure that they do not promote conflicts or human rights violations through their purchases.

2.4 Finland has worked to improve the added value of battery minerals and battery industry

Batteries also play a key role in the achievement of EU's climate goals

In view of the current state of technology, phasing out fossil fuels requires that electricity should be stored in batteries. This is especially the case with passenger cars. A total of 80% of the world's batteries are manufactured in Asia. The EU is of the view that European-based battery manufacturing expertise should also be developed. The European Strategic Action Plan for Batteries, prepared by the European Commission, sets out concrete measures to develop a sustainable and competitive strategic value chain for the battery sector (battery ecosystem). In December 2020, the European Commission also presented a proposal for a European battery regulation¹⁸, which is an integral part of the EU's Green Agenda and the EU's new growth strategy. It is estimated that the annual value of the European battery value chain could total as much as EUR 250 billion by 2025.¹⁹ At the same time, battery mineral mines now play an important role in the combating of climate change. The EU aims to reduce greenhouse gas emissions generated by the transport sector by 90% by 2050 from 1990 levels.

Finland's soil contains deposits of all minerals needed in the manufacturing of batteries (such as cobalt, nickel, lithium and graphite) and in our country they can be extracted in sustainable production conditions. Finland's challenge is to ensure that an increasing proportion of the battery minerals are also processed in Finland.²⁰

In January 2021, the Ministry of Economic Affairs and Employment presented the National Battery Strategy to strengthen the innovative battery sector ecosystem, boost sustainable and low-carbon economic growth in Finland and to support the achievement of trans-

port sector climate targets. Unlike the 2010 Mineral Strategy and the Sustainable Extractive Industries Action Plan presented in 2013, the National Battery Strategy has its focus on a specific sector (battery minerals and battery industry).

It is proposed in the National Battery Strategy that Finland should have a battery sector cooperation body and a post-doc school for battery research

The National Battery Strategy 2025 is based on the following seven objectives for the period 2021–2025:

- growth and renewal of the battery and electrification cluster
- more investments
- better competitiveness
- globally known Finnish battery and electrification cluster
- responsibility
- key roles in emerging value chains of the sector
- promotion of the circular economy and digital solutions.²¹

The strategy also sets out seven measures to achieve the objectives. For example, it is proposed in the strategy that Finland should have a national cooperation body bringing together the different actors of the battery sector (measure 1). Under the strategy, expertise in the battery sector should be developed by providing better educational opportunities and by establishing an internationally recognised post-doc researcher school for the sector (measure 2).²² In addition to industrial investments, the development of the battery cluster also requires the strengthening of expertise and research in the sector. The national cooperation body referred to in the strategy was established in March 2021.

Manufacturing of batteries can be seen as a step-by-step process in which raw materials are processed into a finished product. Each step in the process (business value chain or battery value chain) enhances the value of the product. Finland already possesses expertise in all parts of the value chain. These are the mining industry, processing of battery raw materials, battery manufacturing technologies and services, charging technologies and recycling (Figure 2).

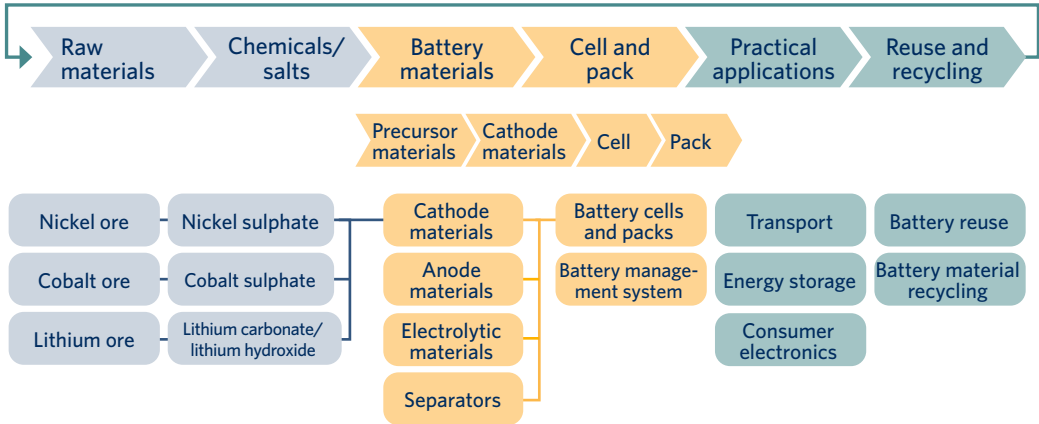


Figure 2: Battery value chain

According to a study on the economic impacts of the battery value chain, developing different parts of the raw material processing could result in new industrial activities in Finland generating added value and boosting employment. It is also envisaged in the study that the value chain could provide a basis for new types of research and development activities and support the circular economy and changeover to carbon-neutral mobility.²³

The Finnish battery cluster is already quite extensive. It comprises more than ten universities and research institutes connected with mining operations, more than 200 providers of mining technology and services, more than 40 mines and ten smelting plants and steel mills.²⁴

The aim of the Finnish Minerals Group is to develop the battery value chain

In June 2018, the mining investment programme of Finnish Industry Investment Ltd was transferred to Terrafame Group, which was renamed Finnish Minerals Group (FMG). With this restructuring, state investments in the mining industry and the development of the battery sector could be concentrated in a single company. The Finnish Minerals Group owns 71.8% of Terrafame and 26.3% of Keliber Oy. The Sokli mine project was also transferred to the company's ownership in December 2020.

The key strategic objective of the Finnish Minerals Group is to develop a responsible electric car battery value chain in Finland. The company envisages that this would lead to investments in Finland totalling about EUR 1.5 billion. The Finnish Minerals Group is currently an upstream operator. The group carries out mining activities and participates in mining and chemical industry projects. Terrafame's battery chemicals plant in Sotkamo, which produces nickel and cobalt sulphates for the manufacturing of electric car batteries, will become operational in early 2021. At the time of writing of this report, the Finnish Minerals Group and the Chinese technology company CNGR Advanced Material are negotiating on the establishment of a precursor plant in Finland. In April 2021, the company also announced that it is planning investments in the sub-processes required in the production of battery materials. These investments are connected with the plans by a British company Johnson Matthey to establish a cathode material plant in Vaasa.

The upstream operations in Finland will be supplemented by Keliber, a company affiliated with Finnish Minerals Group, which has plans to start the extraction and processing of lithium in central Ostrobothnia in 2024. In December 2020, the company also submitted an environmental permit application for a lithium chemical plant in Kokkola.

With its activities, the Finnish Minerals Group contributes to the implementation of the EU strategies described above and the National Battery Strategy. The company is also a founding member of the European Raw Materials Alliance, which has rare earth metals as one of its focus areas.

With the Finnish Minerals Group, the state has once again become a major owner of the mining industry in Finland. The state also owns 50.76% of Fortum Corporation, which develops battery metal recycling, and 38.46% of the Valmet Automotive Group, which manufactures batteries. In addition to these companies wholly or partly owned by the state, Finland also has other companies operating in the battery sector.

There is also cooperation between companies operating in different parts of the battery value chain

Cobalt, which is needed in batteries, is processed by Umicore, an international chemical industry company located in Kokkola. Valmet Automotive started producing batteries in Salo in 2019 and plans to expand the facility. It also intends to start battery production in Uusikaupunki in 2021.

BASF Battery Material Finland Oy is building a battery chemicals plant in Harjavalta. In March 2020, it also concluded a letter of intent with Norilsk Nickel (Nornickel) and Fortum Corporation on the establishment of a battery recycling cluster in the same locality. At present, Nornickel processes nickel and cobalt (both metal raw materials of batteries) in Harjavalta.

Fortum supplies recycled materials for the production of battery chemicals. In early 2020, it acquired Crisolteq, a Finnish growth company developing innovative recycling technology and specialising in battery metal recycling. Fortum also started a mechanical recycling plant for electric car batteries in Ikaalinen in February 2021. The plant can recycle about 3,000 tonnes of discarded batteries each year. The recycling will produce material for about 10,000 electric car batteries. Fortum's battery recycling business supports the implementation of the National Battery Strategy.

The problem with the recycling of battery metals is that using existing technologies, it is difficult to separate metals from each other. The recycling method used by Fortum consists of a mechanical and a hydrometallurgical process, in which more than 95% of the valuable active materials contained in the black mass of batteries can be recovered for use in new batteries.

Recycling is an essential part of the battery value chain. However, the demand for battery raw materials cannot be met with recyclable raw materials alone, as virgin ores and mining are also needed. It can also be said that non-renewable metals can only be extracted sustainably if they remain in circulation for as long as possible. Recycling of metals can help ensure that the metal resources located in the Earth's crust are not exhausted. An effective circular economy based on the recycling of metals also ensures that their supply can meet the demand and that the mining industry remains on a sustainable basis.

In a way, battery metals are expected to meet two conflicting roles in terms of policy objectives. For example, under the European Green Deal and Finland's circular economy programme, consumption of raw materials should decrease. At the same time, however, the production of battery metals and other critical materials should be increased so that climate targets and the needs of the battery, solar energy and wind power industries can be met.

Business Finland is working on research and development projects in the battery value chain

State-supported research and development projects are also under way. The aim of Business Finland's Batteries from Finland programme is to promote the construction of a battery ecosystem. The purpose is to build networks allowing Finnish actors to become partners in international business, to attract foreign investments to Finland and to develop

battery recycling expertise. Ten projects based on the needs of companies will be carried out as part of the Batteries from Finland programme. The BATTRACE and BATCircle projects are the most important of them.

The purpose of BATTRACE and BATCircle projects is to develop the traceability and recovery of battery materials and to create business opportunities in the sector

BATTRACE is a three-year project launched in summer 2020 to promote sustainable production processes and traceability of battery materials. The aim is to develop methods for tracing the production of battery materials from the battery plant to the mine. This would allow the certification of batteries manufactured in a sustainable manner. This in turn could provide responsible mines and metal processors with a competitive advantage. The certification could benefit responsible European production chains.

The project will be carried out by VTT Technical Research Centre of Finland, GTK and a group of business partners. The project has a budget of about EUR 5.8 million, and the funding comes from Business Finland and the research institutes and companies participating in the project.

The aim of the BATCircle consortium led by Aalto University is to strengthen cooperation and Finland's competitiveness in business and research in the field of battery metals. The purpose is to improve the recovery and recycling of battery metals and the production of active materials. Business ecosystems and commercial opportunities created through them will also be examined in the project. Of the project participants, Outotec and Aalto University will also coordinate raw materials and recycling research in the battery sector as part of EU's strategic energy technology programme (Batteries Europe). A total of 22 companies, four universities, two research institutes and two cities have joined the national BATCircle consortium.

Total funding for the first phase of the BATCircle project carried out between 2019 and 2020 was EUR 21 million, and Business Finland provided about EUR 10 million of this sum. The funding application for phase 2 was submitted at the end of 2020 and this phase is expected to be implemented between 2021 and 2023. The purpose of phase 2 is to develop new processes with a lower carbon footprint for the recovery of primary raw materials and metals from recycled batteries. The research topics cover the entire battery value chain. The aim of the business projects carried out as part of BATCircle is to create exports and new business in Finland.

2.5 The Finnish Mineral Strategy and the Sustainable Extractive Industries Action Plan may no longer have any guiding role

The Finnish Mineral Strategy presented in 2010 and the Sustainable Extractive Industries Action Plan adopted in 2013 are gradually becoming out of date. The Ministry of Economic Affairs and Employment has not produced any separate impact studies on them. According to the ministry, in the past, reports on the 2013 action plan were submitted on a twice-yearly basis, and all the measures set out in the plan have been implemented.

An electronic survey on the effectiveness of the Finnish Mineral Strategy and its action plan was conducted as part of the review of the competitiveness and productivity of the Finnish mineral cluster (2020:15). The purpose was to examine to what extent the development of Finland's mineral cluster has been supported by the strategy. According to the findings, Finland's mineral policy has not been strengthened in the manner envisaged in the Finnish Mineral Strategy.²⁵

Many of the experts interviewed by the National Audit Office suggested that the strategies described above may no longer steer the activities. At the same time, the question arises whether these strategies should be updated or overhauled.


A number of mineral policy strategies have been prepared in the EU in recent years. Although Finnish actors also play a role in their implementation, EU-level strategies do not have the same concrete steering effect in Finland as nationally administered strategies. One option could be to work towards a clearer coordination between EU-level strategies and national strategies.

Activities in the field of the battery value chain have expanded in Finland. A battery assembly industry has also emerged in our country. However, Finland does not yet have any battery cell factories. International competition for such investments is tough. However, according to the experts interviewed by the National Audit Office, a battery cell plant may well be established in Finland in the future.

According to the interviews, the mining responsibility system developed by the Sustainable Mining Network has worked well. However, the interviewees suggested that there should be a 'lightweight version' of the system intended for small mines. At the same time, it was also felt that foreign exploration companies should be better incorporated in the responsibility system.

3 Circular economy solutions envisaged for the mining sector can make it easier to achieve the policy objectives set for the circular economy

Circular economy solutions envisaged for the mining sector can make it easier to achieve the policy objectives set for the circular economy. In mining operations, circular economy can mean the reuse of mining by-products. Metals could also be extracted from low-grade ores and mining waste and mines could use by-products generated in other industries. Other circular economy solutions include mines with closed water circulation and reuse of the mining infrastructure.



3.1 Ambitious targets have been set for the circular economy in the Government Programme and in the strategic programme to promote the circular economy

In the circular economy, the aim is to ensure that economic activities remain within the carrying capacity of the environment. Materials and products should be kept in circulation for as long as possible, while at the same time, it should be ensured that they keep their value. In such a situation, the wastage and waste generated by production and consumption are minimised, and economic growth is disconnected from the consumption of non-renewable natural resources. This thinking is based on the awareness that the supply of virgin natural resources is limited. They must therefore be used in a prudent manner ensuring sustainable development. Circular economy is seen as a key means of promoting wiser use of natural resources (resource wisdom). In resource wisdom, we disconnect from the traditional linear economic model in which products are manufactured, consumed and discarded. The aim is to design products and services so that they do not generate any waste or emissions.²⁶

This can be illustrated with the system diagram drawn up by the Ellen MacArthur Foundation (Figure 3). Value is tied to materials and products through work done and energy used. It is best preserved in the small inner circles of the value circle. For example, maintenance activities, such as servicing, repairs and updating, allow the product to remain in use for a long time. The value is lowest on the outer circles. For example, recycling often

consumes large amounts of energy, which reduces value. In the circular economy, the focus is on the inner circles, which is why it must be accompanied by a change in business models, attitudes, legislation and economic steering. In the system diagram, mining operations are considered similar to the production of materials.

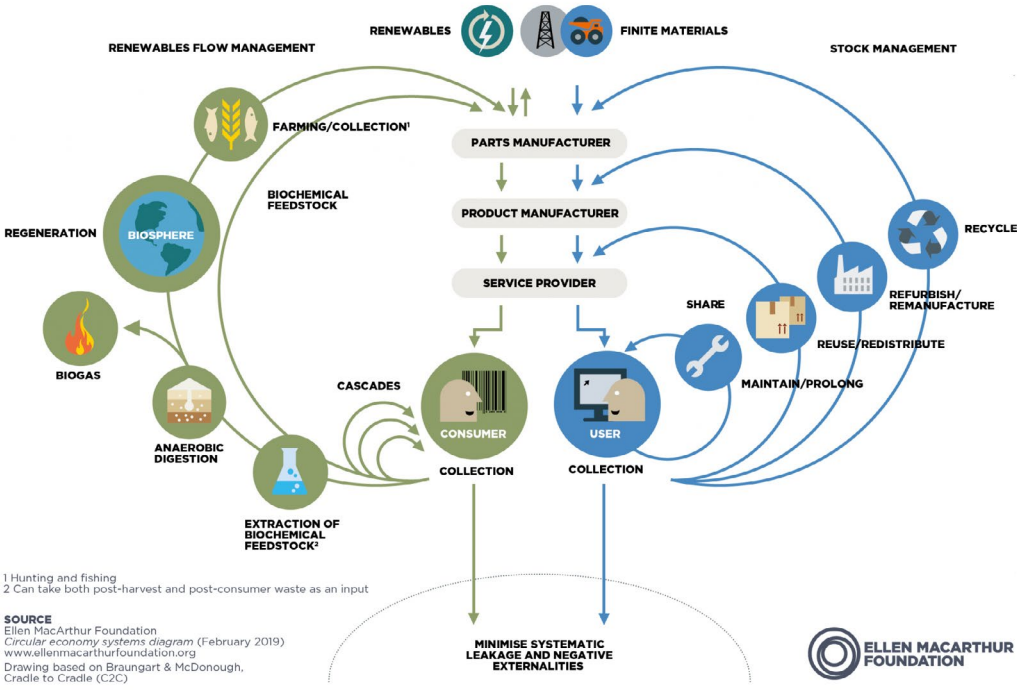


Figure 3: Circular economy system diagram (source: Ellen MacArthur Foundation)

The potential of the circular economy is also recognised in the Programme of Prime Minister Marin’s Government, which envisages a role for Finland as a pioneer of the circular economy.²⁷ In January 2021, a proposal for a strategic programme to promote the circular economy was also presented. It is based on the objectives set out in the Government Programme. Under the programme, total domestic consumption of primary raw materials in 2035 should remain below 2015 levels. Examining the role of the mining tax as an instrument promoting the circular economy is also envisaged in the programme.

According to the programme, transformation to a circular economy is seen as a significant opportunity for Finland. It is seen as a means of strengthening Finland’s export-driven economy and creating jobs. At the same time, the circular economy would reduce the consumption of natural resources and the carbon dioxide emissions and other environmental impacts resulting from it.²⁸ Ambitious policy objectives have thus been set for the promotion of the circular economy. Circular economy solutions envisaged for the mining industry can contribute to the achievement of these objectives.

3.2 Mining by-products can be reused

In mining, the circular economy can mean the reuse of mining by-products. Mining by-products include the excess rock generated during the extraction and not used in ore dressing, and the tailings generated as a by-product of ore dressing. Mining waste also includes mineral soil, sludge, precipitates and wastewater. Most of these products are permanently stored in the mining area as extractive waste.

In 2017, almost 89 million tonnes of mineral waste was generated in mining and quarrying, which accounted for more than 83% of the total amount of mineral waste in Finland. Surplus soil, excess rock and tailings account for most of the waste (OSF 2019). Using this material could contribute to the achievement of the objectives set for the circular economy.

Mines could use extractive waste in their own operations. For example, in the Kittilä gold mine, some of the tailings are used to fill the mine. In the Kittilä mining area, excess rock is used for road construction, dam construction and the filling of underground quarries.

Using by-products of mining activities outside the mining area is often problematic. Use of by-products for such purposes as road construction is hampered by economic profitability considerations. Normally, it is not economically feasible to transport by-products over long distances from the mining area. Mines may also be reluctant to allow excess rock to be used for road construction if there is a danger that harmful substances may dissolve from the material over time.

By-products can occasionally be used outside the mining area. As a rule, by-products of limestone mines (and industrial mineral mines in general) are easier to use than aggregates of metal ore mines. For example, no harmful substances are dissolved from limestone to the environment. It may even be required in the environmental permits of such mines that all extracted and produced fractions should be used. The by-products of limestone mines can also be classified as products that are not waste referred to in the Waste Act. In addition to aggregates, limestone mines can also produce water and thermal energy for surrounding towns and cities. Circular economy solutions can be extensively and systematically used in such mines.

Circular economy solutions are extensively used in the Tytyri mine

At the Nordkalk Tytyri mine, all extracted excess rock brought to the surface can be used as crushed stone products. The crushed stone products made from the aggregate are CE marked. By using the marking, the producer declares that the product meets the essential requirements of the relevant EU directives and regulations. CE marked products are allowed to move freely within the EU. In practice, using the CE marking in crushed stone products requires that the quality of the products is monitored. More generally, the CE marking may be a means of ensuring more efficient use of mineral products.

The Tytyri mine is located in Lohja, where it supplies the city of Lohja with water and thermal energy. Every year, about 650,000 cubic metres of groundwater is delivered to the city from the mine as drinking water. The surplus thermal energy supplied by the mine is sufficient to heat about 1,000 single-family homes.

It may be required in the environmental permit of a limestone mine that the surface soil to be removed and the excess rock generated in the extraction should primarily be utilised as construction material or crushed stone products.

3.3 Metals can also be extracted from low-grade ores and mining waste

According to the principles of the circular economy, the use of natural resources should be optimised in such a way that their value can be maximised. In mining, this approach is reflected in the efficient extraction of valuable metals and minerals.

In Finland, low-grade ores are widely extracted, and Finnish mining operators have also accumulated experience in the dressing of such products. For example, even though the deposit of the Terrafame mine in Sotkamo has a low metal content, advanced technologies allow it to be used.

Efficient use of minerals is not only essential in Finland, but also in global scale. Global demand for raw materials produced by the mining industry may double by 2030. At the same time, the metal content of the ores extracted in the world's mines is decreasing. For this reason, methods to exploit low-grade ores more efficiently are critical.²⁹

Valuable metals and minerals contained in mining waste and waters can also be used.³⁰ For example, old tailings disposal sites can be reprocessed. This type of activity is often described as re-mining. One example of re-mining is the plan to recover ilmenite from the tailings of the Otanmäki mine in Kajaani, which was closed in 1985. Substances such as titanium dioxide, used in the coating industry, can be produced from ilmenite. The revenue from this circular economy project could also be used to finance the restart of metal extraction at Otanmäki.

In recent years, metal recovery in Finland has been developed in the METGROW+, EcoTail and NEMO projects.

Ways to recover metals from low-grade ores, side streams and tailings have been developed in the METGROW+, Ecotail and NEMO projects

A total of 19 organisations from different countries participated in the METGROW+ project, which was carried out between 2016 and 2020. The project was coordinated by VTT and it received funding from the Horizon 2020 programme of the EU. Ways to recover metals from low-grade ores and metallurgical side streams were developed in the project. Material flows were examined from an overall perspective. In addition to the recovery of metals, the use of the remaining mineral substances for such purposes as construction materials and filling of mines was examined. Adding recycled raw materials to existing processes together with virgin raw materials was also studied.

Methods to recover metals from mining industry tailings were developed in the EcoTail project (2016–2018) funded by the Academy of Finland. With this process, environmental properties of the material to be disposed of could also be improved and cost savings achieved. The development work carried out in the EcoTail will continue in the NEMO project coordinated by VTT and funded by the EU. In NEMO, solutions for the recovery of metals from tailings will be piloted in cooperation with industrial partners. The project will be carried out between 2018 and 2022.

3.4 Industrial by-products can be used in the structures of mines

Mines can also use by-products generated in other industries. For example, fly ash from power plants can be used as an alloying element in mine filling materials. A pilot project in which stainless steel slag is used as a raw material for the cover of excess rock disposal sites is under way in Finland. The project was facilitated by the fact that stainless steel slag is a residual product generated in the production process, which is not waste in the meaning of the Waste Act. The project also involved a large number of actors, which is one of the challenges typical of circular economy projects. Coordinating an extensive network of actors is not necessarily easy.

Geopolymer concrete made from stainless steel slag can be used as cover material at excess rock disposal sites

The Digipolis technology park in Kemi coordinated a pilot project in which slag from stainless steel produced by Outokumpu was made into geopolymer concrete. It was used as a material to cover sulphuric excess rock disposal sites at a mine. The project progressed from the laboratory testing phase and small-scale piloting to the building of test structures in the Kittilä mine in 2018. Before the pilot project, the project parties also conducted a dialogue with the Centre for Economic Development, Transport and the Environment for Lapland.

As the project progressed, the number of participants increased from a few actors to a consortium of 20 organisations. Circular economy projects often have a large number of actors. This is also a challenge. The coordination of an extensive network of actors may be difficult.

Based on the measurements made so far, the cover layer works well. In 2018, the project received circular economy spearhead project funding from Business Finland.

Tapojärvi Oy and Hannukainen Mining Oy, which participated in the project, are also planning to utilise industrial side streams in the Hannukainen mine. Use of circular economy solutions is mentioned in its environmental permit application. Geopolymer structures are also tested in the Terrafame mine. The aim is to obtain general approval for the geopolymer structure in the mining sector and start using it more widely.

In the Kittilä pilot project, testing was facilitated by the classification of stainless steel slag as a by-product instead of waste. Tapojärvi Oy has also been working to find similar uses for industrial mineral side streams classified as waste. According to the company, using such waste materials is often problematic. Owners of materials classified as waste are reluctant to make them available for use and transporting them may also be problematic.

Classifying the material as waste may also be discontinued and the waste may cease to be waste. For example, if an industrial side stream is commercially suitable for use, its waste status can be removed in the End-of-Waste procedure (EoW). A material that has undergone the EoW procedure ceases to be waste and becomes a product. It is no longer subject to the Waste Act and is treated in accordance with the product legislation. This means that the material can be processed without an environmental permit, and it is usually better-placed to compete with virgin materials in the market. The End-of-Waste procedure thus promotes the use of recycled materials in the manufacture of products.

There is room for improvement in End-of-Waste procedures

In 2019, the Ministry of the Environment published a memorandum on how waste can be reclassified as a product on a case-by-case basis.³¹ To clarify the legislation on the reclassification of waste as a product, it has also been proposed that the existing information systems should be updated or a new End-of-Waste database created. This could help actors to assess the waste classification of waste-based materials and disseminate information on good practices. This issue has been discussed in such projects as CIRCWASTE - towards circular economy in Finland (2016–2023), which is an EU LIFE IP project. An EU-wide End-of-Waste database is also under preparation.

The End-of-Waste procedure was incorporated into the EU law and the Finnish legislation several years ago. The prerequisites for reclassifying waste as a product are laid down in section 5 of the Waste Act (646/2011). The act is in the process of being overhauled. The provisions on by-products will remain essentially unchanged. The prerequisites for no longer classifying a substance as waste will be revised, and minimum content requirements will be laid down for the criteria specific to each waste type issued by government decree.

3.5 Closed water circulation is a future vision for the mining industry

Large amounts of water are required in mining processes (such as extraction and grinding of ore rock). A closed water cycle is often considered a future vision for the mining sector. New water treatment methods are continuously developed for the mining sector, but a closed water cycle is yet to be achieved.

Efficient water recycling reduces water consumption in mines and the need to discharge wastewater into the environment. There is a shortage of water in many places of the world, and industries may have to compete for scarce water resources. Water shortages have occasionally forced operators to close a mine for several months. Using and managing water in mines also easily leads to conflicts in mining areas. In practice, most of the conflicts and environmental problems arising from mining activities are connected with water use in mines and the harmful environmental impacts of waters discharged from mines.

Mining industry operators everywhere are working to reduce water consumption. It is often difficult to achieve. Closing the water cycles may affect the processes of the mine, and the impacts must be manageable. It is difficult if the dressing process involves several stages, such as flotation and recovering metals from tailings. The potential for water recycling also depends considerably on the types of minerals extracted in the mine.

In the solutions traditionally used in the mining industry, the process waste sludge (finely ground solids and water) are pumped to the waste disposal site where it may be stored for long periods (often for several months or even more than a year). These waste disposal sites cover large areas and their dams are not always strong enough. The dam structures made from rough waste are not strong enough to withstand hydraulic pressure. Dam failures have caused numerous problems in different parts of the world in recent years.

In more recent solutions, the surface area of the waste disposal site has been reduced by building stronger dam structures. The waste is thickened with chemicals so that it is similar in composition to toothpaste (paste thickening) and does not filter out water. A water recycling rate of more than 80% is difficult to achieve. However, there are mines where more than 90% of process waters can be recycled.

Water cycle of the Outokumpu Kemi mine is almost totally disconnected from the hydrological cycle

Only between two and three per cent of all waters in the mine of Outokumpu Corporation, located near Kemi in Finland, are discharged to the waterways outside the mining area. The operations in the mine generate few environmental impacts. Oxidized iron ore is not water soluble. All stone is processed mechanically by grinding and crushing. As no chemicals are used in the production process, the water discharged from the clarification basin to downstream waterways is of the same quality as natural water.

Methods to reduce water consumption and tailings waste in mines were developed and tested in the Integrated Mineral Technologies for More Sustainable Raw Material Supply (ITERAMS) project, which was concluded at the end of 2020. Solutions to problems caused by closed water cycles were also sought in the project.³²

Solutions to water recycling in mines and the use of tailings were sought in the ITERAMS project

The aim of the ITERAMS project was to develop and test methods for the recycling of process waters and the use of solid mineral waste. In order to achieve a problem-free water circulation, water quality must be further optimised and better management methods developed. Water should only be purified to the extent necessary before it is recycled back into the process. Filtering methods, sensors for monitoring impurities and new uses for tailings were developed in the project.

The ITERAMS project was based on thinking that water is not a cost item but a valuable material that must be used. In accordance with this approach, metals are removed from the water: even though selling them may not generate substantial profits, the water treatment costs are at least partially recouped. Water purification is no longer just a cost item, but part of the metal production process.

The three-year project was completed in 2020 and funding came from the Horizon 2020 programme of the European Union. The project had a budget of about EUR 7.9 million, of which the Finnish partners provided about EUR 3.4 million. Seven of the 16 project consortium participants came from Finland (VTT Technical Research Centre of Finland, Outotec, Boliden Kevitsa, University of Oulu, Ima Engineering, Aalto University and Lappeenranta University of Technology).

3.6 Closed mines can be used for new purposes

About 50 of the mines started in Finland since the early part of the 20th century and now closed still remain. New uses have been found for some of them. Reuse of mines (extension of the life cycle of mining infrastructures) is a circular economy operating model potentially suitable for the mining industry.

New uses for old mining tunnels have been developed in the Tytyri mine in Lohja and the Pyhäsalmi mine in Pyhäjärvi. New uses have also been sought for the former Hitura mining area.

There is great potential for reuse of mines

Industrial exploitation of limestone in the Tytyri area began in 1897. Nordkalk currently extracts about 300,000 tonnes of limestone in Tytyri each year. Tytyri Mine Experience, established in the old tunnels of the Tytyri mine, comes under the auspices of the City of Lohja and is one of the most important tourist attractions in the locality. Kone Corporation also has a testing facility in the old tunnels, which includes a shaft reaching a depth of more than 100 metres. It is used as testing laboratory for new lift technology. The suitability of a limestone mine for the maturation of champagne is now being tested in a five-year project. Exhausted parts of the mine are also used for power generation and for storing the factory's own products.

The City of Pyhäjärvi has established the Callio real estate company to find new uses for the Pyhäsalmi mine, which will be closed in the near future. The aim is to attract business operators to the site. Projects already carried out at the site include a preliminary study on a bio-fuel terminal and a fish farm, and FutureMINE in which the establishment of a test centre for mining machinery and equipment was examined. The Geological Survey of Finland studied the potential for geothermal energy production in the mine in 2018 and 2019. Energy storage based on a pumping power station is also planned. In addition, development projects for insect production and technology and an underground fire, rescue and occupational safety and health training centre are also under way. A project to develop an international training cluster in the mining area has also recently been launched.

According to the City of Pyhäjärvi, existing legislation limits the reuse of the mine. As part of the Mining Act reform, the legislation should be changed so that the reuse of the mining infrastructure would be permitted already when the mining concession is still in effect. According to the Ministry of Economic Affairs and Employment, such changes would involve a variety of different problems, which will be reviewed as part of the Mining Act reform.

The Hitura mine went bankrupt in 2015 and new uses have been sought for the mining area in the project 'Closing the mine and new opportunities' between 2019 and 2021. One of the plans would involve the construction of a solar power plant of 40 megawatts in the mining area. The levelling and after-care work of the area is now complete and no major earthworks would thus be required. The power plant would also provide the area with much needed cover. No trees are planned for the area, as their roots could damage the protective structures. If realised, the solar power plant would be the largest in Finland and would produce electricity for the annual needs of about 2,500 electrically heated single-family homes. The project's progress has been slowed down by the mine closure process. The mining company's bankruptcy estate has concluded a letter of intent with the power company. The Centre for Economic Development, Transport and the Environment for Northern Ostrobothnia has the right to approve the final construction plans, provided that the power plant does not damage the cover structures of the mine.

3.7 There are ways to speed up circular economy solutions for mining activities

The potential for the circular economy in mining activities has been discussed above. The examples show that a wide range of different circular economy solutions can be used in the mining industry. However, many of them still remain at testing stage. In fact, the main problem is to make the solutions more widely and systematically available.

Many of the interviewees were also convinced that circular economy solutions can have significant development potential in the mining industry. Public contracts were considered an important way of promoting the wider introduction of circular economy solutions in the mining industry. Circular economy solutions presented by tenderers could be used as one comparison criterion in the competitive bidding process. A circular economy solution could also be set as a requirement for the object of contract.

Public contracts could be used as an instrument in situations in which the public sector needs products and by-products of the mining industry. For example, secondary raw materials could be used in infrastructure construction instead of virgin materials. Contracting entities could also be obliged to determine whether secondary materials from the mining industry could be used instead of virgin materials. It is also proposed in the TEAS project ‘Carbon and environmental footprint in procurement – legislation and measuring’ (HILMI) that contracting entities should have an obligation to determine the environmental criteria applicable to the contract when making purchases with significant environmental impacts.³³

Support for pilot projects has also been proposed as a way of promoting circular economy solutions. In pilot projects, actors are often able to experiment the benefits of new solutions in a reasonably risk-free manner.

Preparing for new solutions already when applying for an environmental permit for a mining project could also be a concrete way of promoting circular economy solutions. If it is stated in the application that the mining project will utilise circular economy solutions, it may be easier to implement innovative solutions within the limits of the environmental permit. Alternatives supporting the circular economy could also be presented as part of the EIA procedure.

Using circular economy solutions in the mining industry also involves challenges. They have also been examined in the report ‘Competitiveness and productivity of the Finnish mineral cluster’. According to this report, secondary mineral deposits have a lot of potential for exploitation. However, there are many factors hindering the exploitation: logistic costs, environmental acceptability of the materials and the availability, affordability and safety of virgin raw materials.³⁴

The use of industrial side streams could also be boosted with productisation. It would create opportunities for enhancing the added value and facilitate the marketing of materials. For example, CE marking, recycled material cards and application instructions could enhance the use of mineral materials instead of final disposal.³⁵

Of the cases discussed in this report, CE-marked crushed stone produced by Nordkalk can be considered an example of successful productisation of mining by-products. The innovative geopolymer structure of Tapojärvi is still in the pilot phase, after which the

structure will be made more widely available. There are situations in which the commercialisation of circular economy solutions can also be promoted through the End-of-Waste procedure.

The survey ‘Competitiveness and productivity of the Finnish mineral cluster’ also highlights research and experimental projects to develop the circular economy of minerals and channels for funding them.³⁶ This report also presents several examples of research projects promoting the circular economy of mining activities.

In a wide sense, the circular economy also includes the reuse of the mining infrastructure. The reuse of a closed mine and projects to extend the life cycle of the infrastructure can be one way of helping the mining locality to adapt to the post-mining era.

4 The mining operator must gain the acceptance of the local community

In order to be commercially successful, a mining company must gain the acceptance of the local community (social licence to operate). As part of the Mining Act reform, operating models promoting the gaining of local acceptance will probably be increasingly incorporated into the binding legislation. Good relations with local residents and other users of the area are important both in the exploration phase and during mining operations. Coexistence between mining and other business operations is often essential for gaining local acceptance and there are also examples of this in Finland.

4.1 Local acceptance is about gaining and maintaining trust

People are often worried about the impacts and risks of mining activities. In order to gain acceptance for their activities, mining companies must not only comply with the law but also adhere to the industry's best sustainable development practices and respect the environment and local communities.

Local acceptance of mining activities is often referred to as the social licence to operate (SLO). It is not an administrative permit granted by the authorities, but an interactive process through which acceptance and trust are gained and maintained.³⁷ The social licence to operate is based on the concept of socially sustainable development and corporate social responsibility. The question is to which parties and in what matters the company is accountable.

Issues concerning the social licence to operate emerged as the most important future risk in an international survey on future risks faced by mining and metal companies published in 2018. The pressure exerted by stakeholders and the mining sector's efforts to make its image sustainable and responsible are the main factors behind this development.³⁸

For a company, the social licence to operate is a tool to ensure the continuity of its operations. It also helps to create socially sustainable practices benefiting local communities. The social licence to operate is based on cooperation with the local community. The aim is to achieve trust between the company and the community. If a mining project lacks a social licence to operate or if a mining company loses it, a conflict between the company and the local community may easily arise.

The social licence to operate is a key part of the Finnish mining responsibility system (see chapter 2.2). Interaction with all parties that may be affected by the mining operations is one of the eight evaluation tools of the responsibility system (stakeholder cooperation). Mining companies complying with the responsibility system must be aware that socially, economically and ecologically responsible practices are a prerequisite for the social acceptance of mining operations throughout the life cycle of the operations.

In the mining responsibility system, stakeholder cooperation is assessed on the basis of the companies' commitment to a dialogue with key stakeholders and the manner in which they use the good practices of stakeholder cooperation in their operations. Openness and transparency must be observed in stakeholder cooperation. This requires that companies provide information and engage in stakeholder consultation at the right time and in an active manner. Impacts of mining activities on local communities are monitored in cooperation with stakeholders. As part of the interaction, feedback must also be collected to develop stakeholder cooperation. The Sámi people are an important stakeholder in northern parts of Finland. Mining companies must undertake to maintain their rights and culture and to not to undermine the practising of traditional livelihoods.

In practice, a social licence to operate is usually a prerequisite for successful development of a mining project. If it does not exist, it may also be difficult for people to work in the mine. Therefore, the absence of local acceptance may undermine job satisfaction.

Some of the experts interviewed by the National Audit Office suggested that the significance of local acceptance may also be overestimated in the Finnish debate. On the one hand, it was felt that the social licence to operate is important in developing countries, where mining activities may cause environmental and human rights violations and which are characterised by huge differences in living standards and social problems. Moreover, mining projects in developing countries are often accompanied by new technology and jobs, which may lead to considerable changes in local conditions. On the other hand, it was also suggested that owners of holiday homes are often the most vocal opponents of mines in Finland. The view was that permanent residents of the areas where the mines are located do not necessarily have equally negative attitudes.

Each mining project is different. Mines differ from each other in terms of size, production methods and life cycle. The potential adverse effects or risks arising from them may be very different. Mines can be located in sensitive natural habitats, close to residential areas or in sparsely populated areas. As a result, there may be considerable differences between mining projects in terms of the preconditions for a social licence to operate and means of gaining such a licence.³⁹

4.2 Social licence to operate is also part of legal regulation

A social licence to operate is not an administrative permit. From the legal perspective, it is voluntary self-regulation applied by a company to its stakeholder relations⁴⁰, which complements binding legislation. Such regulation can also be called soft law (non-binding standards).⁴¹ From the perspective of a mining company, merely complying with the law may not be enough for establishing and maintaining a responsible reputation.

The social licence to operate is based on disseminating information and engaging in a dialogue with local communities. Law-based assessment and permit procedures also include similar interactive operating procedures. An environmental impact assessment procedure (EIA procedure) is required when major mining projects are planned, and local stakeholders are consulted as part of the process. The consultations may include small group discussions, surveys, public events, interviews or requests for opinions.

Numerous administrative permits are also required for mining operations. In permit procedures, the parties concerned and the public are given the opportunity to present their views. In most cases, key stakeholders are also asked to submit their opinions. The permit procedures may also involve dissemination of information about the project.

When discussing the strengthening of the rights of local residents, the Programme of Prime Minister Marin's Government makes several references to mining and regulation of mining operations. It is stated in the document that the rights of property owners, landowners and indigenous peoples in the mining areas and the areas affected by the mining operations should be enhanced. Municipalities should also be given the right to use their land use planning powers to decide whether mining operations can be launched in their areas. References to the development of permit processes and practices regarding the ore exploration rights are also connected with enhancing the legal rights of local residents. According to Government Programme, ensuring the operating prerequisites of mines, making mining operations more acceptable to local communities and giving local residents more say on the matter are some of the objectives of the mining legislation overhaul.⁴²

At the time of the writing of this report, it appears that the new Mining Act will contain provisions strengthening the prerequisites for gaining local acceptance. This also means that the social licence to operate, until now a soft-law instrument of self-regulation, will increasingly assume the role of a law-based operating model.

The draft Mining Act contains a number of proposals for a regulatory overhaul. First of all, the Government is proposing changes to permit procedures. The purpose of the changes is to give better consideration to other livelihoods when applications for permits under the Mining Act are reviewed. Under the changes, a mining permit would not be granted unless it is based on a land use plan approved by the municipality. Measures will also be taken to harmonise the status of reindeer herding cooperatives and to safeguard the rights of the Sámi people when the reservation areas are located in the Sámi Homeland or the Skolt Area.⁴³

At the same time, it should also be remembered that regulation is only of limited use in the promotion of interaction between mining companies and local residents. Thus, voluntary interaction between mining companies and local communities will also play a significant role under the revised Mining Act.

4.3 Local acceptance must already be gained during the ore exploration phase

Gaining local acceptance is hampered by the fact that people do not always know about the impacts of mining operations. Lack of information and a feeling of uncertainty may already have negative effects.

Ore exploration and the opening of a mine are usually slow processes involving multiple stages. The surveying may lead to a reservation valid for a maximum of two years, which gives priority for applying for an exploration permit. In practice, only a small percentage of the reservations will lead to further action and most of them will expire after preliminary surveys. If an application for an exploration permit is submitted, it gives priority for applying for a mining permit. The priority will remain valid for 15 years. A variety of operating permits are also required for mining operations.

The process of opening a mine has also become longer over the decades. About 40 years ago, the process lasted five to ten years (from the exploration to start of the mining operations). Nowadays, the process lasts 20 to 40 years, and most of this time is spent on ore exploration. The length of the process may lead to long-term uncertainty in the local community. It is therefore important that the mining company has good relations with local residents and other users of the area already at the exploration stage.

Ways to promote the local acceptance of ore exploration have been developed in Finland. The Sustainable Mining Network has developed exploration assessment tools for companies. In addition to stakeholder cooperation, they are also intended for assessing environmental responsibility and occupational safety and health. Operating principles guiding the application of the assessment tools have also been drawn up for the exploration system.

The assessment tools are in the process of being introduced and the first self-evaluations are expected to be completed in 2021. The use of the exploration tools involves similar challenges as the mining responsibility system. The assessment requires resources, making it problematic for small exploration companies.

The gaining of local acceptance was also examined in the INFACT project (Innovative, Non-Invasive and Fully Acceptable Exploration Technologies), which ended in late 2020. The acceptance of ore exploration was a key theme in the project.

Good practices of ore exploration methods were studied in the INFACT project

New ore exploration methods that would cause less harm to the environment were studied in the INFACT project carried out between 2017 and 2020. The aim of the project was to increase understanding of good environmental and social practices. In connection with the testing of new ore exploration methods, stakeholders were identified, workshops and other meetings were held, public debate in the media was monitored and proactive measures important to the environment were introduced.

The Sakatti area in Sodankylä where the special conditions of the Natura area and reindeer husbandry are key considerations was used as the project research site in Finland. Timing of ore exploration was one of the issues highlighted in the project. The exploration work must be carried out so that the harm to reindeer husbandry can be minimised. The timetables are also impacted by the bird nesting season. Giving such consideration to environmental matters makes it easier to gain acceptance for both ore exploration and mining.

In the reindeer herding area, discussions with reindeer herding cooperatives are essential when ore exploration is prepared. Due to the nature of their work, reindeer herders have only limited opportunities to take part in surveys or comment on plans.

In the INFACT project, open interaction with stakeholders was identified as a key operating method. Stakeholders must be identified and contacted before the start of ore exploration. In the Sámi Homeland, the Sámi Parliament and in the Skolt Area, the Skolt Sámi Village Meeting must be contacted in advance. In the building of trust, it is important to answer questions and collect feedback and react to it. Presenting the results of ore exploration to stakeholders is also essential. Cooperation with stakeholders requires a long-term approach.

The INFACT project received EUR 5.6 million in EU Horizon 2020 funding and about EUR 741,000 of this total was granted to Finnish actors. The project test areas were located in Finland, Germany and Spain.

4.4 Mining operations must be able to coexist with the other business activities in the area

Already during the ore exploration stage, it may be important to give consideration to the other business activities in the area. The ability of mines and other business activities to coexist in the area is often a key requirement for gaining local acceptance for the mining operations.

In Finland, tourism and reindeer husbandry have been considered as livelihoods that may not easily coexist with mining operations.⁴⁴ They may be affected by a mine located in the same area.

Chances of livelihoods to operate side by side may be impacted by the special characteristics of the mining operations and the locality in question. For example, in the studies conducted in Sodankylä by the University of Lapland, more than half of the respondents were worried about the impacts of mining operations on reindeer husbandry. The critical attitude may have arisen from the fact that mining projects in the municipality that are in different stages were located in the areas of at least three reindeer herding cooperatives.⁴⁵

Mining operations may cause a variety of different problems in the reindeer herding area. Reindeer will stop grazing in the areas surrounding the mine because they try to avoid contacts with humans. The natural wandering routes and gathering places of reindeer will also change. If large sections of the pastures are lost, the remaining areas will start to wear and the number of reindeer will also decrease as a result. There is also a risk that the mining activities will contaminate the drinking water of reindeer. A mine also leads to more heavy traffic in the area, increasing the number of collisions with reindeer.

It is also important that the mine does not damage the reputation of reindeer husbandry or complicate the marketing of reindeer products. Establishing the mine on the periphery of reindeer herding would be the optimal situation from the perspective of reindeer husbandry. In that case, the amount of dust would remain low and the drinking water of reindeer would not be contaminated. When the prerequisites for successful reindeer herding are in place, the livelihood will also remain more attractive to young people.

Mines situated in the reindeer husbandry area are better placed to operate successfully when they work together with reindeer herding cooperatives. For example, Agnico Eagle Finland's Kittilä mine pays an annual damage compensation to the reindeer herding cooperative in the area of which the mine operates. The mining company has also built structures allowing reindeer to move in the area. Reindeer herders are represented in the cooperation group of the Kittilä mine.

Tourism is also a livelihood that may not easily coexist with mining operations. However, the two may also complement and support each other. In Kittilä, a mine is able to coexist with both reindeer husbandry and tourism.

In Kittilä, mining and tourism benefit from each other

The Canadian mining responsibility system (MAC TSM) was adopted in Kittilä in 2011. According to the Kittilä mine, it has helped to improve stakeholder cooperation. The mine has expanded its cooperation with the local community over the years. This has also been supported by the Finnish mining responsibility system, which is similar to the MAC TSM standard.

The Kittilä mine has established a scholarship fund to support the environmental certification of Kittilä-based tourism operators. The mine and tourism operators are also engaged in an active dialogue and work to develop cooperation in a number of areas. The mining company supports recreational and sports activities of local children and young people and cooperates in the arrangement of events.

The mine and the local community conduct a dialogue in a cooperation group, which meets on a regular basis. The aim is to ensure that stakeholders can learn more about the operations of the mine and receive information about its plans.

The perceived impacts of mining operations in Kittilä were studied in 2018 in surveys carried out among local residents, holiday makers and tourism entrepreneurs. The work opportunities offered by the mine are considered to significantly increase wellbeing, especially in the central village of the municipality. The majority of the survey respondents approve the presence of the mine. Most of the tourism entrepreneurs also take a positive view of the gold mine and it is not seen as having a negative impact on tourism. At the same time, however, the respondents were worried about the environmental impacts of the mine. The respondents also considered that new mining projects could increase criticism of mining operations.⁴⁶

The Municipality of Kittilä, tourism in the area (especially the Levi tourist centre) and the mine benefit from each other. The mine is a major employer. This boosts the demand for services, which means that they can also be offered more extensively to tourists all year round. At the same time, the Levi tourist centre and the enterprises operating in the area are important for the mine. Tourism makes the Kittilä mine more attractive as a workplace. Like the mine, the existence of the Levi tourist centre also increases the range of services available in the area. Because of tourism, a wide variety of jobs is on offer in the locality, which makes it easier for the family members of the mine employees to move to the municipality. The distance from Levi to the Kittilä gold mine is 40 kilometres, which means that the mine does not interfere with the operations of the tourist centre.

4.5 A mine located in the vicinity of a residential area may also gain local acceptance

Gaining local acceptance is often easier if the mine is located far away from residential areas. There are also mines in Finland that are located close to residential areas and are able to coexist with the local community. The Tytyri limestone mine of Nordkalk in Lohja is situated in the immediate vicinity of a residential area. The mine is unusual because the perimeter of the nearby residential area is gradually approaching the boundaries of the mining area. The Kemi mine owned by Outokumpu Chrome Oy is also located near a residential area in Elijärvi north of the city. Despite the closeness of settlements, both mines have managed to gain the acceptance of local communities.

Many years of transparent operations help a mine to gain local acceptance

Blasting in the Tytyri limestone mine causes noise, dust and vibration. Measures have been taken to mitigate the harmful effects and restrictions have also been imposed in the environmental permit. Environmental impacts are regularly monitored at measurement points.

According to Nordkalk, making things in a transparent and correct manner is the prerequisite for local acceptance. Local residents are notified of the blastings in advance and major changes are announced in local newspapers. If necessary, public information events (neighbourhood evenings) are held. In small localities, the conditions in the workplace and the well-being of the personnel also have a more general impact on the acceptability of the mine. If necessary, Nordkalk also cooperates with the City of Lohja.

According to Outokumpu, the advantage of the Kemi mine in stakeholder work is that the mine has been in operation for many years. It is therefore easier for local residents to accept its presence. Opposition to a mine is often strongest when it is in the process of being established. In Kemi, gaining local acceptance has also been facilitated by the fact that the nearest settlements are located about 1.5 kilometres from the mine. Outokumpu is also an important employer in Kemi. When a locality benefits from the mine economically, it is also easier to accept. Outokumpu also sponsors sports clubs.

According to Outokumpu, the fact that the Kemi mine has not caused any accidents or other problems has helped it to gain local acceptance. The mine does not produce any environmentally harmful aggregates and it does not require dangerous chemicals for its operations.

4.6 Gaining local acceptance may not be a straightforward matter but it also creates opportunities for development

The social licence to operate is considered important in mining operations. According to the experts interviewed by the National Audit Office, mining companies usually master the operating methods allowing them to gain local acceptance. There are examples in Finland of how mining operations can coexist with other business activities and how a mine can also operate close to a residential area. The significance of the social licence to operate has also been recognised in the Mining Act reform.

Despite positive developments, there is room for improvement in the social licence to operate in Finland. It was pointed out in the interviews that there should be more focus on ensuring coexistence between livelihoods when mining projects are planned. Moreover, not all mining companies keep local residents up to date on their operations. Publishing information that is of interest to local residents on the company's website is a good operating model. However, this is not always done. This may be because the parent company has prohibited the publication of the information. Obliging companies to report on the environmental impacts of their mining projects on their websites could be one solution.

Some of the interviewees were also critical of the mining companies' ability to gain a social licence to operate. There are differences between companies, and the outcome can depend on the companies' internal procedures and on the persons responsible for the matters.

Some of the interviewees felt that it is difficult to gain local acceptance if ore exploration companies have made reservations covering extensive areas. Reservation provisions will probably be overhauled in connection with the Mining Act reform. In its draft proposal, the Government proposes changes aimed at ensuring more detailed regulation of the content of the reservation decision, reducing the average period of validity of the reservation decisions and enhancing the rights of landowners through the revision of impediment provisions applying to the reservation area.⁴⁷

5 Closed mines may involve financial and environmental risks

In the past, many Finnish mines were abandoned and closed using methods that do not meet today's environmental and safety standards. Since the 2010s, the state of extractive waste sites has been examined in KAJAK projects. A legislative project is currently under way to create more comprehensive secondary environmental liability systems. The mine collateral scheme is also in the process of being overhauled. It has also been proposed that provisions on environmental liabilities under public law should be added to the Bankruptcy Act. One pending project involves the Hitura mining company, which was declared bankrupt in 2015. Its mine is in the process of being closed and the process is funded from the state budget. The lessons learned from Hitura can be used in regulatory reforms.

5.1 In certain situations, the state may have to assume liability for the costs of after-care of mining operations

The planning of the mine closure already starts during the early stages of the mining operations. Closure of the mine and its after-care must already be taken into account in the applications for mining and environmental permits. The main principles and a preliminary plan for the after-care of the mining area are set out in the environmental permit. The plan will be specified as the operations progress. The mining company must also provide collateral for post-closure measures and for repairing the environmental damage.

The mining company's responsibility for the impacts of its operations does not end with the termination of mining activities. The company must, no later than two years after the termination of mining operations, restore the mining area and the auxiliary area of the mine to the condition required by public safety and ensure the restoration, cleaning and landscaping of the areas. After the restoration, a final inspection will be carried out in the mining area and a decision on the termination of mining operations will be made. Overall, a mining company's responsibility for the termination of operations and the risks associated with it is strictly regulated.

However, there are also situations in which the state is forced to assume liability for the costs of after-care. The risks arising from abandoned mines closed using outdated procedures must be managed. The party causing the environmental pollution may also be insol-

vent or unknown or is not reached and cannot be held accountable for the costs arising from the after-care and the repair of the damage. In such cases, the state may be held responsible for the problems caused by the mine under the principle of secondary liability. Mines are the most significant category of companies in Finland in which costs have been compensated by the state.

5.2 The state and risk management of closed and abandoned extractive waste sites have been investigated in Finland since the 2010s

Until the end of 1990s, many Finnish mines were closed or abandoned with methods that do not meet today's environmental and safety standards. In some of these mines, the mining company's responsibilities may have expired or the company no longer exists. Environmental damage may occur in the mining areas. The environmental pollution caused by the run-off waters formed in extractive waste sites and the instability of the dam structures of the tailings disposal sites are common problems. These problems are a global problem and they do not only affect Finland.

Under the Mining Waste Directive (2006/21/EC), Member States must prepare a list of decommissioned or abandoned extractive waste sites that cause serious environmental pollution or potential risks to the environment or human health in the medium or short term. The list must be updated on a regular basis. The implementation of the directive has speeded up the examination of closed and abandoned extractive waste sites. In Finland, the work has been carried out as part of the KAJAK projects since the 2010s. Two of the five KAJAK projects are still under way.

The state of closed and abandoned extractive waste sites in Finland has been examined in the KAJAK projects since the 2010s

The first national list of waste sites was published in 2012 and it contained 40 areas. The list was updated on 9 January 2020. On that date, the list contained 31 areas with a total of 42 extractive waste sites. The list was based on the results of the KAJAK I project (YMr24/2013).

More detailed site studies were carried out and recommendations on further investigation needs made in the KAJAK II follow-up project (SYKEra 12/2018). In the third project (2018-2020), guidelines and an operating model were produced for assessing the rehabilitation needs concerning closed and abandoned extractive waste sites (Publications of the Ministry of the Environment 2020:16). In the ongoing KAJAK IV project, the guidelines and operating model will be tested in the Orijärvi mine. A follow-up project (KAJAK V) is also currently under way to investigate legal issues.

A total of 19 closed or abandoned mining areas have been identified in the KAJAK projects and more detailed studies on them will be carried out. The sites will be prioritised, after which the need and options for restoring them and the costs of the operations will be determined and the sites to be restored will be selected. It will also be examined whether the areas are orphan sites, and responsibility issues between the state, mining companies and landowners will be determined.

5.3 A number of legislative reforms concerning the environmental liability arising from mining operations are under way

The legislative reform concerning secondary environmental liability is expected to be implemented in 2022

Legal and economic environmental liability is based on the polluter pays principle. Under this principle, the primary polluter is responsible for preventing and eliminating the harmful effects of its operations (duty to act) and the costs arising from them (cost liability).

Secondary environmental liability refers to the liability of a party other than the polluter in a situation where the polluter is insolvent, unknown or cannot be reached or for some other reason cannot be held accountable for its activities. It is a question of financial liability or who ultimately pays the cost of implementing environmental liability.

At present, the secondary liability for mining activities may be based on the Act on Environmental Damage Insurance (81/1998) or state budget funding.

In a resolution on the supplementary budget for 2017, Parliament called for the Government to ensure proper management of the after-care of mines already during their operations so that the liabilities arising from their closure would not have to be met by the state. The Parliament also called for the Government to determine the amount of collateral required from mining operators.⁴⁸

Developing the legislation on collateral schemes so that environmental liabilities can be managed in all situations has been set as an objective in the Programme of Prime Minister Marin's Government.⁴⁹ In order to achieve this objective, a legislative project was initiated on 3 December 2019 to draw up a Government proposal for a secondary environmental liability reform. The proposal is expected to be presented in spring 2022.

The aim is to create more comprehensive secondary environmental liability systems for environmental risk management, compensation for environmental damage and the carrying out of the restoration measures. The aim is that operators can manage their environmental obligations to the extent possible without any financial intervention of the state. The funding base of the system will also be examined in the project. Funding models for secondary environmental liability were examined in the VN TEAS project TOVARAMA.

Funding models suited for Finnish conditions could not be identified in the TOVARAMA project based on comparative law research

The purpose of the comparative study of financing models for secondary environmental liability (TOVARAMA) was to facilitate the overhaul and development of the secondary environmental liability system by using comparative law research as a basis. The report identified the key financing models for collective liability in use and assessed their suitability in Finland. These models are budget-based secondary liability, statutory collective liability and contractual collective liability.

In the first model, the funds are collected in the state budget for distribution. Statutory collective liability is a statutory off-budget financing system that can be maintained by the state or by a private party. In the contractual collective liability model, operators voluntarily create financing arrangements to tackle, on a secondary basis, pollution caused by insolvent or unknown entities.⁵⁰

At the moment, it seems that financing models that are readily applicable to Finnish conditions have not been identified in the TOVARAMA project. The preparation of the TOVA legislative project will therefore continue on a national basis.

The proposal to add provisions on environmental liability under public law to the Bankruptcy Act has not made any progress

It has also been proposed that provisions on environmental liability under public law should be added to the Bankruptcy Act (120/2004). The proposed chapter 16a would have contained provisions on the extent to which the bankruptcy estate is obliged to take care of environmental liabilities at its own expense and the extent to which it has no duty to act and no liability for costs (HE 221/2018 VP). Under the proposed amendment, the environmental liability of the bankruptcy estate under public law would have been determined in accordance with the Bankruptcy Act, and apart from the situations referred to in the Bankruptcy Act, an authority could not have obligated the bankruptcy estate to take corrective measures under environmental legislation or to have its claims treated as administrative expenses.

The Constitutional Law Committee proposed an amendment to the proposal and the chapter was dropped from the bill. However, the committee stated that there is a clear need for a legislative reform in this respect and that the Government should prepare a new proposal (PeVL 69/2018 VP - HE 221/2018 vp). In its resolution (Parliamentary reply EV 311/2018 vp - HE 221/2018 vp), Parliament called for the Government to prepare provisions on the environmental liability of the bankruptcy estate, which give equal consideration to creditors' right to payments and the aspects of basic environmental law. At the moment, it seems that the Ministry of Justice will not proceed with the legislative reform during this parliamentary term.

The mining collateral scheme is also in the process of being overhauled

The collateral required from mining operators is based on the Mining Act (621/2011) and the Environmental Protection Act (527/2014). Under section 108 of the Mining Act, a mining company must deposit collateral that is sufficient for the closure and after-care measures of the mine. In practice, the sum is usually small, and it can be used to erect such structures as fences and warning signs around the mining area and to block the mine shaft. The financial guarantees based on section 59 of the Environmental Protection Act are of more practical significance than the collateral required under the Mining Act. They are intended for the restoration of excess rock sites, tailings disposal sites and other waste sites in mines so that they do not cause any environmental pollution.

According to the current Government Programme, the legislation on collateral schemes applicable to mining operations should be developed so that the environmental damage caused by them can be repaired in all cases. The effectiveness of mining legislation was assessed by Pekka Vihervuori in 2019. According to his report, when a mine is closed, the restoration of the area is carried out on the basis of two different laws and the collateral provided under them, which leads to confusion and impracticable solutions. Vihervuori was also of the view that the level of collateral compensation should be revised.⁵¹ The Ministry of Economic Affairs and Employment has outlined the concrete criteria for determining the collateral under the Mining Act in its report ‘Termination and aftercare measures covered by collateral under the Mining Act’.⁵²

The Mining Act reform is still in progress and the content of the revised act has not yet been finalised. The collateral provisions will probably be revised as part of the legislative reform. Under the draft government proposal, the provisions on collateral contained in the Mining Act would be developed so that the collateral system set out in the Mining Act, together with the guarantee system set out in the Environmental Protection Act would be harmonised to the extent possible. Under the draft proposal, there would be clarifications to the coverage of the collateral on mining activities and the content of permit decisions. It is also proposed that a new subsection 3 be added to section 109 of the Mining Act, obliging the mining authority to check the amount of the collateral at its own initiative if, after the granting of the permit, the type and scope of the operations have changed so that, because of the change, the type or amount of the collateral should be revised.⁵³ Waste guarantee provisions will be overhauled as part of the changes to the Environmental Protection Act.

However, changes to the collateral provisions do not eliminate the need to reform secondary environmental liability provisions. The collateral and secondary environmental liability systems have been created for different purposes. The purpose of the collateral is to cover the waste treatment measures foreseen at the permit granting stage as well as the closure and after-care of the mining operations. The secondary environmental liability system is more extensive and it also covers other activities. These include unauthorised activities, unexpected environmental damage, insolvency, and liabilities arising from the activities of unknown parties.

5.4 The state has incurred considerable financial liabilities as a result of the after-care measures in the bankrupt Hitura mine

Mines are the most important category of companies in which environmental liabilities have been compensated with state budget funding. About EUR 29 million (an average of EUR 4 million per year) were spent on companies' secondary liabilities between 2013 and 2019. This sum does not include the Talvivaara mine. About 120 million euros have been spent on Talvivaara and about 27 million euros of this total has been recouped by the state. The second major mining project that has required considerable amounts of budget funding (over EUR 21 million) is the one involving the Hitura mining company. It went bankrupt in 2015 and the closure process is now under way.

The prolonged closure of the Hitura mine is expected to be completed in autumn 2021

The Hitura mine, which is located in the city of Nivala in Northern Ostrobothnia, started operations in 1970. The mine mainly produced nickel and copper. In 2007, Outokumpu Mining Oy sold the mine to the Canadian company Belvedere Resources Ltd, which was, however, declared bankrupt on 27 December 2015. It was decided to close the mine after no buyer was found for the facility.

Many of the solutions used in the Hitura mine proved unworkable. For example, the tailings were stored on top of a water-permeable ridge and there was contaminated groundwater in the mining area. Measures were taken to prevent damage while the mine was still operational, but the old water treatment plant located in the area was inefficient.

Between 1992 and 1996, Outokumpu transported jarosite waste from its cobalt plant in Kokkola to a site near the mine dressing plant. This purpose was to process the waste when more advanced technology becomes available. An environmental permit for the transfer of the jarosite had been granted. The jarosite waste contains arsenic, which is a hazardous substance, but none of it has entered groundwater in Hitura. The assumption is that this waste will present the greatest environmental risks in Hitura.

The closure of the Hitura mine is under way. One of the tailings disposal sites, part of the old tailings disposal site and the jarosite area were first drained and covered. Modernisation of the water treatment system was also started. The second phase, now in progress, covers a larger area. The second tailings disposal site, the clarification basin and the recirculated water basin will be drained and covered as part of the work. Serpentinite and mica gneiss heaps in the excess rock disposal site will be partially covered. The closure work is expected to be completed in autumn 2021.

After the bankruptcy of the Hitura mine, it had to be determined which party would be responsible for the closure measures. There was no legislation in Finland under which an authority could assume responsibility for the matter. Finally, the Centre for Economic Development, Transport and the Environment for North Ostrobothnia took responsibility for the closure measures.

Section 182a was subsequently added to the Environmental Protection Act, and under this provision, a state supervisory authority can take the necessary action to prevent or limit environmental pollution if the party responsible for the work cannot be determined. The amendment was prompted by situations resulting from bankruptcies in which the authorities were not able to take effective action under the Environmental Protection Act. The bankruptcies of Talvivaara Sotkamo Oy and the Hitura mine were mentioned as examples of such situations in the preparatory work for the amendment (HE 116/2018 vp pp. 6–8).

In Hitura, it also proved difficult to determine to what extent the bankruptcy estate was responsible for managing waste. It was unclear whether these costs constituted the bankruptcy estate's own debt (administrative expenses) for which the estate is responsible and which is paid to the creditors first. In the future, it may also be possible to resolve such problems under the Bankruptcy Act if an amendment similar to the proposed chapter 16a is incorporated in the act (see chapter 5.3).

In 2012, Belvedere Mining Oy, the company operating the Hitura mine, submitted an implementation plan for the closure of the mine to the Regional State Administrative Agency for Northern Finland. In its decision on the matter (No 125/2014/1, reg. no. PSA-VI/11/04.08/2012), the Regional State Administrative Agency increased the security required from the mining company from EUR 2 million to EUR 4.27 million.

However, the Hitura mining company had only been required to provide security under the Environmental Protection Act, and no collateral based on the Mining Act existed. Under the current legal state, the mining operator must provide the collateral referred to in the Mining Act to cover the costs of the closure measures. The Supreme Administrative Court has stated that the obligation to require collateral is absolute and that the mining authority has no discretion in the matter (KHO 2017:177).

The Regional State Administrative Agency for Northern Finland decided that unlike the original collateral, the collateral is subject to value added tax. This was because the Centre for Economic Development, Transport and the Environment must be able to order the closure work from an external contractor in a situation where the operator is unable to meet its obligations. Based on the decisions of the Supreme Administrative Court, the security based on the Environmental Protection Act is only sufficient if the invoice subject to VAT charged by an external entrepreneur for performing the neglected after-care measures can be paid from the security in all cases (KHO 2017:24).

The collateral required from the Hitura mining company was significantly increased before the company's bankruptcy. However, it only covers a fraction of the costs of closing the mine. The collateral was used to pay the costs arising from the preparation of the closure. The system of collateral for mines is currently being overhauled. It is possible that after the introduction of the legislative reforms, the collateral will also cover a larger proportion of the costs of the after-care measures carried out in the bankrupt mine.

The after-care work in the Hitura mine will have to be funded from the state budget. A total of EUR 21 million in budget funding is required for the closure of the mine. The additional cost caused by jarosite accounts for about EUR 5 million of this sum. No compensation for the closure of the mine was received from environmental damage insurance as it was not an environmental damage covered by insurance.

The environmental damage insurance system based on the Act on Environmental Damage Insurance (81/1998) is in practice a secondary financing system accrued through compulsory insurance contributions collected from operators subject to a permit. It has not worked as expected and anticipated. There are very few cases of damage eligible for compensation in relation to what was anticipated when the law was passed. The system has also been criticised for being inefficient. The compensations paid from the insurance system amount to only about one per cent of the insurance contributions collected from companies. It has also been suggested that the insurance system should be reformed.⁵⁴ The role of the environmental damage insurance system will probably be reviewed as part of the ongoing overhaul of the secondary environmental liability system.

5.5 The lessons learned from the Hitura mine closure process can be used in legislative reforms

Closed and abandoned extractive waste sites and the management of the risks arising from them have been examined in Finland for many years. Legal issues are being examined in the KAJAK V project and the purpose of the TOVA legislative project currently under way is to update the secondary environmental liability systems. The Mining Act reform is also relevant in this respect. More time has been granted for the preparation of the reform as provisions on interest comparisons in which the benefits and negative impacts of mining projects are examined will be incorporated in the overhauled Mining Act. A study on interest comparisons as part of the mining permit process was recently initiated.

In general, based on the Hitura mine closure process, it can be said that the secondary liability of the state may in certain situations constitute a major problem and cause the public sector to incur significant costs. The Hitura mine was closed using up-to-date procedures and the actual closure costs of the facility are known. It can be used as a benchmark when reforming legislation on the sufficiency of collateral and assessment of secondary liability.

From the perspective of state liabilities, it is also desirable that progress would be achieved in the plans to add provisions on environmental liability under public law to the Bankruptcy Act.

6 Summary

Mining and the industries and services related to it play a significant role in the Finnish national economy. Even though mining is a commercial activity, it is connected with the state and central government finances in many ways. The authorities play a key role as parties regulating mining operations and issuing permits. The Geological Survey of Finland (GTK) operating under the auspices of the Ministry of Economic Affairs and Employment plays a major role in the use of Finland's ore and mineral resources. Research and development connected with mining operations is financed from public funds. Occasionally, the state may also have to assume liability for the costs and environmental problems arising from closed mines. Environmental protection and ecologically sustainable mining have been major themes in Government Programmes in the 2010s.

The Finnish Mineral Strategy published in 2010 and the Sustainable Extractive Industries Action Plan presented in 2013 are the two key strategies guiding Finland's mining and mineral policy. The latter plan was prepared in the aftermath of the problems in the Talvivaara mine. The Green Mining programme carried out by Tekes between 2011 and 2016 was a key part of the implementation of the first-mentioned strategy. The Sustainable Mining Network and the mining responsibility system created by it were established on the basis of the recommendations set out in the Sustainable Extractive Industries Action Plan. Mining sector actors have been mostly satisfied with the networked activities and the responsibility system.

Numerous mining and mineral policy strategies have been drawn up in the EU in recent years. Finland also presented its national battery strategy in early 2021. Batteries play a key role in the achievement of climate targets. Finland has also worked to improve the added value of battery minerals and battery industry. The key strategic objective of the state-owned Finnish Minerals Group is to develop an electric car battery value chain in Finland. With this company, the state has once again become a major mining industry owner in Finland. The state also owns shares in a number of other companies working to develop the battery value chain.

The 2010 Mineral Strategy and the Sustainable Extractive Industries Action Plan of 2013 do not necessarily guide the activities any more. In fact, the question arises whether these strategies should be updated or overhauled. National and EU-level strategies could also be coordinated with each other more effectively.

Circular economy solutions for the mining sector can be used to implement circular economy policy objectives. Circular economy can mean the reuse of mining industry by-products. Metals can also be extracted from low-grade ores and mining waste. Mines can also use by-products generated in other industries. Closed water circulation would be one form of circular economy. This still remains a future vision. Reuse of mines (extension of the life cycle of mining infrastructures) is also a potential circular economy operating model for the mining industry. Most of the circular economy solutions are still on a trial basis. The problem is to make the solutions more widely and systematically available.

In order to be commercially successful, a mining company must gain the acceptance of the local community (social licence to operate). Interaction with stakeholder groups is also one of the eight evaluation tools set out in the mining responsibility system. As part of the Mining Act reform, operating models promoting the gaining of local acceptance will probably be increasingly incorporated into the binding legislation. Good relations with local residents and other users of the area are important both in the exploration phase and during mining operations.

Each mining project is different. The prerequisites for and means of gaining a social licence to operate may vary substantially from mine to mine. Coexistence between mining operations and other business activities is often key to gaining local acceptance. Tourism and reindeer herding may be affected by a mine located in the same area. However, there are also examples of coexistence between livelihoods in a mining locality. Sometimes, the companies even complement each other. There are also mines in Finland that are located close to residential areas and have nevertheless received the social licence to operate.

Gaining local acceptance is not always a straightforward matter. There may be major differences between operating practices of mining companies and they sometimes fail to receive the social licence to operate.

In the past, many Finnish mines were abandoned and closed using methods that do not meet today's environmental and safety standards. The risks arising from such mines must also be managed. If the party causing the environmental pollution is insolvent or unknown or is not reached and cannot be held accountable, the state may have to take responsibility for the problems arising from the mine under secondary liability.

In Finland, the state of closed and abandoned extractive waste sites has been examined in the KAJAK projects since the 2010s. A number of projects to reform the environmental liability legislation applicable to mining operations are also under way.

The project to reform the secondary environmental liability legislation aims to create more comprehensive secondary environmental liability systems to prepare for environmental risk management, compensation for environmental damage and the implementation of restoration measures. The mining collateral system is also in the process of being overhauled. It has been proposed that provisions on environmental liability under public law should be added to the Bankruptcy Act (120/2004). Such reforms could reduce state liabilities in situations in which the party causing the damage cannot pay for the restoration work. A major mining project that has required considerable amounts of budget funding (over EUR 21 million) involves the Hitura mining company, which went bankrupt in 2015. The mine closure process is under way. The closure is carried using up-to-date methods and thus it can be used as a benchmark when reforming legislation on the sufficiency of collateral and assessment of secondary liability.

Appendix 1: Government Programmes, government resolutions, strategies, guidelines and reviews

Programme of Prime Minister Jyrki Katainen's Government 22 June 2011

In mining activities and when exploiting the natural resources of the Arctic, ecological sustainability and the rights of the indigenous peoples must be respected.

The Government uses various means to encourage growth and internationalisation of mining companies. In its enterprise policy, the Government will target the generation of new enterprises and the promotion of growth and internationalisation of the existing businesses.

The state will strengthen its involvement in the value chain of the domestic mining industry. Domestic ownership within the mining sector and the acceleration of mining projects will be promoted by setting up a programme making investments in mining sector projects, an investment fund or an investment company. Mining sector training and research will be increased. The Government aims to increase the processing of minerals in Finland and develop the metal industry. The resources of the Finnish Safety and Chemicals Agency will be secured in order to accelerate the processing of licences. Mining sector expertise will be made a priority of the Finnish EU policy, and active influence will be exerted on relevant EU decision-making.

Non-recurring investment in a mining fund through Finnish Industry Investment (EUR 30 million).

Finland, a land of solutions. Strategic Programme of Prime Minister Juha Sipilä's Government 29 May 2015

Mining activity will be transferred back to electricity tax class II and within the scope of the energy tax ceiling.

Programme of Prime Minister Antti Rinne's Government 6 June 2019 and Programme of Prime Minister Sanna Marin's Government 10 December 2019. Inclusive and competent Finland - a socially, economically and ecologically sustainable society

Reforming mining legislation

Mines will be transferred to category I electricity tax and removed from the scope of the industrial energy tax rebate system. The prospects for introducing a new mine tax will be studied in order to ensure that society is reasonably compensated for mineral wealth extraction. The possibility of taxing profits on the sale of mining rights in Finland even when foreign corporations hold these rights will be investigated.

Finland's mining legislation will be overhauled. The purpose of the reform is to improve the level of environmental protection and ensure the operating conditions of mines, while also improving local acceptability and influencing opportunities. Provisions will be made to give municipal authorities the right to decide through land use planning whether it is possible to carry out mining activities in the municipality. The position and right to information of property owners and landowners in the area affected by mines will be improved. When significant mining projects are undertaken, the rights of indigenous peoples will be taken into account as required by the current legislation. Compatibility of mining permits and environmental permits will be improved. The environmental impacts of planned mines will be taken into account at the earliest stage possible. Measures will be taken to develop the ability to take into account the uranium content of ore when the environmental impacts of mines are assessed. Measures will be taken to develop the legislation on securities so that environmental responsibilities are dealt with in all situations. Mining activities targeting minerals in the sea bed will also be included within the scope of the legislation. The permit processes, practices and possible need for restriction concerning mineral prospecting rights in nature conservation areas will be explored.

Reforming the legislation on corporate social responsibility

In cooperation with the business sector, Finland will develop a binding regulatory framework on corporate responsibility as a part of the reform work under way in the UN and the OECD.

The possibility to legislate at EU level on corporate social responsibility based on due diligence, which takes into account companies of different sizes and international value chains, will be investigated.

Finland will become a leader in social responsibility. A report will be prepared with the objective of enacting a corporate social responsibility act based on a duty of care imposed on companies regarding their operations in Finland and abroad. This report will be prepared together with confederations and organisations for industries, entrepreneurs and employees, paying special attention to the position of small and medium-sized enterprises. Similar goals will be promoted in the EU.

Finnish Mineral Strategy 2010

The aim of the strategy is to promote domestic growth and wellbeing, create solutions to global challenges arising from the mineral chain, and mitigate environmental problems. The themes of the proposed measures are as follows: strengthening mineral policy and securing the supply of raw materials, reducing the environmental impacts of extractive industries and boosting productivity, and strengthening R&D activities and expertise.

Making Finland a leader in sustainable extractive industries 2013

The action plan sets out measures helping extractive industries to gain social approval for their activities.

European Green Deal. Making Europe the first climate-neutral continent. European Commission

Action plan to promote efficient use of natural resources through transformation to clean circular economy, to restore biological diversity and to reduce pollution. The required investments and available funding instruments are outlined in the plan.

Communication from the Commission 3.9.2020 COM (2020) 474 final. Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability

The communication presents the EU 2020 list of critical raw materials, the challenges for a secure and sustainable supply of critical raw materials and actions to increase EU resilience and open strategic autonomy.

A comparative study of financing models for secondary environmental liability (TOVARAMA). Publication series of the Government's analysis, assessment and research activities 2020:14 (in Finnish, with English abstract)

By way of comparative law research, the project aims at supporting the reform and development of the secondary environmental liability system in Finland.

Termination and aftercare measures covered by collateral under the Mining Act. Publications of the Ministry of Economic Affairs and Employment 2020:41

The report analyses the concrete criteria for determining the collateral under the Mining Act that is composed of the measures based on obligations imposed under the Mining Act.

New directions - The strategic programme to promote a circular economy. Publications of the Finnish Government 2021:1 (in Finnish, with English abstract)

The strategic programme to promote a circular economy sets out objectives for the use of natural resources and measures through which society based on a carbon-neutral circular economy will provide a sustainable foundation for our economy in 2035.

Carbon and environmental footprint in procurement - legislation and measuring (HILMI). Publications of the Government's analysis, assessment and research activities 2021:2 (in Finnish, with English abstract)

The objective of the project was to find out how legislation and other means of governance should be developed, and the procurement activities monitored and measured, in order to decrease the carbon and environmental footprints of public procurement in a cost-efficient manner.

National Battery Strategy 2025. Publications of the Ministry of Economic Affairs and Employment 2021:2

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