

An aerial photograph of a mountain valley at sunrise. The sky is a mix of orange and blue. In the foreground, a dark blue lake is surrounded by green grass and a dense forest of evergreen trees. The middle ground shows rolling green hills with patches of forest and small villages. In the background, a range of jagged, rocky mountains is silhouetted against the bright sky.

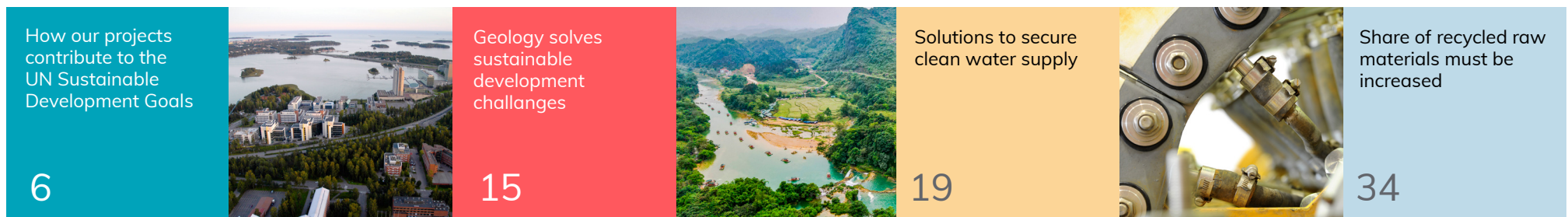
# Solutions to Accelerate the Transition to Sustainable and Carbon-neutral World

Sustainability Report 2021  
Geological Survey of Finland GTK



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# 1 Director General's Review: Time to Act

This new decade has proved many challenges remain to be solved. In its first years, we have seen a pandemic and war in Europe. The climate crisis has not disappeared either – the newest IPCC climate report states that the time to act is now and that emissions must be reduced quickly.

The challenges we face may be as big as mountains, but I am convinced we can overcome them. Our technological competence is stronger than ever, and we have the scientific understanding to tackle complex challenges. New tools are continuously emerging thanks to research and technology.

Where there's a will, there's a way. The pandemic forced us to create location independent working culture in leaps and bounds. I believe that this incomprehensible war will force us to do the same in becoming independent from fossil fuels.

Geology can contribute to this goal. In 2021, we summarised our activities as follows: based

We use  
research and  
technology to  
continuously  
develop new  
solutions.

on geoscientific understanding, we provide companies and society with solutions to accelerate the transition to a sustainable, carbon-neutral world.

To abide by this, last year, we chose the UN Sustainable Development Goals to which we can most contribute. The Geological Survey of Finland was established in 1885, but we have evolved with time and focused on today and tomorrow.

You are reading our very first Sustainability report. With our work on sustainability, we aim to share information on the work we do, steer our activities towards promoting sustainable development, be a great employer, and find out where we have room for improvement.

I thank our personnel, our partners and our customers for their cooperation.

The time to act is now.

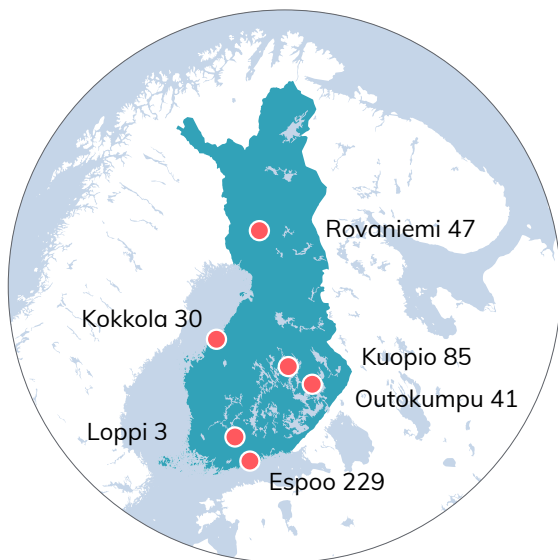
*Kimmo Tiilikainen*  
Director General

Read more: [gtk.fi/strategy-2020-2023](https://gtk.fi/strategy-2020-2023)

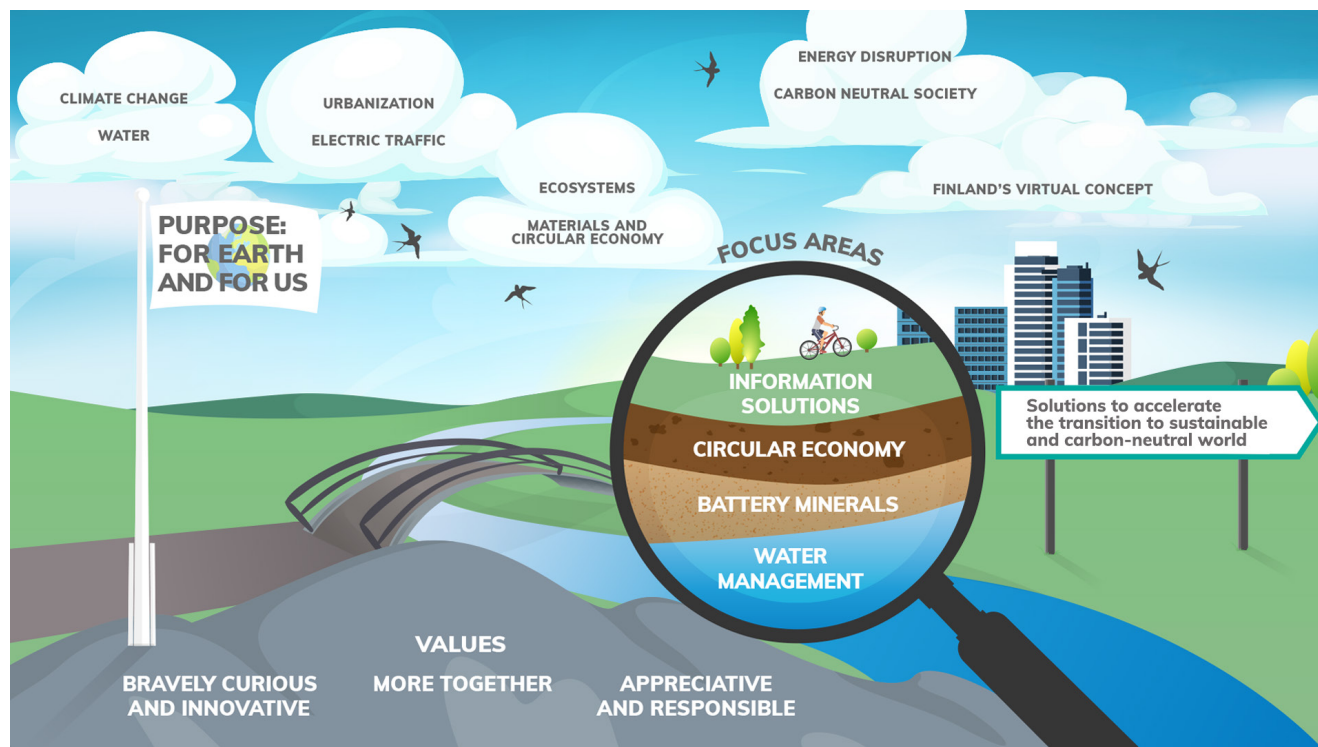


## 2 GTK in Short

At GTK, we aim to work for the Earth and for Us. We conduct objective research to find solutions to challenges posed by climate change, the energy transition, and the circular economy. Our 400 experts are specialists in the mineral economy, green energy, water management, the environment, and digital solutions. Together with our Finnish and global partners, we are building sustainable and carbon-neutral future. GTK is a research organization governed by the Finnish Ministry of Employment and the Economy.



*Our more than 400 experts are based in six different localities.*



### Our Strategy Responds to Global Challenge

Solutions based on geological competence and geoscience information respond to challenges related to global megatrends such as climate change, urbanisation, increasing energy needs, the transport transformation, sufficiency of clean water, and technological advances. Geological competence and solutions based on it can be used to create sustainable growth, both in Finland and globally.

In 2021, we specified our identity and overall impact target: we are one of the world's leading geosurveys and provide companies and society with solutions based on geological understanding to accelerate the transition to a sustainable, carbon-neutral world.



### We Produce Applied Research Data

GTK operates independently of its customers. We serve society and companies by producing and refining data, customer solutions, and science and innovations to support decision making.

Our role is to produce applied research data. Of our key partners, universities and higher education institutions are responsible for the basic research and education in the field, and companies are responsible for commercialising innovations and product development.

In 2021, we created practices for the internal handling of invention disclosures. Two disclosures were submitted in 2021.

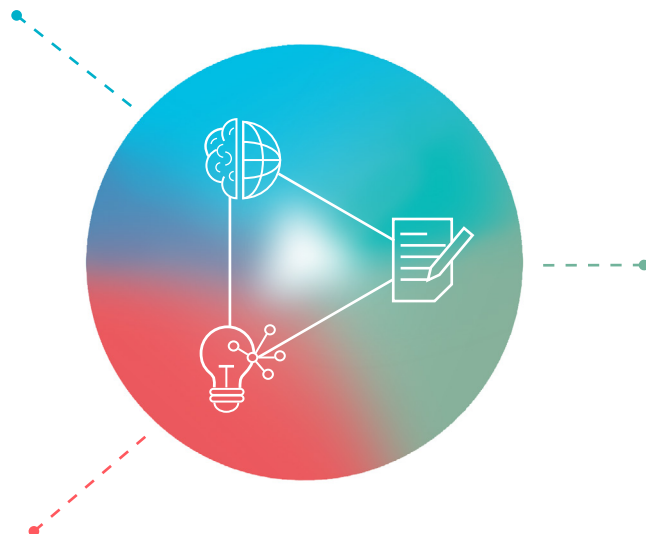
### Results Are Achieved via Projects

Our operating results are primarily achieved via projects. Our project activities are therefore key for our productivity and impact. Our research and project activities are divided into self-financed, co-financed and commercial projects.

## GTK's Three Synergic Roles

### Geoscience Information

Provides, gathers, refines and distributes geoscience information. As a part of the ecosystem develops information capital and improves the utilization possibilities of data and knowledge.



### Customer Solutions

Provides and develops customer solutions based on high-level expertise and data.

### Science and Innovations

As an active operator in the ecosystem, provides scientific results and innovations which address key challenges.



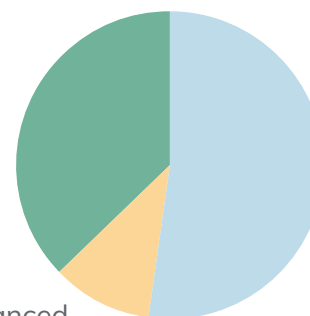
We conduct self-financed project activities with government funding. In co-financed activities, funded for example by the Academy of Finland and EU, we cooperate with research organisations and companies. Commercial projects are carried out on commission for Finnish and international customers and organisations.

### Project Portfolio in 2021

We had 300 projects in 2021.

111 Co-financed projects

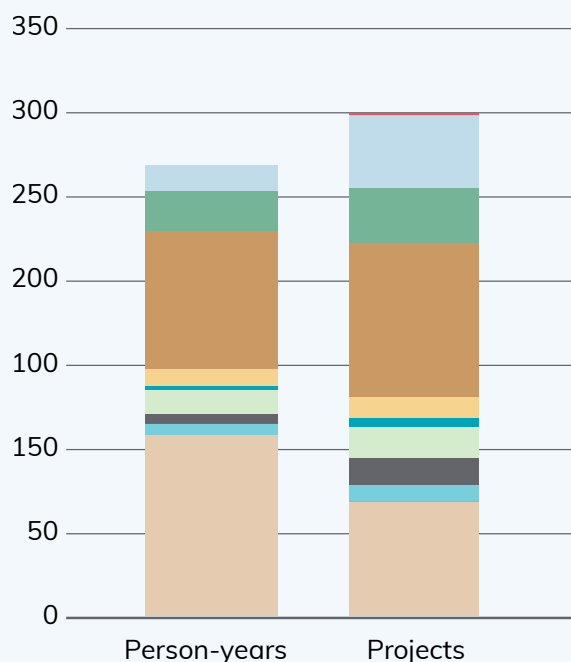
32 Self-financed projects



157 Commercial projects

### Our Projects Contribute to the UN Sustainable Development Goals

We have defined what UN Sustainable Development Goals (SDGs) each of our projects in 2021 primarily contributed to. The category 'Other' consists of projects for which an SDG was not defined.



- Good health and wellbeing
- Clean water and sanitation
- Affordable and clean energy
- Resilient industry, innovation and infrastructure
- Sustainable cities and communities
- Responsible consumption
- Climate action
- Life below water
- Partnerships for the goals
- Other

	Person-years	Projects
Good health and wellbeing	0	1
Clean water and sanitation	16	44
Affordable and clean energy	24	33
Resilient industry, innovation and infrastructure	83	93
Sustainable cities and communities	10	13
Responsible consumption	3	5
Climate action	14	19
Life below water	6	16
Partnerships for the goals	7	10
Other	109	66



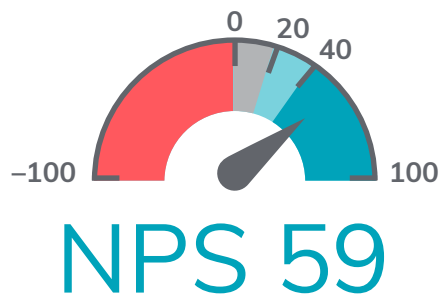


### Customer Services

Our customer activity focuses on the market sectors that have a demand for GTK's research-based competence. Our customers include companies and organisations from the mining, water and environment management, energy, metal and chemistry, transport infrastructure and construction sectors.

In addition to collecting continuous customer feedback, we conduct a customer satisfaction survey every two years from a third party. A total of 58 customers provided feedback in the

#### A Valued Partner



- Excellent: 40+
- Good: 20–39
- Satisfactory: 0–19
- Weak: under 0

#### Net Promoter Score

The NPS is calculated by subtracting the number of those who gave a rating of 9 or 10 from the number of those who gave a rating of 0 to 6.

2021 survey. Our overall customer satisfaction and Net Promoter Score (NPS) improved compared to the previous survey in 2019, and remained excellent. In the latest survey, the share of satisfied and extremely satisfied customers was 88% (82% in 2019), and our NPS was 59 (58 in 2019).

Satisfaction with our ability to produce solutions that benefit our customers' business further improved. Improvements were desired in customer focus, active communication, and process agility.

#### Customer Satisfaction Remained at an Excellent Level in 2021

**71%** of customers received new innovations or practices for their business

**88%** were satisfied or extremely satisfied

*Satisfaction with our ability to produce solutions that benefit our customers' business further improved.*



### Aiming for Balanced Finances

Our financial situation remained balanced throughout 2021. The EUR 10.2 million in appropriations transferred to 2022 was partly due to the savings in expenditure resulting from the extraordinary circumstances. The effects of the pandemic on GTK's operations and on the achievement of our targets proved smaller than expected.

### Statements Support Decision Making in Society

GTK is an unbiased research organisation that contributes to public decision making by evaluating permit applications, EIA procedures, and legislative drafts, among other things. We provide statements on request on issues under our expertise.

The subject of the statement is typically related to the environmental impact of a planned activity. In addition, we provide statements for different legislative projects and other administrative development projects.

In the Environmental Protection Act, GTK is listed as an expert organisation in matters related to environmental permits. We are therefore asked to provide a statement on most environmental permits and assessments related to mining operations. We also often provide statements related to land use, road network plans, and nature conservation.

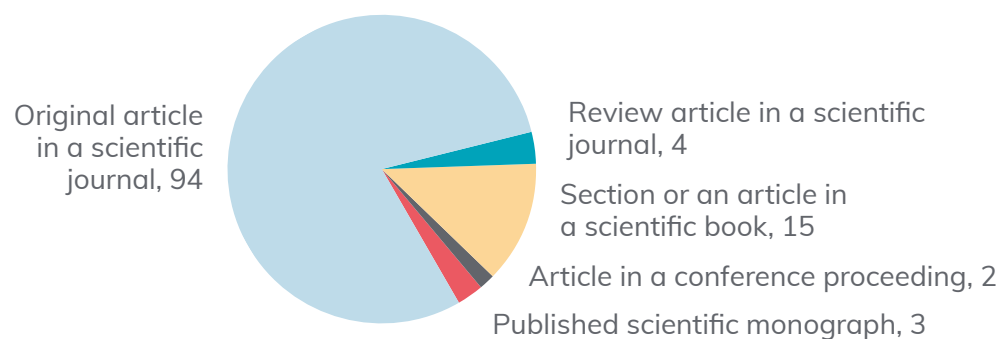
In accordance with good governance, we do not provide statements in matters related to customer services we have provided.

In 2021, we responded to 80 statement requests, of which 66 were related to GTK's expertise, and 14 to administrative or other issues. Of the expert statements, 35 were related to permit processes.

### Scientific Impact via Publications

In 2021, we published 118 peer-reviewed articles. The number increased from 106 in the previous year. Of the publications, 73 were authored with international partners, i.e. they were international joint publications.

Peer-reviewed Publications by Type 2021



*In 2021, we responded to 80 statement requests, of which 66 were related to GTK's expertise, and 14 to administrative or other issues. Of the expert statements, 35 were related to permit processes.*

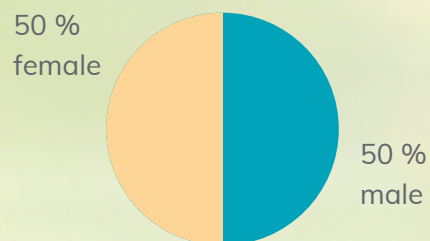


# 3 Us and Our Ways of Working

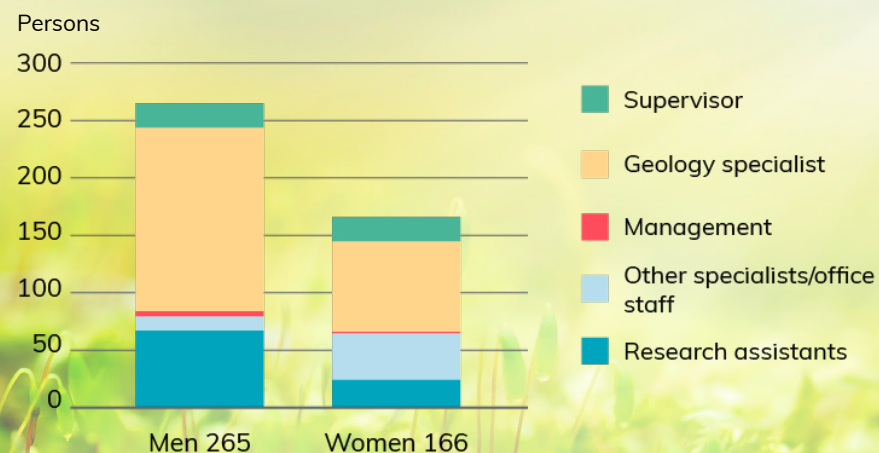
## Person-years

**429** in 2021  
**430** target for 2022

## Our supervisors



## Gender Distribution



## Nationality

**92%** Finnish  
**8%** non-Finnish

## Of our personnel,

**79%** have a higher education or doctoral degree

## Personnel satisfaction

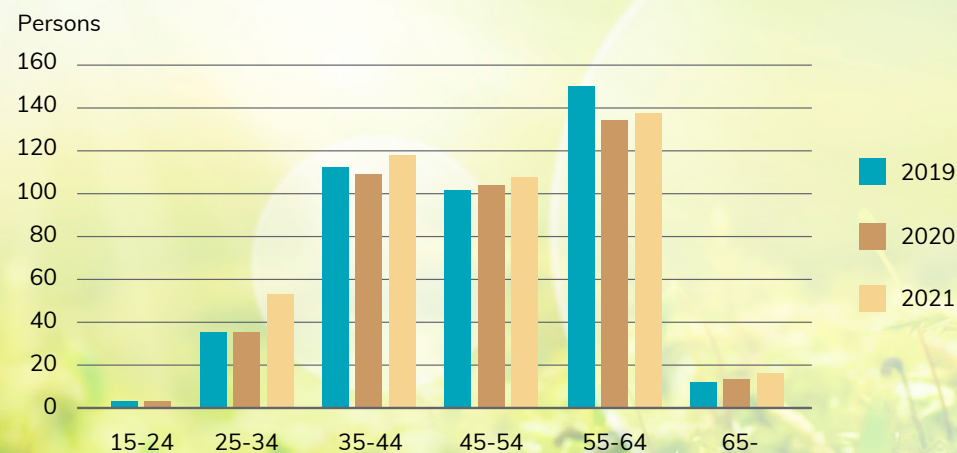
**3,77** overall job satisfaction in 2021  
**3,80** target for 2022

VMBaro  
 Overall job satisfaction of government employees 3.65  
 Scale 1–5

*In 2021, we recruited 60 talented people.*

*The share of younger age groups is increasing.*

## Age Distribution



### Ethical Conduct

We are committed to complying with the guidelines provided by the Finnish Advisory Board of Research Integrity on responsible conduct of research (RCR) and procedures for handling allegations of misconduct. In 2021, no RCR reports were filed on our activities.

Our Code of Conduct was published in 2020 and will be updated in 2022.

**81%** of our peer-reviewed articles in 2021 are open access

### Open Science

Open science and open access publishing are part of responsible conduct. We encourage our researchers to publish their research results in publication series that have a significant impact and are ideal for the research theme, and we recommend open access whenever possible.

We are therefore committed to the national Declaration for open science and research; one of its aims is to improve open access publishing of scientific publications. We are also committed to the recommendations concerning open access publishing of research results supplementing the Declaration. In 2021, of our peer-reviewed articles published in journals, yearbooks and other periodicals, around 81% were open access.

### Equality, Diversity and Fairness

Our Non-Discrimination and Equality Plan was updated in 2021. In addition, we carried out

a supplementary survey related to non-discrimination and equality; due to the VMBaro results of 2021, we wanted to investigate questions related to non-discrimination and equality more closely. Based on the survey, equality is at a good level in the leadership methods of supervisors, our work community, and our everyday work in teams, units and working environments. Some improvement is required in our pay and reward systems and in expediting career advancement.

### Principles of Project Activities

Since solutions to accelerate the transition to a sustainable and carbon-neutral world lie at the core of our research, we strive to ensure our project management and project practices are also sustainable and responsible. The realisation of the benefits pursued through project activities requires clear procedures and an organisational commitment to their compliance.

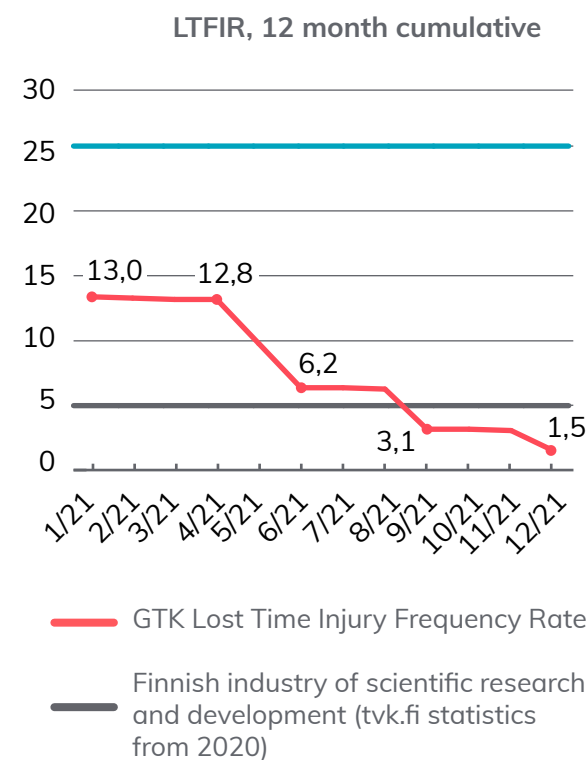
We strive to avoid causing negative effects to the environment in our project activities. In field-work, we aim to minimise environmental effects.

We carry out projects according to our shared project practices, which are in line with the quality and environmental policy guidelines defined in our Quality Manual. With project risk management we aim to avert barriers or threats that could prevent the achievement of our targets. In 2021, we have developed our project methods and tools such as knowledge-based management to ensure the results of our projects more effectively correspond to the goals we have

set. Our virtual, nearly paper-free way of working and sustainable procurement decisions serve as examples of responsible everyday project work. We continue to develop the responsibility and safety practices of project activities.

### Occupational Safety and Developing Our Safety Culture

A significantly lower number of safety observations was recorded in 2021 than in 2020. In 2021, our Lost Time Injury Frequency Rate (LTIFR) was 1.5. Injuries that occurred during working hours and led to an employee's inability to work the next full workday are included in the LTIFR.





In 2021, we recruited an Occupational safety Specialist whose tasks include the development of occupational safety processes and supporting supervisors to ensure they have good capabilities to fulfil their occupational safety responsibilities.

Feedback collected from projects and from our personnel indicated there was room for improvement in our occupational safety culture. At the end of 2021, we began drafting a development plan for occupational safety; the aim is to advance occupational safety processes and tools to ensure that our safety measures are more proactive, systematic, and effective in the future. In particular, we will focus on proactively identifying work related hazards and developing risk assessment practices.

In 2021, our Lost Time Injury  
Frequency Rate (LTIFR) was

1,5

### Competence and Promoting Wellbeing at Work

We are trailblazers in promoting the Government's future model of location independent work. In 2021, the GTK 2.0 location independent work change programme was piloted. As part of the programme, our employees participated in a six-part Cognitive Ergonomics course in groups of 60 to 70 people. Dozens of employees took part in different experiments involving ergonomics. We shared our experiences with other government organisations and held more than ten stakeholder events on the subject. In October 2021, we organised the 'Uuden ajan

*In 2021, we recruited  
an Occupational safety  
Specialist whose tasks include  
the development of occupational  
safety processes and supporting  
supervisors in occupational safety.*

äärellä' ('Beginning of a new era') seminar, at which working life experts encouraged participants to adopt novel working methods. We also organised informal virtual events, celebrations and get-togethers for our personnel with the goal of finding ways to retain a sense of community in hybrid work.

We support our supervisors and management's work by providing management coaching. In 2021, twenty team managers and directors from management participated in the Kippari coaching. We also provided personnel training in communications, facilitation, English for those working in international projects, and sales for those responsible for project sales. Developing strategic competence was supported with special funding allocated to training personnel. During the year, we focused especially on project management coaching.

### Multilocational Recruitment and Investing in Induction

We strive for location independent work. It facilitates and equalises our personnel's working environments and enables us to recruit from

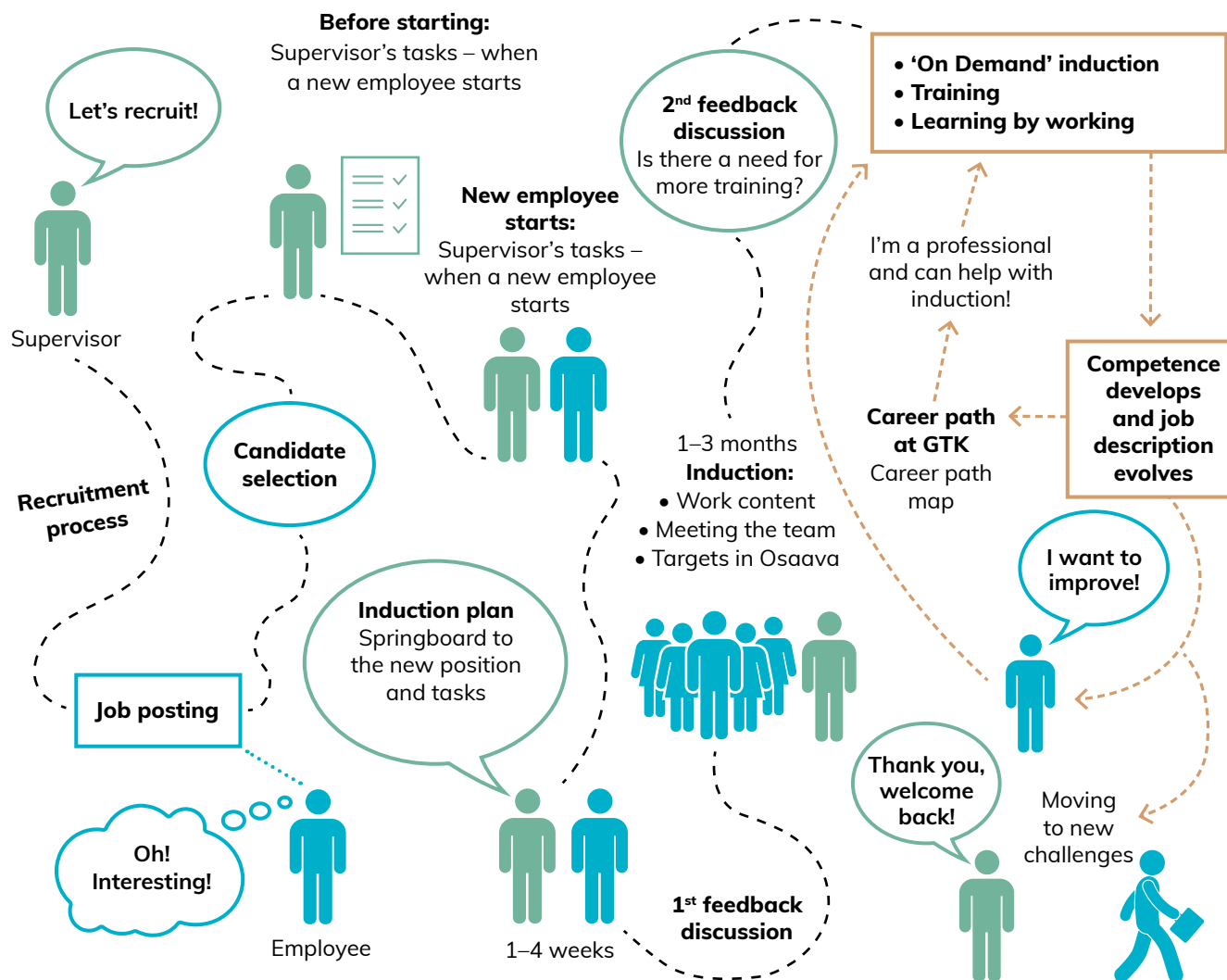


a larger selection of candidates. In 2021, we recruited 60 people, and 70% of recruitments were multilocational (the job posting listed more than one option for a location). In our recruitment processes, we comply with the Government's recruitment principles: openness at every stage, transparency, and non-discrimination.

In 2021, we recruited 32 summer trainees and took part in the Vastuullinen kesäduuni ('Responsible summer job') campaign. Based on the feedback provided by the summer trainees, we did well as an employer. Nearly all the respondents were satisfied with their induction, the content and amount of their work, and our team spirit, and felt that the job met their expectations.

Based on our personnel survey, we needed to develop our induction practices. We launched an updated induction plan template that better supports both the trainer and the trainee and ensures that the new employee can integrate into our work community and their tasks. We developed our induction process by starting an 'On Demand' concept for our entire personnel. The 'On Demand' training includes different modules in which one of our experts in the specific topics organises induction training or a discussion event on demand. In 2021, six of these modules were organised, with five to ten participants in each.

## GTK's Onboarding Process



*In 2021, 70% of our recruitments were multilocational.*



## 4 Management and Development of Sustainability at GTK

The UN Sustainable Development Goals is the framework for our sustainability work. We also want to contribute to the Prime Minister's Office's Agenda 2030 roadmap with our work and to its six key areas of change.

Sustainability is managed and developed overarchingly. Coordinating sustainability has been under the Communications and Sustainability area of responsibility since the start of 2022, and it is under the management of Director of Communications and Sustainability, who is part of GTK's management team.

In 2021, we designed the operating model for our sustainability work. The management team regularly addresses the related guidelines and themes. Sustainability issues are also discussed in forums open to all of our employees. A permanent network comprising of members from our core activities and support functions issues statements on sustainability matters.

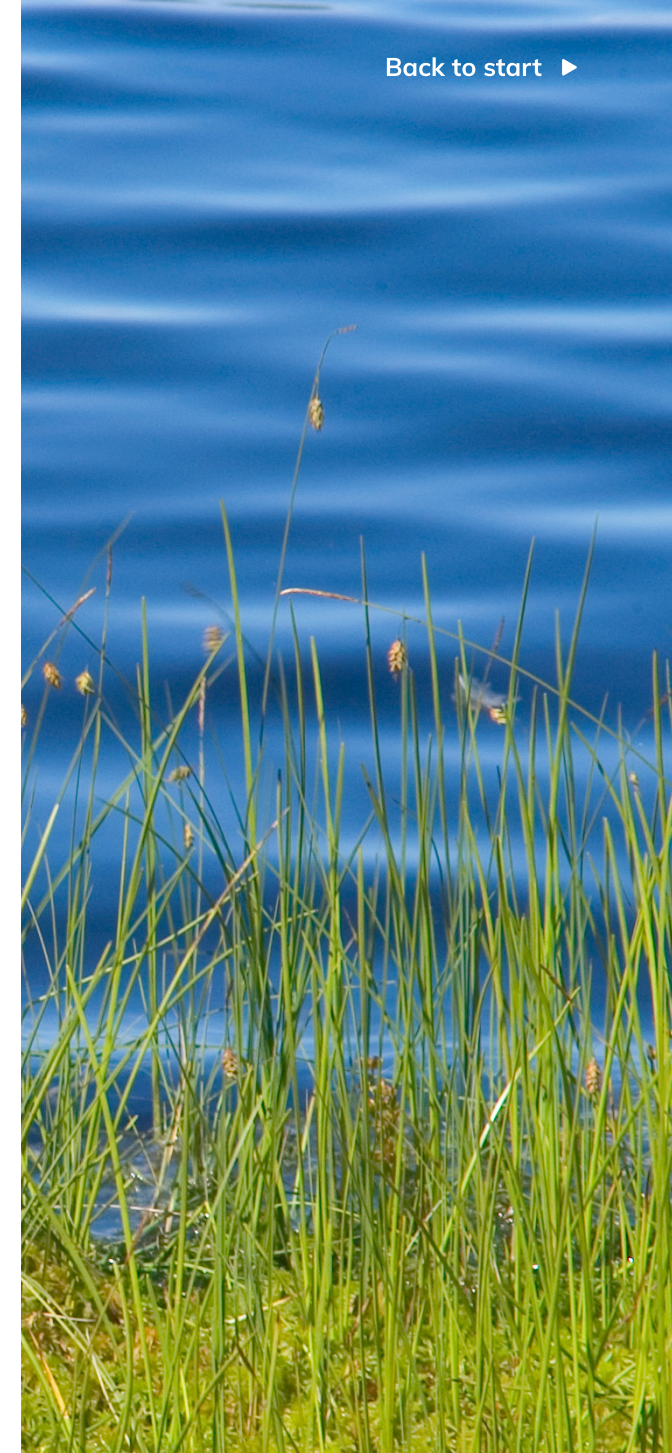
We started our sustainability work in the autumn of 2021 when GTK's management prioritised five UN Sustainable Development

Goals to which GTK could most significantly and effectively contribute. In addition to the prioritised SDGs, our work contributes to many other SDGs as well. The extensive management proposed a set of prioritised SDG targets to senior management, who made the final selection.

The SDGs are part of our project activities, project definitions, and project planning, starting from 2022. The main SDG to which a project can contribute to will be defined for each project before it starts.

Sustainability also extends to our internal activities and ways of working. In our internal activities and their development, sustainability includes the promotion of socially responsible practices such as increasing equality, diversity and fairness. Economic sustainability is promoted with responsible procurement practices that include sustainability as one of the criteria, for example.






Sustainability is considered as part of our strategic planning, annual operative planning, and risk management.





## Sustainability Goals

The UN Sustainable Development Goals (SDGs) form the frame of reference for our sustainability activities. We have prioritised five SDGs on which we can have the most significant impact through our activities.

Prioritised UN Sustainable Development Goal	Highlights on How We Contribute to the Goals	We Focus on
	<ul style="list-style-type: none"> <li>• We promote the sustainable use and management of water resources</li> </ul>	<ul style="list-style-type: none"> <li>• Water management in mining</li> <li>• Groundwater reserves</li> <li>• Industry process waters</li> </ul>
	<ul style="list-style-type: none"> <li>• We promote the research, usability and introduction of low-carbon energy production methods</li> </ul>	<ul style="list-style-type: none"> <li>• Geothermal energy</li> <li>• Site selection for nuclear plants and the final disposal of nuclear waste</li> <li>• Offshore wind farms</li> </ul>
	<ul style="list-style-type: none"> <li>• We promote sustainable and responsible mining</li> <li>• We study the potential and use of minerals required in the energy transition</li> <li>• We promote sustainable construction</li> <li>• We create innovations and new methods</li> </ul>	<ul style="list-style-type: none"> <li>• Circular economy</li> <li>• Technology development</li> <li>• Raw materials</li> </ul>
	<ul style="list-style-type: none"> <li>• We promote the sustainable use of natural resources such as minerals and groundwater</li> <li>• We develop future processes that are more efficient, sustainable, and which generate less waste</li> </ul>	<ul style="list-style-type: none"> <li>• Metal and mineral production value chain</li> <li>• Recyclability and traceability of raw materials</li> <li>• Reducing and reusing waste</li> <li>• Considering sustainability in procurement</li> </ul>
	<ul style="list-style-type: none"> <li>• We collaborate with Finnish and international partners</li> </ul>	<ul style="list-style-type: none"> <li>• Research and education partnerships</li> <li>• Exporting competence, research data and research methods to developing countries</li> <li>• Combining competence in different scientific fields and methods</li> </ul>

# Geology Contributes to the UN Sustainable Development Goals

Geosciences play an important role in the global achievement of the UN Sustainable Development Goals. Geology can be used in managing the impacts of climate change, supporting decision making related to environmental change and protection, and ensuring the supply and sustainable use of critical raw materials.



Source: The Geological Society, 2021.





## 5 Clean Water and Sanitation

Water management is one of our strategic focus areas. We have prioritised the following UN Sustainable Development Goals to which we can most significantly contribute.

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.







### How Can We Contribute to the Goal?

Sustainable use of water resources is one of the largest issues affecting the wellbeing of people and the global ecological carrying capacity. The main themes of our research are groundwater management and water management in mining sector. In addition, water management research is important in assessing the environmental impact of landfill sites, the final disposal of nuclear waste, and geothermal energy solutions.

Our solutions are based on scientific research in several projects, our expertise in the processes of the hydrogeological cycle, information gathered in the field and networks, adoption of new methods and extensive datasets. Our water management expertise can be used in overarching water management issues such as in determining the impact of climate change on groundwater conditions. We engage in international

collaboration related to sustainable water management, support local competence development and produce and store hydrogeological data.

### Our Progress in 2021

In 2021, we carried out ten structural surveys of Finnish groundwater areas. Groundwater surveys produce important information for the regional authorities and waterworks, increasing the efficiency of water supply, improving water and land use planning as well as information on the risk factors affecting groundwater. We also participate in a regionally important water supply project that is ongoing in Kurikka, western Finland.

Managed aquifer recharge (MAR) is an environmentally friendly and cost-effective solution for sustainable water management in areas where natural groundwater reserves are

not sufficient. In 2021, our work on solutions based on MAR progressed at the pilot site of Jänneniemi groundwater intake plant in Kuopio. The work is part of the Hydrogeology and the Global Change (HYGLO) project. Globally, we are studying solutions for MAR in the ICI VietMAR project in Vietnam funded by the Ministry for Foreign Affairs.

Methods towards safe drinking water supply are being developed in the ICI NeAs project in Nepal. The aim of the project is to increase the competence of Nepal's water sector operators in relation to the use and sharing of information on groundwater arsenic levels and reducing the amount of arsenic in drinking water.

In the RAINMAN project, completed in 2021 and including regional collaboration, we developed and implemented solutions for securing the good status of surface waters and groundwaters in the

*Sustainable use of water resources is one of the largest issues affecting the wellbeing of people and the global ecological carrying capacity.*





changing climate. The project focused on urban runoff, the management of urban flooding, and the protection of water resources.

The results included more efficient practices for urban climate change adaptation, particularly for use in Northern Europe.

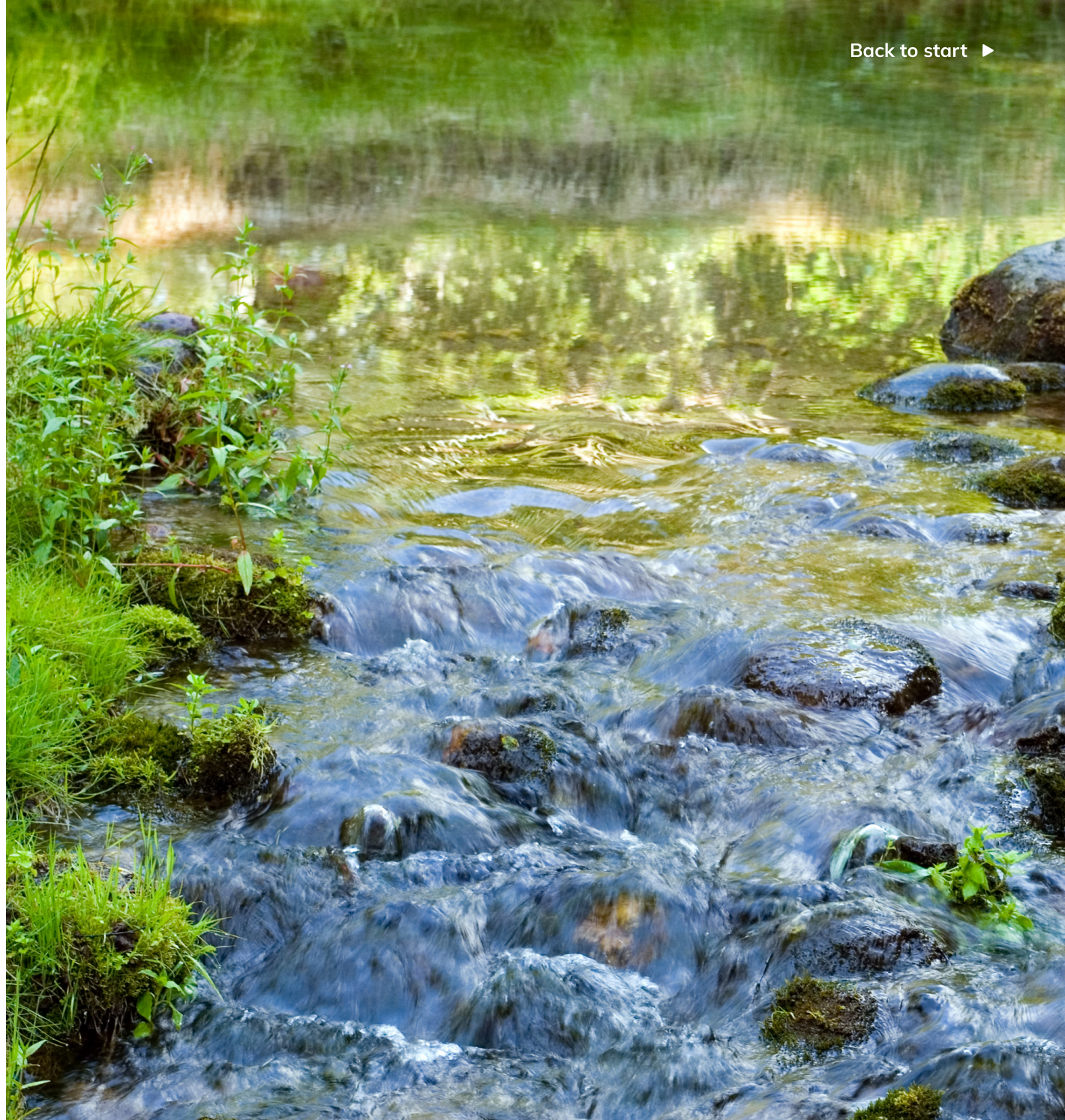
We are part of the EcoClimate Future climate change and environmental research network. In 2022, we will increase our participation in the network's activities, for instance with collaboration carried out at the Oulanka Research Station in Kuusamo.

In the future, we will promote water management services and information management by intensifying our collaboration with other water sector operators and data producers, both in Finland and internationally.

The coronavirus pandemic still somewhat hindered our work in international projects in 2021.



**44** projects contributing to  
UN SDG 6 in 2021





## CASE: Clean Water and Sanitation

## Solutions to Secure Clean and Adequate Drinking Water



Nearly all liquid fresh water in the world is groundwater. As the world's population grows, land use and housing become denser, and climate change

progresses, the role of groundwater protection as an important household water provider becomes even more critical. In 2020, GTK launched the Hydrogeology and the Global Change (HYGLO) project, in which we produce new research data for groundwater questions related to the climate change and respond to the challenges presented by the global change both in Finland and throughout the world.

GTK's HYGLO project responds to climate change challenges by creating research-based, comprehensive and sustainable water management solutions. More than 70 experts from different units work for the project in three different work packages. The first work package includes testing new research methods and developing new service concepts. In the second work package, we concentrate on hydrogeological research and testing stations, global monitoring networks and groundwater data handling. The third package focuses on managed aquifer recharge (MAR) research and applications, and especially on understanding bank filtration processes.

*We export groundwater competence to Nepal, Vietnam, Kyrgyzstan and Uzbekistan.*

Thus far, various natural tracers and groundwater age dating methods have been tested in the project, as well as methods for studying the interaction between surface water and groundwater, including groundwater studies in bedrock. The Jänneniemi groundwater intake plant in Kuopio has been selected as one of the research areas. In particular, our experts focus on questions related to bank filtration in collaboration with Kuopion Vesi Oy. Knowledge and competence on MAR filtration and bank filtration is required. In addition, tools for risk management are needed, since algal blooms growing thicker, pharmaceuticals and microplastics ending up in waterbodies, and changes in groundwater processes are already current global challenges, while their impact is expected to increase and expand to Finland as well.

The project also includes collaboration with the Oulanka Research Station of the University of Oulu. At the station located in Kuusamo, a monitoring studies on climate and environmental change are in progress. This experimental study

focuses on the impact of changing snow conditions on the vegetation and further more for the environment.

In the future, the project will involve establishing more testing stations in different types of geological and hydrogeological environments across the country to support groundwater research, and building national and international networks with universities, research organisations, water supply plants and other industrial companies.

#### Clean Water Is a Common Cause

The HYGLO project develops groundwater competence and research in Finland, but GTK also export its water expertise to other countries. In 2021, GTK had ongoing and planned ICI development cooperation groundwater projects funded by the Ministry for Foreign Affairs in Nepal, Vietnam, Kyrgyzstan and Uzbekistan.

In Vietnam, GTK researchers currently enhance the capability of the local organisations to implement managed aquifer recharge (MAR) as a climate change adaptation measure. In a MAR project, the aim is to increase the recharge of an aquifer artificially by rainwater or surface water infiltration. When implemented correctly, MAR can utilize natural treatment processes to purify the infiltrated water, guarantee consistent




water quality throughout the year, and secure a subsurface storage for raw water.

“Infiltrated rainwater or surface water is naturally purified before it enters the aquifer if the residence time of infiltrated water is sufficient. The locations of abstraction wells and pumping rates play a key role when aiming to benefit nature’s own treatment methods efficiently. Soil layers can even provide natural attenuation of pharmaceuticals and microplastics from the infiltrated water. However, in water management, solutions should always be adapted to the local environment. For example, littering can affect groundwater quality, and in case of heavy pollution, more chemicals treatment is needed,” says **Jaana Jarva**, Chief Expert at GTK.

If everything goes as planned, by the end of the project, Vietnamese experts will have competence based on GTK’s research, as well as guidelines to plan a feasible MAR managed aquifer recharge project, understanding in which situation MAR can be used, and knowledge of the studies that need to be carried out for MAR implementation. In the future, this will enable Vietnamese experts to implement sustainable water management solutions and secure water supply during droughts with nature-based methods as much as possible.



The goal of **managed aquifer recharge (MAR)** is to produce groundwater comparable to natural aquifer by infiltrating rainwater or surface water in a groundwater body without any water treatment or by pre-treating water as little as possible, thereby increasing the volume of water in subsurface aquifers.



**When implemented correctly**, MAR is an environmentally friendly, climate-resistant, reliable and cost-effective way of securing year-round water supply in very different types of climatic conditions and hydrogeological environments.

Compared to surface water plants, **the benefits of MAR** include natural water treatment without the need to use chemicals, consistent water quality throughout the year, and having a raw water reserve protected under layers of soil.

**ICI projects** are projects funded by the Ministry for Foreign Affairs that contribute to sustainable development and support developing countries in eradicating poverty and inequality. In the ICI projects, GTK researchers draft reports on how human rights are observed and promoted, and how gender equality, fairness, climate change and low-emission development are considered in the project work. GTK’s ICI projects also advance the targets of Finland’s International Water Strategy.

The Lähde dataset service provides access to GTK’s research data on Finnish groundwater catchment areas. Currently, the service includes research data on some 150 groundwater areas. The service is open access (provided in Finnish only) [lahde.gtk.fi](http://lahde.gtk.fi)







## 6 Affordable and Clean Energy

By promoting research on and the usability and introduction of low-carbon energy production, we can contribute to the following UN SDG targets:

- By 2030, increase substantially the share of renewable energy in the global energy mix.
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.







### How Can We Contribute to the Goal?

We support Finland's climate and carbon-neutrality targets by advancing the research, usability and introduction of low-carbon energy. The choice of low-carbon energy type is a key aspect of managing the impacts of climate change. Methods of energy production also affect Finland's and Europe's self-sufficiency and the functioning of the energy market.

Our low-carbon energy solutions focus on geothermal energy and nuclear energy. We anticipate that the importance of these as part of decentralised national and regional energy generation systems will increase in the future. In addition, we support research related to other types of low-carbon energy by investigating the potential of offshore wind farms.

We produce information on the suitability of soil and bedrock for construction and energy

production, assess the related risks, and produce data to support decision making related to energy generation. With our geothermal energy research, we aim to increase the use of carbon-free geothermal energy sources and the diversity of generation methods in district heating, among other things. In addition, we investigate and model different options for the seasonal storage of geothermal energy.

In relation to nuclear energy, we focus our research on the disposal of nuclear waste and the assessment of its long-term safety, and site selection and site studies for new nuclear plants.

We collaborate with Finnish and international research organisations and companies, share our competence and train operators in the field.

### Our Progress in 2021

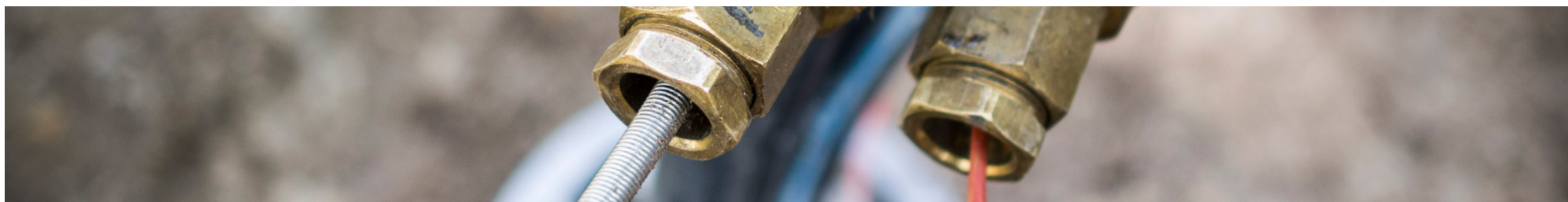
In 2021, we had 33 projects that aimed to

promote the use of low-carbon energy solutions in Finland and globally. Our aim is to further increase our international competence exports to regions and organisations that still lack competence in geothermal energy and nuclear energy.

Our three-year Geoenergy Innovations project aims to strengthen our international research and development collaboration and promote the import of new ideas to Finland's geothermal energy markets.

The project aims to create new opportunities for research focusing on the use of bedrock temperature, or geothermal energy, in solutions related to bedrock and groundwater.

*In 2021, we had 33 projects that aimed to promote the use of low-carbon energy solutions in Finland and globally.*







In the SMART Otaniemi project, we made advances in research on methods for measuring the energy efficiency and energy wells in larger geothermal energy applications. Within the project, we took part in the work of the International Energy Association (IEA) on heat pump technology. The project was based on an innovation ecosystem of the private and public sectors that supports the development of new geothermal energy solutions.

We strengthened our connections with international research networks and working groups by participating in the preparations for the European EURADSCIENCE research institution network. We also contributed to several co-financed projects that promoted research on the disposal of spent nuclear waste.



33 projects contributing to  
UN SDG 7 in 2021





## CASE: Affordable and Clean Energy

## More Efficient Use of Geothermal Energy Could Reduce Use of Fossil Fuels and Resulting Carbon Emissions



The top layers – down to around 300 metres – of the earth’s crust in Finland store nearly 1,000 times as much energy as Finland produces.

In 2020, GTK started the Geoenergy Innovations project, which aims to create new opportunities for the application of ground heat and geothermal energy. The project covers potential geothermal energy solutions based on both bedrock and groundwater.

The earth’s crust stores massive amounts of heat. Finland has only begun tapping into this energy source, although a significant share of Finland’s total emissions results from heating. The potential is great, and GTK’s Geoenergy Innovations project focuses precisely on this. The aim is to improve the usability of geothermal energy to at least partly enable the abandonment of combustion-based energy.

Ground heat has increasingly been used for the heating of detached houses since the turn of the century. In addition, as the heat pump and drilling technologies improve, using geothermal heat has become more popular in larger systems with more than a single energy well; these can be used to heat larger sites such as terraced houses, apartment buildings and logistics centres.

”In principle, geothermal energy is a source that can be used to cover all heating needs, but the challenge is to control the output. Geothermal energy systems produce heat consistently, but the output is always controlled by nature, which means that it is impossible to only use geothermal energy in situations where spikes in demand are expected,” says **Teppo Arola**, the Project Manager of the Geoenergy Innovations project.

Energy systems based on groundwater can help to a limited degree, and these are also studied in the project. ”Energy systems based on groundwater are a more promising option when control of output is required, since these systems enable larger temporary increases in output. However, only small-scale systems are currently in use.”

The continuous usable output in groundwater-based systems is around 110 MW for the surveyed groundwater areas in Finland. A significant share of the properties located in groundwater areas or near them could be heated with the energy produced in one year with this output.

### Development, Testing, Modelling

The Geoenergy Innovations project includes development, testing measuring instruments, and fieldwork. Measuring stations have been

set up in several locations in Finland.

In the project, researchers develop a solution for modelling bedrock fractures that can be used to assess both energy production potential and the effects of bedrock on a project’s risks. Bedrock fractures is a significant risk for the success of drilling and for the viability of the entire project.

*GTK researchers were the first in the world to use AI in studying geothermal energy potential.*

In addition, the project includes using research to develop a new method for measuring bedrock heat conductivity that can be used to calculate how energy flows underground. This will help in designing solutions for the use of energy, since heat exchange varies depending on bedrock composition and structure.

The project also investigates opportunities in the Arctic region, covering Finland from Oulu upwards and even Alaska in the United States. The current results indicate that the Arctic region has geothermal energy potential, but pilot sites are needed for the efficient utilisation of that significant potential.





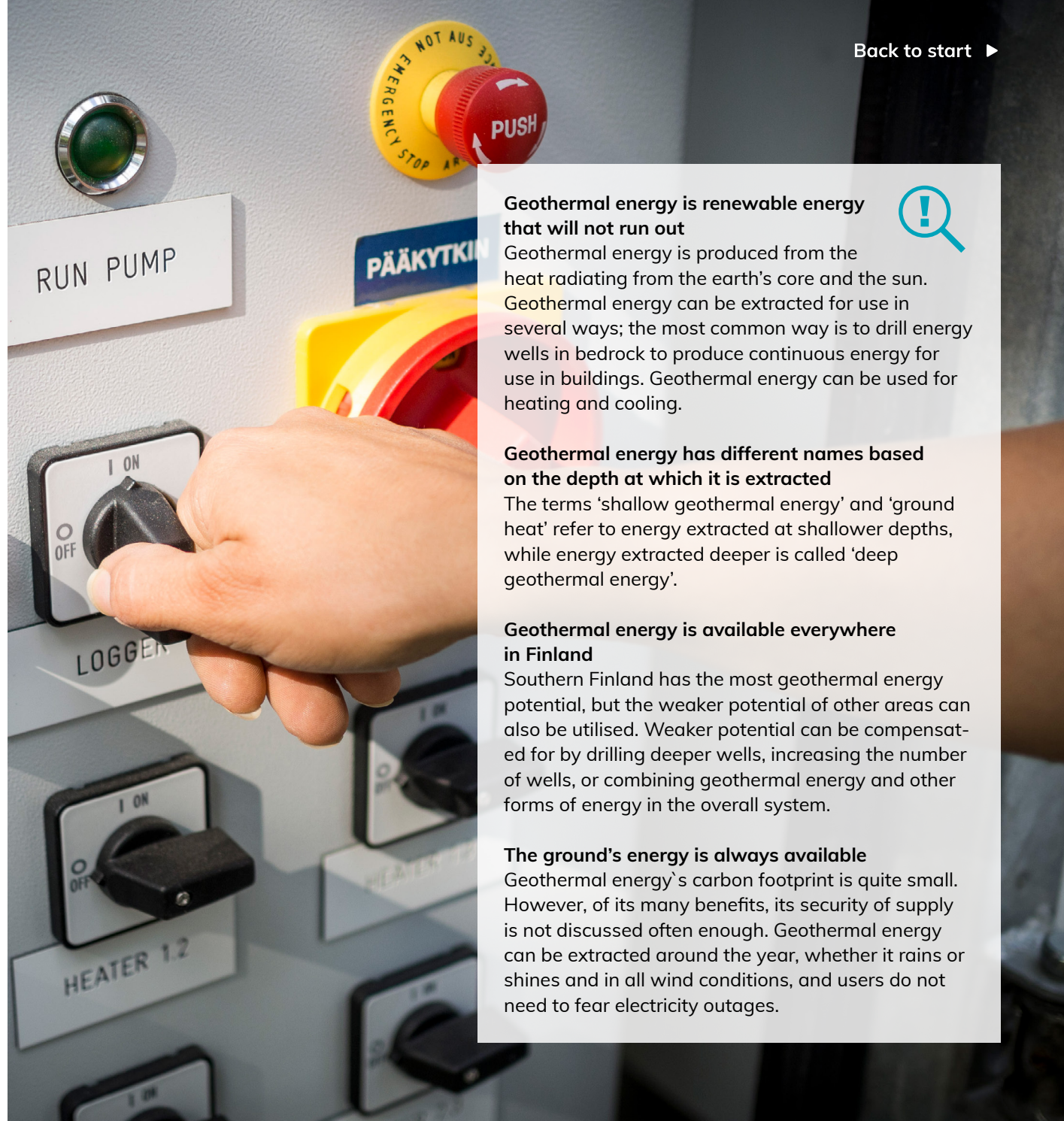
### AI Predicting Geothermal Energy Potential

Novel technology is also introduced in the project. GTK researchers were the first in the world to use AI in studying geothermal energy potential. The researchers developed an AI application that was trained to predict geothermal energy potential with different thermogeological parameters. The AI was successfully used to create maps of geothermal energy potential in Finland; calculating the potential would have been impossible without the AI due to the calculating power and the time demanded.

Smart applications will be key in the future. We must invest in competence to be able to use the energy stored in the ground more efficiently. "The field is growing, and education is needed – there isn't enough talent currently," concludes Teppo Arola.

The maps of geothermal energy potential in Finland can be accessed at [gtkdata.gtk.fi/Maankamara](https://gtkdata.gtk.fi/Maankamara)

The service includes an extensive map database on ground formations covering the whole of Finland, with some 200,000 polygons and more than 300,000 lineations.



#### Geothermal energy is renewable energy that will not run out



Geothermal energy is produced from the heat radiating from the earth's core and the sun. Geothermal energy can be extracted for use in several ways; the most common way is to drill energy wells in bedrock to produce continuous energy for use in buildings. Geothermal energy can be used for heating and cooling.

#### Geothermal energy has different names based on the depth at which it is extracted

The terms 'shallow geothermal energy' and 'ground heat' refer to energy extracted at shallower depths, while energy extracted deeper is called 'deep geothermal energy'.

#### Geothermal energy is available everywhere in Finland

Southern Finland has the most geothermal energy potential, but the weaker potential of other areas can also be utilised. Weaker potential can be compensated for by drilling deeper wells, increasing the number of wells, or combining geothermal energy and other forms of energy in the overall system.

#### The ground's energy is always available

Geothermal energy's carbon footprint is quite small. However, of its many benefits, its security of supply is not discussed often enough. Geothermal energy can be extracted around the year, whether it rains or shines and in all wind conditions, and users do not need to fear electricity outages.



## 7 Industry, Innovation and Infrastructure

By promoting resilient construction and industry such as sustainable mining, we aim to contribute to the following UN SDG targets:

- Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
- Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.
- Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.





### How Can We Contribute to the Goal?

We promote sustainable and responsible mining. The systemic change of the mining industry towards sustainable operations based on the circular economy supports the overall willingness to invest, the development of technology, and the EU's raw material self-sufficiency. Raw material challenges are global. The demand is high for new innovative solutions and relevant competence outside Finland as well.

The soil and bedrock data we produce are a good foundation for building infrastructure and industry. We study the potential, use and effects of battery minerals and other minerals required in the energy transition.

The circular economy is one of our four focus areas. The circular economy includes developing solutions for processing ore, industrial minerals and other geomaterials, process water management, and recycling waste and side streams and benefitting from them. In

addition, our competence in mining waste and wastewaters and their management and reuse adds responsibility to industry and infrastructures.

GTK Mintec, the only pilot plant and laboratory of its kind in Europe, promotes sustainable mining and the circular economy. The environmental impact of mines can be significantly reduced by using mining by-products more efficiently or processing them into a less hazardous form.

We develop geophysics-based, modern, ecological and cost-effective measurement, sounding, and interpretation services for soil and bedrock. For the sustainable planning and implementation of civil engineering, we develop geomodels that improve the cost-effectiveness of civil engineering and transport infrastructure projects, especially in areas with bedrock or soft soil. We work together with other organisations in the field to include the use of geomodels in

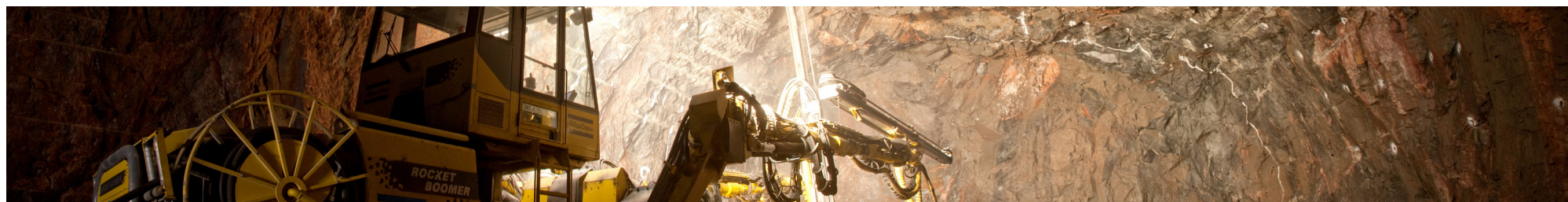
*The environmental impact of mines can be significantly reduced by using mining by-products more efficiently or by processing them into a less hazardous form.*

land use planning and construction. We also promote the use of sustainable and recyclable domestic natural rock in construction.

The solutions we have developed for managing environmental changes and risks improve the sustainable use of land and sea areas. Among other things, we produce solutions for sustainable seabed use and safe and cost-effective operations in geochemical risk areas.

### Our Progress in 2021

The European transition to a low-carbon society requires metals and minerals. In 2021, Finland published its National Battery Strategy;





GTK chaired the related working group. We coordinated a preliminary study on the raw materials in the bedrock of the Nordic countries; they could cover a significant share of this need. The study was commissioned by Nordic Innovation under the Council of Ministers.

The project for the development of Closuresmatic, a management tool for continuous mine closure, was completed in 2021. Continuous closure is started at the planning stage of a mining project, and it reduces the risks and uncertainties related to mining operations. The development project was funded by EIT Raw Materials.

The New Exploration Technologies (NEXT) project funded by the EU Horizon 2020 programme was also completed. The project involved the development of modern mineral exploration methods that conserve nature. The methods include using earth observation data and measurements made with remote-controlled UAVs. The extensive Mining and Metallurgy Regions of EU (MIREU) project, funded under the same programme, was also completed. The project focused on the environmentally sustainable production of mineral raw materials in Europe and modelling good practices for use in different EU countries.

We were granted funding to update the

GTK Mintec pilot plant and laboratory, which also enables us to promote sustainable mining and the circular economy. In 2021, froth flotation cells were installed that enable us to test an environmentally safe and efficient mineral separation process.

Acid sulfate soils and high geochemical background concentrations are a significant risk in construction and land use planning. In 2021, we completed a 10-year project surveying acid sulfate soils in Finland. The result is the most comprehensive database on the occurrence of acid sulfate soils in Finnish coastal areas. The database is a significant asset that can be used as background information in the risk management of different regions and land use sectors. In addition, in the HASUdigi project, we create digital open data on acid sulfate soils for the use in the construction sector in particular. We also completed an EU-funded project (AgriAS) in which we investigated the occurrence of a harmful substance, arsenic, and the related risk management in agricultural lands in Southern and Central Europe.



93 projects contributing to  
UN SDG 9 in 2021





CASE: Resilient Industry, Innovation and Infrastructure

## Material Efficiency to Respond to Climate Change and Green Transition Demands



Innovative research platforms and overall process management are needed to enable companies to test and modify their processes

in a more sustainable direction. GTK Mintec responds to this need. Its development into the world's leading circular economy and mineral processing pilot and research platform was kicked into high gear in 2021.

Located in Outokumpu, GTK Mintec is a globally unique pilot plant and research environment that has for years promoted the circular economy, material efficiency, and the recycling and use of mineral-based raw materials. The research environment serves mining, mineral exploration, circular economy and metal industry companies and research organisations from around the world.

We decided to upgrade GTK Mintec's infrastructure and research platforms to ensure the plant could better respond to the needs of climate change, green transition and digitalisation. As part of the upgrade, the offices will also be renovated which will provide new opportunities for research. The aim is to produce solutions that make the recovery of valuable materials more precise and reduce the quantity

of side streams. "We will increase our research capacity and competences to be able to offer environmentally friendly solutions in the areas of the circular economy, battery minerals and water management," says **Jouko Nieminen**, Head of Unit at GTK's Circular Economy Solutions.

*GTK Mintec is a globally unique pilot plant and research environment that advances the circular economy and material efficiency.*

The laboratory and pilot plant will be updated and expanded, and the offices will be renovated to include a workspace that customers and partners can rent. Finally, the pilot plant in Outokumpu will be modernised.

### The Project Starts

The upgrade will be in full swing in the autumn of 2022 with the renovation of the offices and the laboratory, but the work began in 2021 by installing new smart flotation cells that enable better monitoring in mineral processing research and planning material-efficient processes.

"With these new flotation cells, our domestic and international customers can use highly





modern technology in the study of battery minerals and recycled materials, for example,” summarises Jouko Nieminen.

New research is required, because the currently known mineral deposits will be insufficient on their own to meet the demand of electronic vehicle batteries and renewable energy technologies. Thus, managing mining side streams and circular economy solutions are key in making the sector sustainable. Reuse of side streams is also important. The GTK Mintec pilot plant will work more efficiently to find solutions to these challenges.

GTK’s Ground properties map service provides information on Finland’s soil and bedrock.  
[gtkdata.gtk.fi/Maankamara](https://gtkdata.gtk.fi/Maankamara)



### More circular economy solutions are needed



Currently, recycling can only cover a small part of the metals and minerals needed for the transition to a society free of fossil energy. Sustainable mining, research, and the development of recycling opportunities for industrial side streams are therefore essential.

### Europe’s only cobalt mines are in Finland

All the cobalt produced in Europe currently comes from three Finnish mines, i.e. the Kevitsa, Kylahti and Terrafame mines. Europe also has 104 cobalt deposits that would probably be viable. Of these, 79 are in Finland, Norway and Sweden. The global demand for cobalt is increasing quickly as we transfer to a low-carbon society, because cobalt is needed for electric vehicle batteries, for example.

### The battery sector is a major opportunity for Finland

Finland has a National Battery Strategy that outlines how Finland can become a competitive operator in the international battery sector. The upgrades to GTK Mintec promote research related to material efficiency and the circular economy and contribute to the goal of creating a viable and sustainable battery cluster in Finland.

### Our competence should be leveraged

Finland’s strengths include raw material resources and their processing, as well as competence in battery materials, recycling, and digitalisation. Becoming a significant operator in the battery sector will require further development of these strengths. In addition, GTK’s geological datasets are among the best in the world, creating a foundation for sustainable mineral production.



## 8 Responsible Consumption and Production

By promoting responsible consumption of minerals, chemical elements and groundwater, as well as sustainable seabed use, we can contribute to the following UN SDG targets:

- By 2030, achieve the sustainable management and efficient use of natural resources.
- By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.
- By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.
- Promote public procurement practices that are sustainable, in accordance with national policies and priorities.
- Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.





### How Can We Contribute to the Goal?

We promote responsible consumption, especially in relation to natural resources such as minerals, chemical elements and groundwater, and sustainable seabed use.

We produce research information and develop solutions for the entire metal and mineral value chains, and especially for the upstream of the chain, i.e. mineral potential surveying and extraction, as well as recycling. We develop methods for making the process as efficient, low waste and responsible as possible.

According to Statistics Finland, 75% of all the waste generated in Finland resulted from mining and extraction in 2019. By promoting the

circular economy, we aim to reduce the amount of waste and reuse existing waste. The aim is to find diverse practical uses for the waste rock and tailings generated in mining. We also utilise side streams from other industries. It is vital to create environmentally safe chemical and process water treatment processes.

We research battery minerals and develop solutions for the recycling, traceability and processing of raw materials. Green transition requires mineral extraction. The amount of recycled materials is insufficient to meet the demand, but the share should still be increased. We also promote research related to the traceability of minerals.

*By promoting the circular economy, we aim to reduce the amount of waste and reuse existing waste*





## Procurement

Responsibility is one of the cornerstones of Finland's National Public Procurement Strategy. Ministries are committed to contributing to the targets of the Procurement Strategy in their own activities and in the activities of their administra-

tive sector with a decision-in-principle issued by the Government (Government decision, 10 September 2020). GTK is under the Ministry of Economic Affairs and Employment's and there-

fore drafted its own action plan in 2021 for contributing to the targets of the Procurement Strategy.



Target	Measures	Indicators
<p><b>Ecological sustainability</b></p> <p>We contribute to Finland's target of being carbon neutral by 2035, the creation of a circular economy, and the preservation of biodiversity.</p>	<p>The procurement categories with the greatest potential for environmental impact are identified. At the next stage, category- and/or procurement-specific targets and criteria are designed with experts in the matter.</p> <p>Practices for sustainable procurements will be drafted with GTK's Communications and Sustainability unit (in line with the Government's Code of Conduct).</p> <p>Scoring and/or minimum requirements must emphasise the sustainability of the suppliers' processes (production methods, carbon footprint, recyclability of materials, certifications, etc.).</p>	<p>The relative share of the carbon footprint of the procurement volume will be reduced by 20 per cent by 2024 compared to the initial level (source: Hankintapulssi)</p> <p>Joint working groups have been established with core functions (Y/N)</p> <p>Practices for sustainable procurement have been drafted and introduced (Y/N)</p> <p>Ecological criteria/requirements/contract terms have been used in procurements (number, share of procurements)</p>
<p><b>Social sustainability</b></p> <p>We promote the fulfilment of human rights and basic labour rights in our procurements.</p> <p>We promote the employment of those with a poor position on the labour market with procurements suitable for this.</p>	<p>The procurement categories with the highest risk of violating human rights are identified. At the next stage, category- and/or procurement-specific targets and criteria are designed with experts in the matter.</p> <p>Practices for sustainable procurements will be drafted with GTK's Communications and Sustainability area of responsibility (in line with the Government's Code of Conduct).</p> <p>The procurement categories most suitable for including terms and conditions on employing vulnerable people have been identified, and such terms have been included in the suitable requests for proposals.</p>	<p>Joint working groups have been established with core functions (Y/N)</p> <p>Practices for sustainable procurement have been drafted and introduced (Y/N)</p>
<p><b>Economic sustainability</b></p> <p>We combat the shadow economy and promote responsible taxation practices.</p> <p>Our procurements are planned and cost-effective.</p> <p>We develop our procurement process and centralise procurements to reduce process costs.</p>	<p>We will vet our suppliers more thoroughly (also during the contract period), Data sources: Cloudia, AlmaTalent and the Business Information System).</p> <p>Sufficient resources (incl. support services) will be reserved to carry out larger procurements (procurements related to funding proposals).</p> <p>In procurements related to funding proposals, a cost-benefit analysis will be carried out.</p>	<p>At a minimum, suppliers' information in the Business Information System have been checked (Y/N)</p> <p>Support services have also reserved resources for procurements related to funding proposals (Y/N)</p> <p>Cost-benefit analyses have been carried out (Y/N)</p>



GTK's future annual Sustainability reports will include updates on the progress of the above targets. As part of our responsible consumption practices, we comply with the targets set in the Government's Strategy for Travel. We assess whether meeting in person is necessary, the number of participants necessary and the mode of transport. When choosing the mode of transport, we consider the total duration of the trip and its environmental impact.

### Our Progress in 2021

We published Associate Research Professor Simon Michaux's research report 'Assessment of the Extra Capacity Required of Alternative Energy Electrical Power Systems to Completely

Replace Fossil Fuels'. The report revealed that replacing the current fossil fuel energy systems with renewable energy systems will be more challenging than expected. The key content of the report was presented to decision makers in several fora in 2021.

GTK Mintec was granted funding in 2021. The investment is important for promoting the circular economy.

In our project activities, we contribute to this goal in several ways. In the Digitalisation and natural resources project completed in 2021, we studied recycling the metals and minerals in smart phones and televisions. The results of the project were presented to various stakeholders.

The BATCircle 2.0 (Finland-based Circular Ecosystem of Battery Metals) consortium

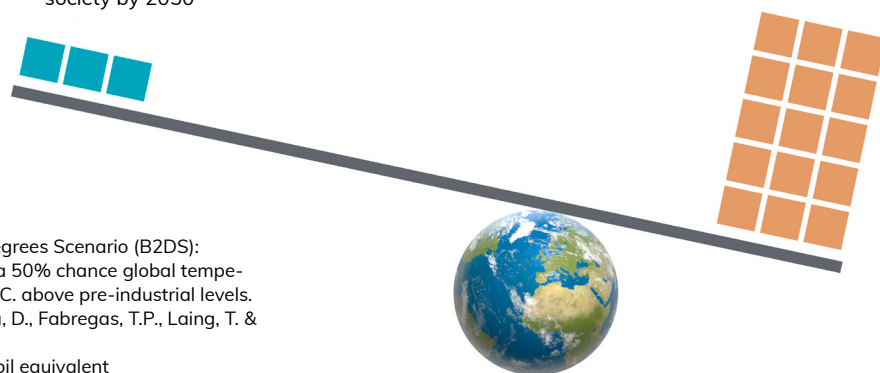
established in 2019 was granted additional funding to improve the manufacturing processes of the extractive and metal industry and battery chemicals, as well as increase the recycling efficiency of lithium-ion batteries. Aalto University coordinates the collaboration.

Verifying the origin of metals is important when aiming for sustainable battery production. In the BATTRACE project carried out with VTT, we study whether battery mineral deposits have compositional characteristics that could be used in tracing the origin of a battery mineral, metal or material. In 2021, we analysed lithium samples taken at different steps of the value chain and started doing the same for graphite samples. In 2021, we approved our new procurement strategy, in which a key criterion is responsible procurement practices.

### Simon Michaux's study: Current mineral resources are insufficient for building infrastructure relying on non-fossil energy

Around 3 billion tonnes of metals and minerals are needed to establish a global low-carbon society by 2050\*

Globally, we use around 15 billion tonnes of coal, oil and gas\*\* each year



\* The Beyond 2 Degrees Scenario (B2DS): Aims to limit with a 50% chance global temperature rise to 1.75°C. above pre-industrial levels. (Hund, K., La Porta, D., Fabregas, T.P., Laing, T. & Drexhage, J. 2020)

\*\* gas in tonne of oil equivalent

**5** projects contributing to UN SDG 12 in 2021

The Mineral Deposits and Exploration (MDaE) map service provides information on all Finland's mineral deposits and mines, as well as mine register data, geological and geophysical maps, and observation and measurement data. [gtkdata.gtk.fi/mdae](http://gtkdata.gtk.fi/mdae)



## CASE: Responsible Consumption

## Minerals Are Key to Enabling Digitalisation



In 2021, GTK studied the raw material consumption resulting from digitalisation with VTT, the Finnish Environment Institute SYKE, and the Finnish Innovation

Fund Sitra. The research project analysed the value chain of the metals and minerals used in smartphones and televisions, from mining to recycling. The aim was to find ways to improve the recycling of raw materials.

The current trend of digitalisation is challenging from the perspective of mineral resources; valuable metals are used in products whose life cycles grow increasingly short and production amounts increasingly great. Several special metals are required for the new technologies and functions of society. The products are complex and can include up to 50–80 different chemical elements; this not only strains primary produc-

tion, but also makes recycling the products more difficult.

In theory, metals can be recycled indefinitely without losing anything in terms of their characteristics or performance. However, achieving this cycle with ICT equipment is challenging. Several of the raw materials are only used in small quantities and as part of complex metal alloys, which makes recovering and recycling the metals expensive, energy- or resource-intensive, or even impossible. Currently, around 83% of all waste from electrical and electronic equipment (WEEE) globally is not documented, collected or recycled appropriately (Forti et al., 2020).

### Product Design Is Key

In a study headed by GTK, it was observed that product design was extremely important for ensuring the recyclability of a product. The European Commission estimates that up to 80%

*Recyclability must be considered at the product design level by choosing metal alloys that can be recycled to recover the metals.*

of a product's lifetime environmental impacts are locked in at the product and material design stages. For example, the design dictates which raw materials, other materials, components, chemicals, and manufacturing methods will be used, as well as how repairable and recyclable the product and its materials are respectively.

"Recyclability must be considered at the product design level by choosing metal alloys that can be recycled to recover the metals. Naturally, it is also important that the device itself has a long useful life and that it is repairable," says **Toni Eerola**, Senior Specialist at GTK and one of the authors of the study.



We can also reduce the need for minerals by reducing consumption, supporting the use of repair services, and improving the collection and recycling system.

### Increasing the Extraction and Processing of Minerals Cannot Be Avoided

The demand for raw materials and components is expected to increase as we transition to a low-carbon society. Since recycling can only cover a fraction of the demand, increasing the extraction and processing of minerals cannot be avoided. It is therefore important that metals and components are produced in countries with strict social and environmental legislation, carbon emissions that are as low as possible, and continuous and flexible supply. This means that mines, mineral processing and component production must also be increased in Europe. For example, Finland could produce a significant portion of the raw materials required by digitalisation in the EU.

The Digitalisation and Natural Resources study can be found in Finnish at: [tupa.gtk.fi/raportti/arkisto/53\\_2021.pdf](https://tupa.gtk.fi/raportti/arkisto/53_2021.pdf)

## Results of the Digitalisation and Natural Resources Project



### Challenges

- Increasing consumption
- Increasing need for raw materials
- Use of critical or conflict minerals
- Competition with other industries (electric mobility, renewable energy)
- Short life cycle of ICT products
- Imbalance between the time required for the formation, discovery and production of ICT raw materials and product life cycles
- ICT products becoming more complex: the increasing selection of raw materials required, more complex raw material alloys
- The complexity of ICT products makes recycling them challenging
- Import-dependency, security of supply, critical and conflict minerals (devices, components and raw materials)

### Solutions

- Ecological design in terms of materials and products
- Improving traceability and developing digital materials and product passports
- Optimising recycling
- New models for sharing and owning complying with the principles of the circular economy
- Increasing self-sufficiency in the EU's internal and responsible supply chains
- Decreasing consumption by increasing awareness and through incentives and legislation
- Transferring from the consumption and production of materials to services





## 9 Partnerships for the Goals

We provide latest research information and we train experts in Finland and worldwide to develop solutions with our partners. Together we contribute to the following UN SDG targets:

- Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.
- Enhance the Global Partnership for Sustainable Development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the Sustainable Development Goals in all countries, in particular developing countries.





### How Can We Contribute to the Goal?

We work with partners globally and our competence is highly valued internationally. We provide the latest research information, train local experts and develop solutions in collaboration with our partners. We promote the development, transfer and dissemination of environmentally friendly technologies, for example with GTK Mintec's environmentally sound processes.

### We Seek Impact by Collaborating with Companies

We combine competence in and methods of different disciplines with our partners. We tackle challenges in a multidisciplinary approach by seeking new partnerships in different fields.

We create international partnerships. We are founding members of significant international consortia such as the Coordinating Committee for Geosciences Programmes in East and

Southeast Asia's Regional Center for Urban Geology (CCOP-RCUG).

The United Nations Framework Classification for Resources (UNFC) is an international system for the classification, management and reporting of energy, mineral and raw material resources. The UNFC promotes sustainable development by enabling the efficient and responsible management of natural resources.

The UNFC is a neutral and flexible tool for the classification of mineral resources, as well as peat resources, and the reusable materials from tailing ponds and waste rock piles of old mines. Since 2017, we have increased our UNFC expertise by participating in international collaboration. GTK is a known UNFC expert in Europe.

### Our Progress in 2021

In 2021 we had 12 international customer projects, some of which were delayed due to

the Corona virus pandemic. We conducted five international ICI sustainable development projects funded by the Ministry for Foreign Affairs.

In the final quarter of 2020, the Government submitted a proposal on amending the act on the Geological Survey of Finland to Parliament. It proposed that the management of the bilateral expert services related to the international activities falling under the scope of GTK's mandate be transferred to a new enterprise. In 2021, the Ministry of Economic Affairs and Employment and GTK decided that the matter required more planning.

The need for the legislative amendment proposed has not disappeared. We continue the related careful planning and preparations internally.

In 2021, as part of an international consortium, we started GTK's largest ever international collaboration with the Saudi Geological Survey (SGS). Already in

*In 2021, we had 12 ongoing international customer projects.*





December 2021, the project launched an updated version of the portal for the geological database of Saudi Arabia, from which some materials can be freely downloaded. The collaboration will continue until 2027.

We increased our international collaboration with the Natural Resources Institute Finland Luke. The collaboration supports both organisations in meeting the requirements of international calls for proposals. These require extensive expertise in contributing to the UN SDGs and in responding to the changes in

natural resources management.

We carried out a value network survey with businesses in the mining and circular economy sectors.

The collaboration aims to make the management of waste rock and tailings, as well as the related water treatment more efficient.

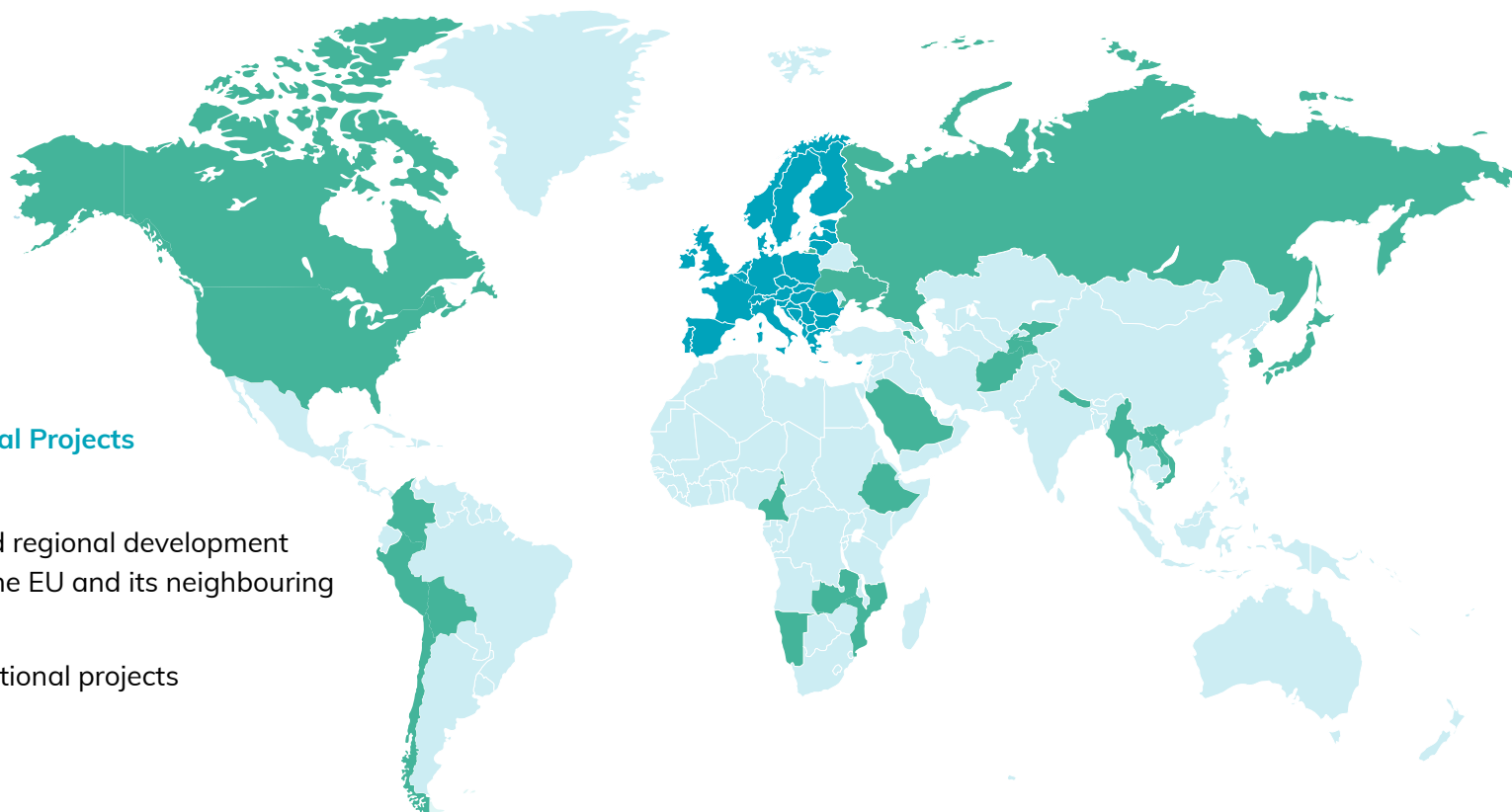
In 2021, we integrated the UNFC in our open access database on Finland's ore deposits and published guidelines that national and international experts and institutions, including policymakers, can use. The guidelines contribute to promoting mineral resource surveying and

harmonised natural resource management in the EU. We also provided training on the topic both in Finland and internationally.

10 projects contributing to UN SDG 17 in 2021

### GTK's International Projects in 2011–2021

- Research and regional development projects for the EU and its neighbouring regions
- Other international projects



## CASE: Partnerships for the Goals

## Collaboration to Build a Sustainable and Carbon-neutral World

17 PARTNERSHIPS FOR THE GOALS



GTK takes part in several international research projects that promote sustainable development, the circular economy and ending the use of fossil fuels.

Internationally, GTK carries out dozens of projects funded by various donor institutions and customers.

As an example, GTK conducts mineral potential surveys and Quality assurance and quality control tasks. These produce vital information on mineral resources. The produced data supports the improved use of minerals and circular economy. Mineral potential projects have been carried out in Malawi, Cameroon and Saudi Arabia, for example.

"The task to phase out fossil fuels requires an unprecedented amount of minerals for producing and storing alternative energy sources. Demand strongly outnumbers mineral production, and

known reserves, too. The challenge lies in finding more minerals and simultaneously developing a circular economy in which the minerals used for the alloys in the products can be recovered and reused. The circular economy is thought to be the solution, but we need to have enough material to circulate for it to work," says **Philipp Schmidt-Thomé**, Head of International Projects at GTK.

#### GTK Supports Saudi Arabia to Decrease Oil-dependency

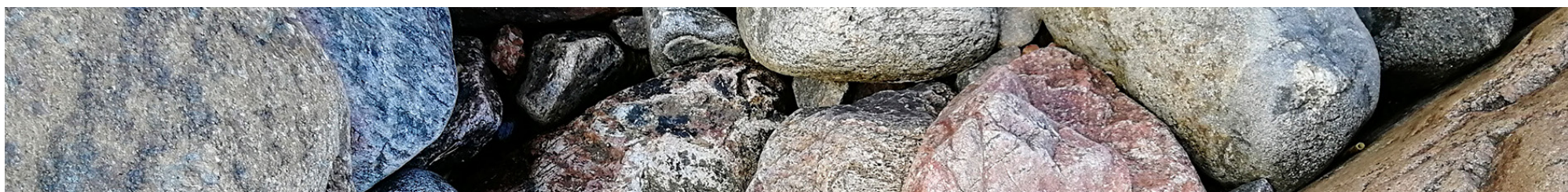
Saudi Arabia is aiming to decrease its oil-dependency by developing and diversifying its economy. The country has launched an extensive development programme, the Saudi Vision 2030, and one area of the programme is the country's mining sector. The aim is to make mining and mineral processing a significant part of the country's economy.

The mining sector development is a huge task, involving a large number of partners and

companies, and hundreds of their specialists. In the project, GTK is working as the Technical Partner the Saudi Geological Survey (SGS) as a member of an international consortium. The task of the consortium is to support and assist the SGS in developing its activities and assessing, steering and supervising an extensive portfolio of research projects.

In the consortium, GTK will be responsible for the control, monitoring and specialist tasks related to the development of a national geodata system and drill core archive. GTK will also participate in the quality assurance and quality control of the geological, geophysical and geochemical mapping of the Arabian Shield,

*The data will be used to support the development of the mineral sector and circular economy.*



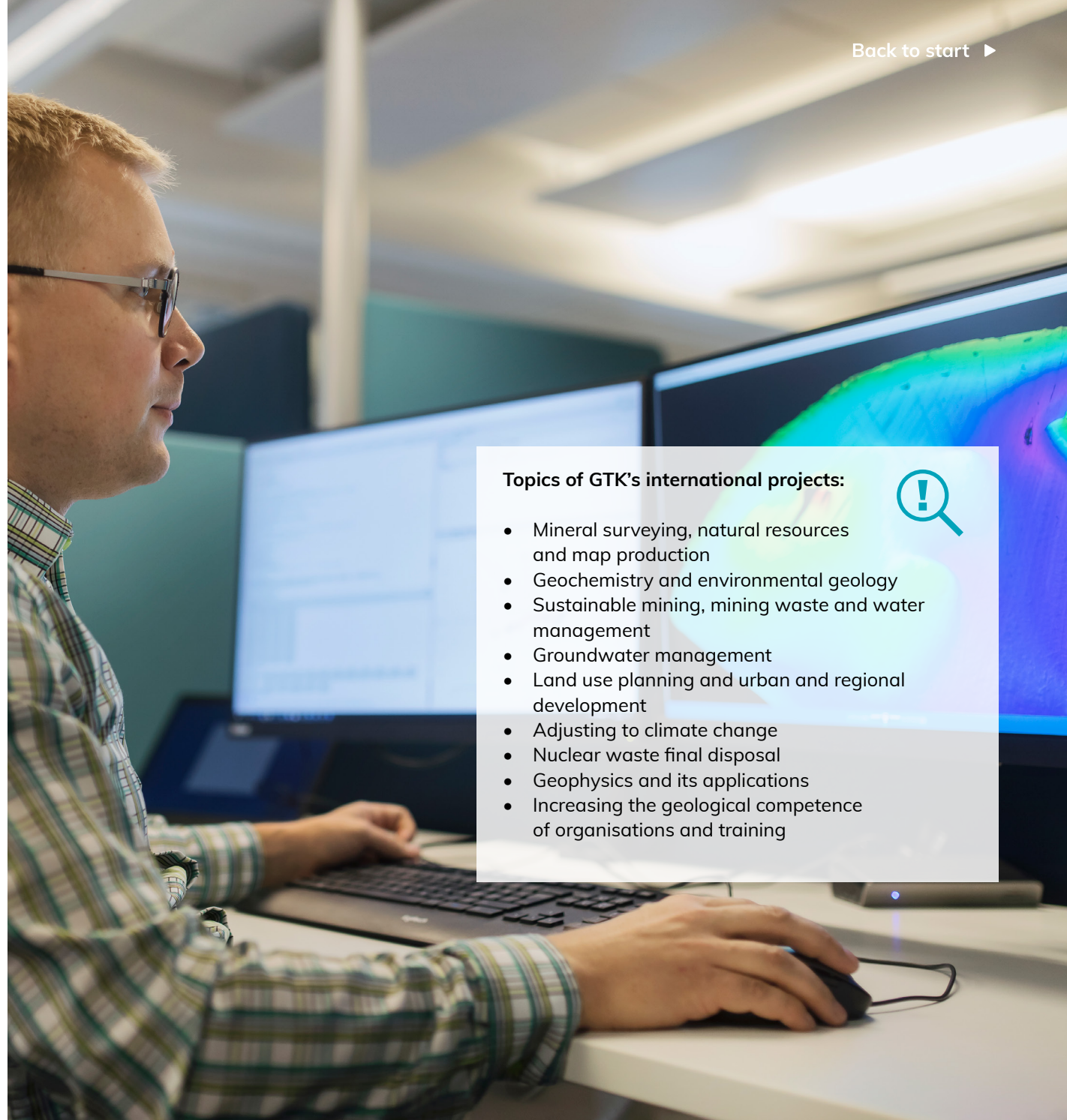




including institutional capacity building and training.

The collaboration is part of GTK's commercial international activities, and it is based on treaties between Finland and Saudi Arabia on promoting economic and technological cooperation between the countries. The project will be implemented in 2021–2027, GTK's share of the project is of approximately EUR 12 million. The project is significant, because it increases GTK's international commissioned project budget by half from the usual annual level of EUR 3–4 million.

The Hakku service provides spatial data related to Finland's geology and a selection of geological data products [hakku.gtk.fi/](https://hakku.gtk.fi/)



#### Topics of GTK's international projects:



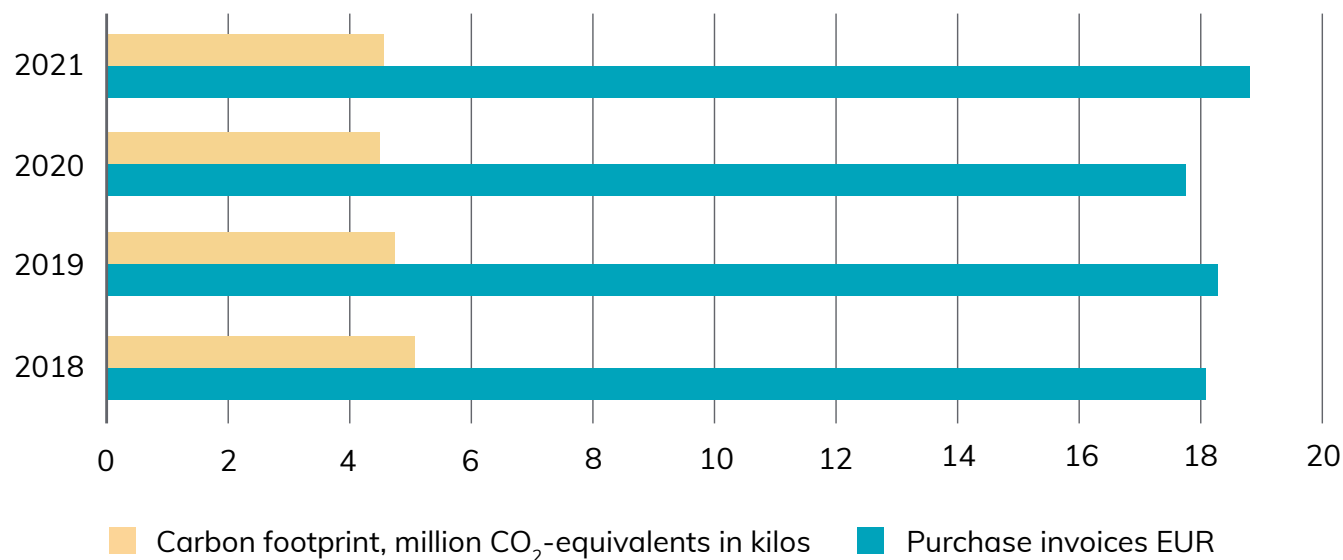
- Mineral surveying, natural resources and map production
- Geochemistry and environmental geology
- Sustainable mining, mining waste and water management
- Groundwater management
- Land use planning and urban and regional development
- Adjusting to climate change
- Nuclear waste final disposal
- Geophysics and its applications
- Increasing the geological competence of organisations and training

# 10 The Footprint of Our Activities

We have started to collect information on the footprint of our activities. In our next Sustainability report in 2022, we will provide more information on the ecological, social and economic impacts of our operations.

In the future, we will also report the size of our carbon footprint calculated based on the data provided by different state enterprises. These data were not yet available (excl. the procurement data) at the time this report was drafted.

**Carbon Footprint of GTK's Purchase Invoices 2018–2021**



The carbon footprint is based on the calculation model developed by the Finnish Environment Institute (SYKEra, 15/2019). The estimates of the carbon footprint of the different procurement categories are based on the average footprint of products available on the Finnish market; they do not necessarily correspond to the actual carbon footprint of any individual procurement. An exception has been made for electricity: its carbon footprint – purchased through the Hansel framework agreement, and the origin of which has been verified – has been marked down as zero.





## 11 Information on the Report and Drafting Method

This is the first Sustainability report of the Geological Survey of Finland. The report covers 2021. Sustainability report will be published annually from 2021 onwards.

This report was drafted in early 2022. The report is adapted from the sustainability report template provided by the State Treasury. This report is published on our website at [www.gtk.fi/en/sustainability](http://www.gtk.fi/en/sustainability).

The information included in this report will be supplemented in future reports. In this report, we have provided information on the most significant projects and activities we have carried out to contribute to our sustainability goals in 2021. Future reports will include refined data on the targets, indicators and our footprint. Our personnel and key stakeholders will be featured in the production process.

Read more about sustainability at GTK:  
[www.gtk.fi/en/sustainability](http://www.gtk.fi/en/sustainability)

