

ANNUAL REPORT 2019

What an amazing time to be alive

beyond the obvious

VTT in brief

VTT is a visionary research, development and innovation partner. We help society to develop and businesses to grow through science-based innovations. Our brand promise is to challenge ourselves and our partners.

We have more than 75 years of experience in cutting-edge research and science-based results. Smart industry and energy systems, knowledge-intensive products and services as well as solutions relating to natural resources and the environment are at the core of what we do.

We are driven by global challenges that we turn into opportunities for sustainable growth. Finland's national metrology institute and national standards laboratory MIKES is part of VTT.

VTT makes an impact by matching innovations to business.

[Read more about VTT](#) >

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An exciting time for innovations

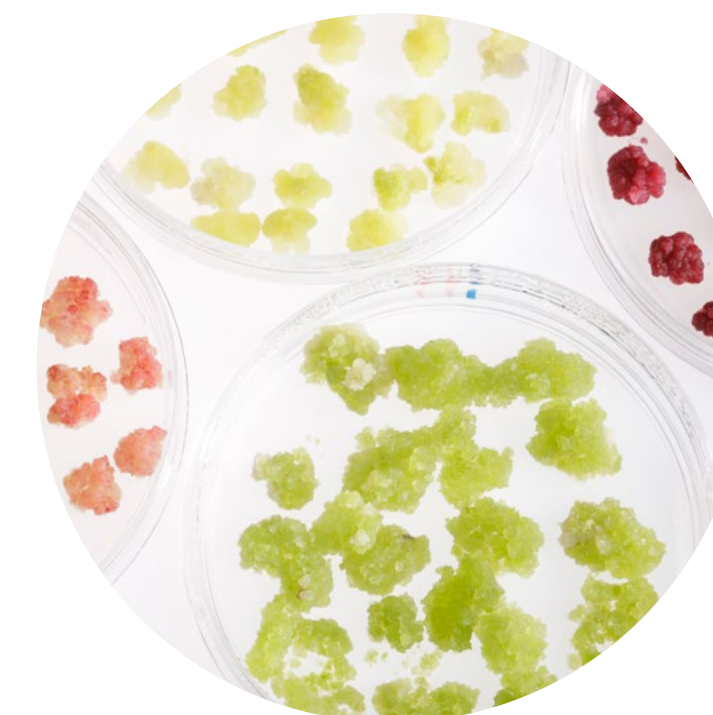
The year 2019 showed that VTT is on the right track strategically, Antti Vasara writes in Greetings from the President & CEO.

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Food from air with a new process

Solar Foods, which is a start-up established as the result of a joint research venture of VTT and LUT University, produces edible protein using carbon dioxide captured from the air.

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The new era of materials is here

VTT and the FinnCERES ecosystem research and develop biomaterials for replacing plastics and moving away from fossil raw materials.

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A year of accelerating development

The year 2019 was a time of rapid development both for global science and for VTT. We made new scientific and technological breakthroughs and created impact through many joint ventures. We are in a good position to tackle the challenges of the 2020s.

An exciting time for science-based innovations

The year 2019 was a time of rapid development for global science and VTT. Our challenge-driven strategy is linked to the key questions of our time, and we do high-quality research on the frontline of science. We believe that science-based innovations will play a key role in turning humanity’s challenges into opportunities in the 2020s.

‘The beginning of a new decade is a great time for scientific and technological opportunities’

The year 2019 was a good year for VTT, proving that the path we have chosen for our research and innovation work is the right one. Already in 2016, we made the tackling of global challenges – such as climate change and the sufficiency of natural resources – the starting point for our strategy. This strategy has proved to be timely. The public debate is strongly demanding rapid climate actions as well as industrial and social renewal aimed at promoting sustainability. To achieve this, practical scientific innovations are essential.

VTT turns challenges into opportunities by developing innovations relating to, for example, clean energy, sustainable food production, and the circular economy. One of the core areas of our research in 2019 was the circular economy for plastics, which we are expecting to generate breakthrough innovations in the 2020s.

Inspiring examples of our topical research in 2019 are VTT spinoffs, which include startup companies such as Solar Foods, which produces edible protein using car-

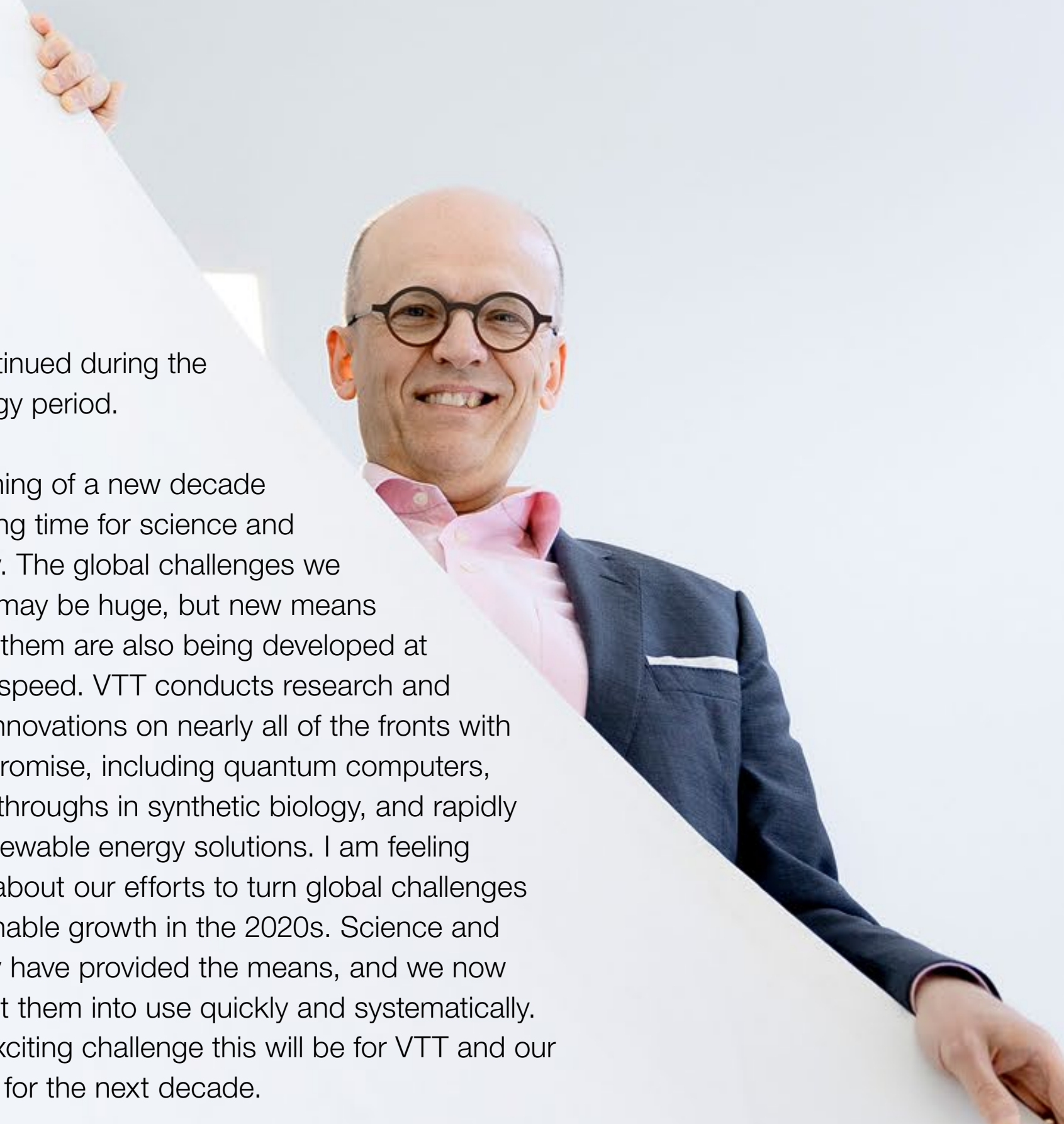
bon dioxide captured from air, and IQM, which is developing Finland’s first quantum computer. Spin-offs show how applied research generates new business that offers outside-the-box solutions to global challenges. We also accelerated the establishment of new deep tech startup companies in Finland by investing in the new deep tech fund, Voima Ventures, and by introducing the internal deep tech incubation program, VTT LaunchPad, for supporting VTT employees in the commercialisation of research. In addition, the subsidiary VTT SenseWay was established to develop autonomous mobility systems for land, sea and air applications.

Our goals for 2019 were to develop innovation ecosystems, increase the turnover and profitability of VTT’s sales to customers, and recruit new top talent. The ecosystems we have established have gotten off to a good start; for example, the Smart Otaniemi ecosystem for developing smart energy solutions has attracted plenty of interest internationally. Our recruitment process was also successful. We did fall a little behind on our financial goals, but we are moving in the right direction. The bold, customer-oriented improvement of our operations

will be continued during the next strategy period.

The beginning of a new decade is an exciting time for science and technology. The global challenges we are facing may be huge, but new means for solving them are also being developed at a dizzying speed. VTT conducts research and develops innovations on nearly all of the fronts with the most promise, including quantum computers, new breakthroughs in synthetic biology, and rapidly scaling renewable energy solutions. I am feeling optimistic about our efforts to turn global challenges into sustainable growth in the 2020s. Science and technology have provided the means, and we now need to put them into use quickly and systematically. What an exciting challenge this will be for VTT and our customers for the next decade.

President & CEO
Antti Vasara



We need to have more of an explorer's attitude

VTT has done well in a highly challenging operating environment, bombarded by expectations. There is an ever-increasing need for competence in applied research.

The operating environment sets certain expectations on VTT; the way in which operations are run in the public sector does not always coincide with a commercial way of thinking. Surrounded by conflicting expectations, the company must have a clear understanding of its role, goals and position in the overall scheme of things. As I see it, VTT has succeeded in its recent years' transformation from a state-owned enterprise subject to net budgeting to a company that has its own balance sheet and is operated like a business.

Securing financing for the long term is vital for a research organisation like VTT. Competition for all the forms of financing available to VTT – government grants, jointly funded research and private assignments – is ever-increasing. VTT's remarkable achievement has been to successfully apply for a total of almost 190 million euros through the Horizon 2020 and other EU research and innovation programmes in the past six years. Hard work is still needed for VTT to maintain its current competence and communicate about it, sell its competence to the Finnish business and industry, and continue to do well in international competition in the future as well.

This means that VTT must keep crystal clear the two criteria it has set for itself: excellence and impact. VTT carries out state-funded research and joint ventures in order to create top-level competence for itself and its network. A strong background in science and top-level competence sets VTT apart from consultancy firms and helps it maintain its position as a preferred research partner in both Finland and abroad. To ensure impact, customers must also benefit from the work they commission from VTT.

In the Ministry of Economic Affairs and Employment's evaluation published in early 2019, VTT's research competence and networking skills were deemed to be of a high standard: on a European scale, VTT was viewed to be a significant research institute and of national importance. Also, based on the Finnish Science Barometer, the Finnish people's trust in VTT was at an all time high in 2019. The results show that VTT has succeeded in its work.

Global challenges have changed from threats to something much more concrete. This presents a genuine need for business and industry to start addressing the challenges and reforming. Applied science is taking giant leaps when it comes to AI and quantum comput-



ing. More pressure and demand keeps mounting up for VTT competence.

The situation we are in is similar to that of the explorers: they also needed to be adventurous and believe in the future. Putting together expeditions was expensive and their outcome could not be guaranteed. Even now, hard work, willpower and a visionary approach are needed in many areas. The duties of VTT Board include ensuring conditions that enable VTT employees to focus on their work. For VTT employees, the year 2019 was full of meaningful work. Big thanks to all of you!

Chair of the Board
Matti Hietanen

'A strong background in science and top-level competence set VTT apart from consultancy firms'

VTT 2019 in figures

VTT's goal is to help customers and society to grow and regenerate through applied research. A brighter future is created through science-based innovations.

During 2019, we successfully promoted collaboration between international research institutes and business life by focusing our efforts on eight international innovation ecosystems.

In regard to our own organisation, we renewed and strengthened the practices that clarify research and its management with the help of a joint research agenda for contents and teams. We also continued to invest in our pilot and research environments in order to ensure the continuous development of world-class expertise.

The adjacent key figures illustrate our successes during the year and our ability to create an impact through scientific and technological excellence.

[Read more](#) >

Total revenue, EUR million

245

Doctors and licentiates

664

Patent families on 31 December 2019

406

Number of employees on 31 December 2019

2,103

International scientific articles

467

Invention disclosures

215

The figures are for the entire VTT Group. At the end of the financial year, VTT Group consisted of the parent company and five subsidiaries: VTT Memsfab Ltd, VTT Ventures Ltd, VTT International Ltd, VTT SenseWay Ltd and VTT Holding Ltd.

Financial statements

VTT Technical Research Center of Finland Ltd is a Finnish non-profit limited liability company owned by the state. The company falls within the mandate of the Ministry of Employment and the Economy. According to the law VTT is an independent and impartial research organization. VTT operates as a research, development and innovation partner to help the society and companies to grow through technological innovations.

During 2019 the Finnish government has set a target of increasing R&D investment to 4% of GDP, expecting growth to come primarily from further investments in R&D by companies. VTT received a level increase of 7 M€ in government grant from 2019 onwards, and additional funding of 3 M€ annually for 2020 and 2021 to promote the circular economy. Nonetheless, VTT's government grant is still significantly (-17%) lower than in 2009, when Finland's R&D expenditure as a percentage of GDP was close to the 4% target of the current government.

Key financial figures

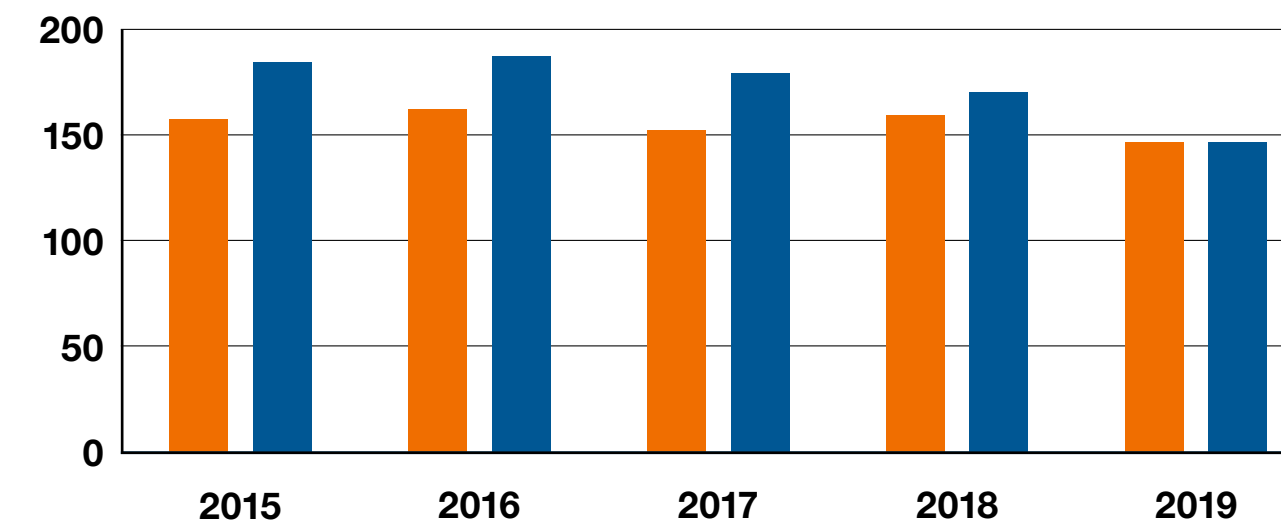
	VTT Group			Parent company		
	2019	2018	2017	2019	2018	2017
Net turnover (1,000 euros)	147,471	171,163	180,219	147,179	159,785	153,183
Other operating income (1,000 euros)	97,549	96,738	77,345	97,728	81,286	82,372
Government grant	78,509	71,135	73,154	78,509	71,135	73,154
Government special grant	10,400	-	-	10,400	-	-
Other	8,640	25,603	4,191	8,819	10,151	9,218
Operating result before special items* (1,000 euros) (operative, unaudited)	-5,630*	-1,968*	-2,245*	-4,819*	-1,821*	-2,883*
Operating result (1,000 euros)	3,129	9,876	-17,536	3,940	-7,794	-18,175
Operating result (%)	2.1	5.8	-9.7	2.7	-4.9	-11.9
Result of the financial year (1,000 euros)	3,644	13,503	-15,459	2,997	15,480	-17,676
Return on equity (%)	2.4	10.0	-11.7	1.5	7.5	-14.1
Equity ratio (%)	66.0	66.3	59.6	64.6	64.6	58.3

VTT Technical Research Centre of Finland Ltd's net turnover consisted of 61% public sector revenue (Group 61%) and of 39% private sector revenue (Group 39%). The domestic revenue accounted for 53% (Group 52%) and foreign revenue for 47% (Group 48%) of the net turnover.

* Comparable operating result before special items does not include the government special grant for the decommissioning of FIR1 research reactor and restoration old hotcell facilities (2019: 10.4 M€) or the additional provisions made in previous years for the future decommissioning and restoration costs (2017: 15.3 M€; 2018: 5.4 M€). In the 2019 state budget, the Finnish government reserved a 13.5 M€ budget authority for the decommissioning of FIR1 and restoration of hotcell premises. The Group's operating result before special items (*) does not include the proceeds from the divestment of the subsidiaries. In the parent company the proceeds from the divestment are presented in the financial income, not in the operating result.

** VTT sold VTT Expert Services Oy and Labtium Oy, which offer testing, inspection and certification services, to Eurofins Scientific Group on May 31, 2018. VTT Expert Services Oy and Labtium Oy are included in the Group's figures until the date of sale.

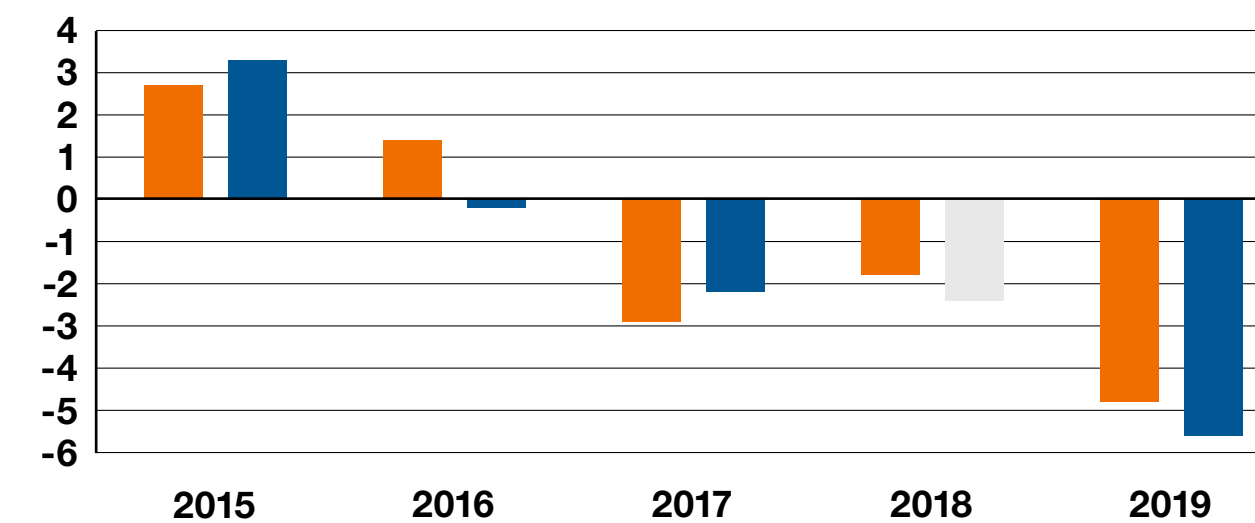
Net turnover M€



The parent company's **net turnover decreased by 8%** during the financial year mainly due to a decline in commercial business and Business Finland funding. The group's net turnover decreased also due to the divesting of subsidiaries**

Parent company VTT Group

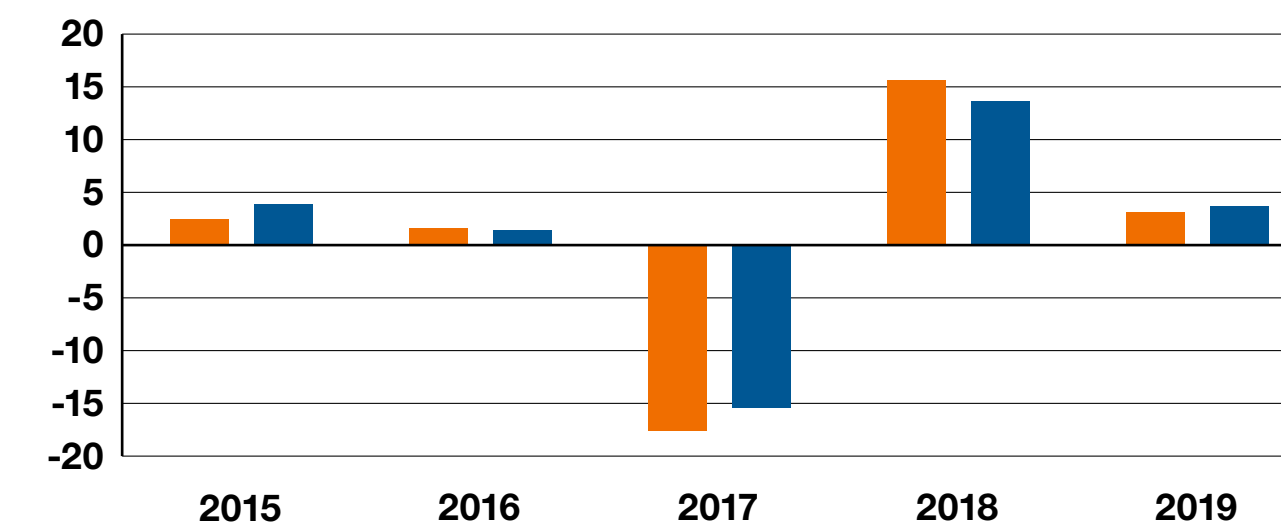
Comparable operating result M€



The comparable (adjusted) operating result of the parent company and the Group* **remain at a loss** despite the significant savings made in the operating expenses.

Parent company VTT Group

Result of the financial year M€



The parent company's and the Group's **result of the financial year were positive** mainly due to the government special grant received by the parent company.

Parent company VTT Group

The 2020s will be a pivotal decade

In 2019, we took important steps in developing our impact and excellence. Next year will see the culmination of the strategy period 2016–2020, and we want to continue turning global challenges into opportunities for sustainable growth with our customers also in the 2020s.



Advancements and competition in science are accelerating

The pace of scientific progress in the world is rapid and the competition for investments in research is international in scope. VTT is rising to the challenge by focusing its research on solving global problems and creating local innovation ecosystems that gather world-class competence to Finland.

VTT operates in a global scientific field, where competition for the business and private sector investments in research is increasingly fierce. The spearhead of global scientific development is moving to the developing countries. China is an engine of scientific growth. The emerging global science themes are above all connected to information technology, such as digitalisation and electronics, but also to materials and climate change management. In response to the increasing competition, VTT is focusing its efforts on solving relevant global challenges, which include climate action and industrial renewal.

No changes to public funding for applied research

VTT's strategy for solving global challenges is well-aligned with the phenomenon-based Government

Programme of Finland's new government appointed in 2019. However, in the Finnish innovation system, the emphasis is more on the basic research carried out by universities. The amount of government funding granted to VTT for applied research was reduced during the previous government's term of office, and the new government has not significantly increased it. It is, however, very positive that we are still Finland's most successful applicant for EU research funding – in 2019, we participated in 399 EU-funded projects and successfully applied for 39.4 million euros of EU funding.

Ecosystems have a key role to play

The investments made by Finnish companies in research and innovations have increased slightly, if we exclude the reduction in R&D investments of a few major corporations. Large and medium-sized enter-

prises operate internationally and search for research partners from outside of Finland as well, which means more competition for VTT.

Emerging as another important means of creating impact alongside traditional contract research are innovation ecosystems, in which VTT often acts as a coordinator. We bring together companies and organisations to carry out ambitious R&D projects aimed at creating world-class competence centres in Finland. The projects also give small enterprises access to innovation activities. In 2019, we participated in a total of eight ecosystems, which developed innovations related to autonomous systems, bio-based materials, and new energy solutions, for example.

FIVE VTT LIGHTHOUSES STEER ALL OUR RESEARCH SUSTAINABLY:



Climate action



Resource sufficiency



Good life



Safety and security



Industrial renewal

VTT lighthouses and opportunities




CLIMATE ACTION




RESOURCE SUFFICIENCY




GOOD LIFE




SAFETY AND SECURITY




INDUSTRIAL RENEWAL

LOW-CARBON MOBILITY

RENEWABLE MATERIALS

DISRUPTION OF WORK

RESILIENT SOCIETY

DESIGN FOR FUTURE

ENERGY INTELLIGENCE

CIRCULAR PLASTICS

CITIZEN-CENTRIC CARE

CYBER SECURITY

REBIRTH OF PRODUCTION

LOW-CARBON ENERGY

REDESIGN MINERAL AND METAL LOOPS

SMART BUILT ENVIRONMENT

AUTONOMOUS SYSTEMS

DISRUPTIVE BUSINESSES

CARBON REUSE ECONOMY

FOOD ECONOMY 4.0

LOW-CARBON INDUSTRY

IMPACT FROM VTT:

- 1 We work in a challenge-driven way to create solutions to the current and future needs of our customers and society.
- 2 We formulate our research agenda based on future market growth opportunities (lighthouses).
- 3 We co-develop with customers according to differentiated service models matching their needs.
- 4 We proactively bring different customers and partners together around ambitious innovation initiatives.

EXCELLENCE FROM VTT:

- 5 We want to learn and improve. That's why we continuously evaluate the impact of our work.
- 6 We always improve our way to lead people and substance to ensure excellence and continuous competence development.
- 7 We work with leading international customers and partners to further develop our competencies and identify new growth opportunities.
- 8 We invest in excellence through funding from multiple public and private sources.



Solving of global challenges is set to boom in the 2020s

Our strategy is to turn global challenges into opportunities for sustainable growth through scientific innovations. In 2019, we continued to put effort into developing our expertise in research and technology. It is what forms the basis of VTT's impact, which is set to be more in demand than ever during the 2020s.

VTT's strategy for 2016–2020 is guided by major global challenges that we will be turning into sustainable growth through science and technology. Our strategy has five themes referred to as 'lighthouses': climate action, resource sufficiency, good life, safety and security, and industrial renewal. Read more about what we do under these themes in 2019 on pages 14–18.

highly competent, and their knowledge and skills must be made available to customers and society in the best way possible.

In 2019, we implemented Project Orange as a measure to improve excellence, sharpening the leadership skills related to research and competence. The structure of VTT's research areas and teams was renewed while ensuring that each team had a common and ambitious research agenda.

Customer-oriented approach and ecosystems

Our work has the most impact when we combine the best of the knowledge and skills available at VTT to solve the customer's challenges. We continued with the development of a customer-oriented approach at VTT. Also, our own design team for developing better customer co-operation models together with researchers started its work in 2019.

Innovation ecosystems have emerged as an important component in creating impact. They bring together enterprises, research partners and the public sector to solve complex challenges, such as the renewal of the energy system or the development of autonomous



systems. Co-creation managers were designated for ecosystems led by VTT in 2019 to boost the joint creation of innovations.

The solving of challenges to boom in the 2020s

In an evaluation report of the Ministry of Economic Affairs and Employment published in 2019, VTT's challenge-driven strategy was found to be positive and its direction was widely accepted. We will bravely implement the current strategy also through the coming year. The year 2020 will see the strategy updated for the next period.

Solutions to the challenges of climate change and the Earth's carrying capacity must be put into use very quickly in the coming decade. We want to contribute to giving humankind a brighter future in the 2020s.

'We want to contribute to giving humankind a brighter future in the 2020s'

New opportunities in plastics circulation

We have identified growth opportunities under each strategic theme. For example, combating climate change requires increasing

the production of low-carbon energy, and maintaining resource sufficiency requires renewing the food system.

In 2019, we further clarified the growth opportunities identified and introduced circular economy for plastics as a growth opportunity under the resource sufficiency theme.

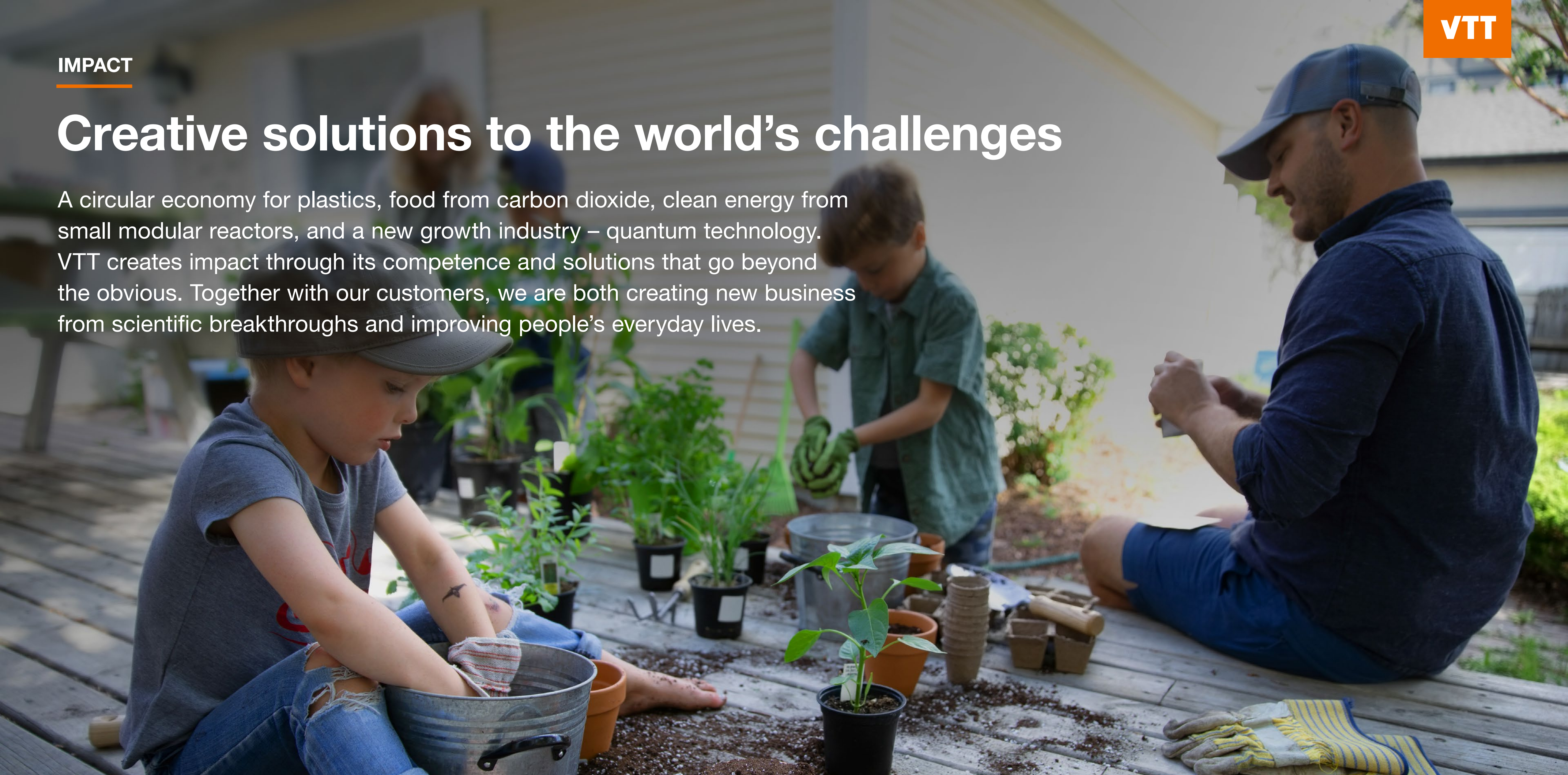
[See page 10 for all the growth opportunities.](#)

The key to creating impact is competence

Our impact creation is based on scientific and technological excellence. VTT employees are expected to be

Creative solutions to the world's challenges

A circular economy for plastics, food from carbon dioxide, clean energy from small modular reactors, and a new growth industry – quantum technology. VTT creates impact through its competence and solutions that go beyond the obvious. Together with our customers, we are both creating new business from scientific breakthroughs and improving people's everyday lives.



Hydrogen energy storage and cement as carbon sinks

Climate change is the most pressing challenge for humankind. Its mitigation requires carefully weighing which type of data is used and how it is applied. VTT has used its analysis skills to support the achievement of Finland's energy and climate targets and take significant development steps related to the hydrogen economy and carbon-neutral cement materials.

In 2019, the public debate over climate change became more heated than ever. There is no time to waste; the transition to an energy system that generates less emissions must happen now. Finland's carbon dioxide emissions can be markedly reduced by changing the processes in the energy and industrial sectors.

The European Union is putting words into action: a roadmap for achieving the energy and climate targets was drawn up for Finland. The roadmap process brought VTT's climate analysis skills to the fore. Impactful innovations for climate action were created during the year. VTT had a breakthrough with cement materials – we successfully developed new materials which have a small or even negative carbon footprint and can potentially be used as carbon sinks.

The flexibility of energy systems is enhanced by an innovation for the hydrogen economy – a fuel cell electrolyser system, which enables storing wind power as hydrogen and then converting it back into electricity. VTT is the coordinator of the Smart Otaniemi ecosystem, in which smart solutions and co-operation are applied to change the value chains for energy production and energy consumption. Due to the growing share of renewable energy generation, energy systems are required to have the ability to manage production that is ever more dispersed and diverse. The key to predicting the climate of the future is data.

CASE

CLEAN ENERGY FOR EUROPE FROM SMALL MODULAR REACTORS?

In order to tackle climate change, humankind must transition from fossil sources of energy to low-emission alternative energy. The ELSMOR project coordinated by VTT aims to contribute to increasing the use of low-emission small modular reactors (SMR) in Europe.

The share of fossil fuels in primary energy consumption in the world is currently 80%. Combating climate change requires a transition to using low-emission sources to produce energy. Currently under development, small modular reactors representing a new wave of nuclear energy may provide a solution to this.

By expanding the range of potential uses for nuclear energy, new applications can be created for district heat and industrial process heat production, for example. VTT is coordinating the spreading of small modular



reactors in Europe under the ELSMOR project (Towards European Licensing of Small Modular Reactors), which is aimed at removing any obstacles hindering the deployment of SMRs.

'Small modular reactors are already in the licensing phase in the United States and in China, and SMRs are seen as part of the future collection of means to curb climate change in Europe as well,' says Ville Tulkki, the project's coordinator at VTT.

The issue of safe use is often associated with nucle-

ar power. With SMRs, the aim is to achieve the safety level using safety features based on natural forces and innovative solutions, such as an integrated primary coolant system using pressurised water. As a result, the plant does not have any large pipes that could break and cause the water to be quickly discharged from the reactor.

One of the Finnish participants of the ELSMOR project is Fortum, whose role is to ensure that the stakeholders are identified and their needs met.

'SMRs provide an effective tool for combating climate change. This project is an important step for the development of the nuclear power sector as a whole and for the future of SMRs,' says Antti Rantakaulio, project leader of the SMR research project at Fortum.

Various renewable energy sources and advancements such as small modular reactors provide society with the tools needed on the path towards a low-carbon future.

[Read more >](#)

Alternatives to plastic, reuse of carbon

Growing and increasingly prosperous societies consume more and more, but the Earth's carrying capacity is not getting any bigger. In its search for resource-wise solutions on saving natural resources and recycling them more efficiently, VTT is turning to science and technology.

Growing and increasingly prosperous societies consume more and more, but the Earth's carrying capacity is not getting any bigger. In its search for resource-wise solutions on saving natural resources and recycling them more efficiently, VTT is turning to science and technology.

VTT has identified five areas in which the challenge of resource sufficiency can be turned into an opportunity for growth: renewable materials, circular economy for plastics, redesigning mineral and metal loops, carbon reuse economy, and food economy 4.0. In these areas, we are developing solutions for maintaining sufficient natural resources.

We are seeking ways to recycle non-renewable materials and utilise industrial side streams. We are developing renewable materials to replace oil-based materials, such as plastics. We are examining ways of using the carbon in the Earth's atmosphere and ensuring the sufficiency of high-quality food for the growing world population.

In 2019, we developed a collection of means to replace and recycle plastics and to utilise industrial side streams. We manufactured alternatives to plastic from cellulose and by using microbes and mycelia. In the 'Korvaa' project, headphones were built from six different materials produced by means of biotechnology. In the FinnCERES flagship project, VTT and Aalto University researchers studied interactions between lignocellulose and water with the aim of engineering new biomaterials with certain plant properties.

Among the highlights for the year were projects that studied how atmospheric carbon dioxide could be used as raw material for fuels or in food production.

CASE

FOOD FROM AIR

The research collaboration of VTT and LUT University resulted in the creation of a new process for producing protein from carbon dioxide captured from air and water. The invention represents a completely new type of food production, independent from land use and without emissions.

In their joint research project Neo-Carbon Energy, LUT and VTT built equipment to produce food from air with electricity in a process based on growing microbes with a high protein content suitable for human consumption. This scalable invention could help solve the world's food production problems.

Carbon-neutral protein production

In the process, carbon dioxide and water are used in integrated water electrolysis to produce hydrogen and oxygen, which microbes with a high protein content need to grow and multiply. The carbon dioxide required for the bioprocess is taken directly from the air – as is the water, if necessary. If the energy source is solar or wind

power, the protein production process is emission-free. The technology is expected to solve major challenges associated with food production, population growth and the environmental load of agriculture.

Food production from raw materials with unlimited availability, without land use

Nearly all the raw materials for the protein produced in the process are obtained from the air, and the process is not dependent on arable land or pastures. The equipment for the production process can be set up e.g. in a freight container and transported to wherever renewable energy is available. Protein can be produced in harsh and dry conditions, without



having to cut down trees. Contrary to conventional agriculture, there is no need to use pesticides, and runoffs into water systems or strong greenhouse gas emissions will not be generated.

The joint research has already resulted in the establishment of a Finnish startup company: Solar Foods is developing its own protein production and has initiated the approval process certifying the protein's safety as a novel food in the EU.

[Read more](#) >

Sustainable health care and quality of life through smart solutions

Good health, meaningful work and a nice environment improve the quality of life. VTT is involved in building the future of health care and developing automated and digital solutions for enhancing the sustainability of public infrastructure.

VTT's vision for the future of health care is to combine individualised treatment with support from the community. Data and smart technology can be used to create personalised solutions which can be adopted at the right moment. In the future, health care will be a life-long process rather than just treatment of illnesses. Support from the community refers to a sense of community, interaction and co-operation. As the population grows, it is important to ensure that the needs of the whole population will be met with high-quality care in a cost-efficient manner.

Under the good life theme in 2019, VTT focused particularly on improving the sustainability, functionality and safety of health care and the infrastructure of society. VTT started developing ecosystems for building a health care system of the future in co-operation with the Kuopio Health innovation ecosystem and the Finnish Centre for Artificial Intelligence (FCAI). Also, in view of the coming year, a more detailed vision was prepared to facilitate more agile creation of opportunities for a good life.

The year also opened up many doors to doing research with the pharmaceutical industry and Finnish health sector operators. The disruption to business models resulting from digitalisation represents an important transitional phase before adopting new ones. New, exciting and diverse jobs will be generated to replace conventional work tasks that automation has made obsolete.

CASE

SNIFFPHONE DETECTS CANCER FROM BREATH

SniffPhone – currently in its prototype phase – enables early diagnosis of gastric cancer from a person's exhaled breath. The new method could revolutionise cancer screening worldwide. VTT was part of the consortium of nine partners developing the device under the EU's Horizon 2020 programme.

SniffPhone is a compact handheld device connected to a smartphone that measures exhaled breath for early diagnosis of cancer. The device is easy to use. It takes a sample of the exhaled breath and measures the contained Volatile Organic Compounds (VOCs), using highly sensitive nanotechnology-based chemical sensors. SniffPhone sends the measurements via Bluetooth using a smartphone to a dedicated cloud platform, where the results are analysed by the appropriate medical personnel.

As stated in its vision, VTT develops technologies that improve quality of life. SniffPhone's new method for early



diagnosis of cancer has many advantages over traditional screening methods. The device is comfortable and painless to use. Currently in the prototype phase, the device has been developed and validated, e.g. through clinical trials. The next step in the project is to find financiers to support the commercialisation of the device, which will most likely involve setting up a spin-off company.

SniffPhone was developed in a consortium of nine partners from six countries. VTT's role was to build analysis tools and methods for recognising high-risk gastric cancer patients. In addition, VTT developed a platform for

'SniffPhone's method may revolutionise cancer screening all over the world'

the SniffPhone device, in which a mobile application guides the user in providing a breath sample and issues a preliminary analysis of the sample. An analysis tool has also been developed for physicians to display the analysis results of breath samples.

VTT was in charge of the implementation of responsible research and innovation in the project by such methods as engaging final users and stakeholders in the development work through interviews and workshops, as well as integrating responsible design practices into project operations.

[Read more >](#)

Safety and security ensure human well-being and business continuity

New means and tools for identifying, preventing and recovering from security threats are needed in order to secure society's vital functions. VTT develops sustainable solutions to meet the world's changing needs.

To ensure safety and security in society, VTT invests in the design and development of safe systems, as well as in building understanding of the overall picture of safety and security. As society becomes more and more digitalised and automated, the systems that secure and support critical functions must be flexible and self-adaptive. Predictive and precise design will help make vital infrastructures and supply chains more sustainable.

In 2019, we promoted research and development in safety and security in many ways. For instance, together with stakeholders, we prepared a common vision that will make working together to enhance safety and security more efficient in the future. VTT's safety and security strategy also includes influencing national and EU legislation, and steps were taken in the desired direction during 2019.

One of the highlights of the year was the launch of the design phase of the Space Security testing laboratory. VTT was also active in the Research Alliance for Autonomous Systems (RAAS) and Smart Otaniemi ecosystems. In the latter, work began to improve the cyber security of energy networks. In addition, VTT's experts attended many invitation-only events as speakers and were influential in various national and international networks.

CASE

A NEW SUBSIDIARY FOR AUTONOMOUS MOBILITY AND LOGISTICS

In 2019, VTT established a new subsidiary – VTT SenseWay – to strengthen the development of autonomous and remotely controlled solutions for transport and logistics. Autonomous systems are renewing the industrial sector, logistics and the way people move – on land, at sea and in the air. The new company will help Finnish industries and society to reap the benefits of autonomous systems.

Turku has some of the world's leading expertise in autonomous shipping systems. For this reason, it is also home to VTT SenseWay, a subsidiary established by VTT in 2019. The company specialises in developing autonomous mobility and logistics systems for shipping and the transport and logistics sector as a whole, as well as for mobile work machines. The demand for autonomous systems will increase, as resource sufficiency and in-

dustrial renewal call for new and innovative automation solutions. VTT estimates that the global market size will exceed EUR 70 billion in 2023.

VTT's mission is to ensure that the results of cutting-edge research reach markets more rapidly than before, to become a part of the business world and people's everyday lives. The aim is to help Finnish industries and society to adopt the changes in modes of operation and business practices enabled by the new technologies. VTT has long been conducting research on autonomous systems at the international level.

'Autonomous systems are revolutionising transport and logistics on land, at sea and in the air'

VTT SenseWay will leverage VTT's extensive technological and scientific expertise in a multidisciplinary manner in a wide range of projects. The company aims to inte-



grate innovations and new technology, and it will offer a new channel for using VTT's intellectual property rights.

Autonomous systems are revolutionising transport and logistics. In the future, automation will make these systems even more efficient and safer. Autonomous production systems, on the other hand, enhance the competitiveness and productivity of the industrial sector.

[Read more >](#)

Industry faces constant disruption – quantum technology is emerging

Industrial renewal calls for building a deeper understanding of the impact of technology and identifying potential for growth. Quantum technology could become a new industry branch in Finland that will solve the greatest challenges of our time.

The Finnish economy needs export industry innovations. At the same time, the international competition for industrial innovations is becoming fiercer. Global industry must rapidly change to align itself with the sustainable development goals, and Finnish industry must safeguard its attractiveness. This calls for a clear innovation and research strategy for industry that will help boost future competitiveness.

In 2019, VTT put a strong emphasis on international co-operation. We took part in creating ecosystems, value chains and innovations for industry, both in Finland and internationally. We created industrial renewal roadmaps and coordinated the European Factories of the Future strategy.

Right now, the renewal of industrial processes is driven by the innovative approaches offered by synthetic biology, for example. At the same time, the deployment of automation and digital solutions is accelerating. From the viewpoint of export, it is essential for Finland's industrial sector to be one of the leading players in implementing future digital solutions and business models. It is equally essential to truly understand digitalisation and the relevant laws in value chains. The end result may be, for example, an innovation ecosystem that revolutionises the manufacturing industry.

CASE

A QUANTUM COMPUTER IS ALREADY BEING BUILT IN ESPOO

VTT is part of the quantum computing revolution that will change computer technology – and maybe the whole world – forever. In 2019, we organised a seminar on quantum technology, and we were joined by Professor of Quantum Technology Mikko Möttönen, who is leading the Quantum Computing and Devices group in developing a quantum computer in Otaniemi.

The world is believed to be on the brink of a second quantum revolution: quantum technology innovations may revolutionise drug design or even simulate the universe.

Quantum technologies are exerting a significant impact on the future of research institutions, the academic world, industries, business, and politics. VTT is part of the 10-year Quantum Flagship programme launched in 2018, which is among the EU's largest and most ambitious

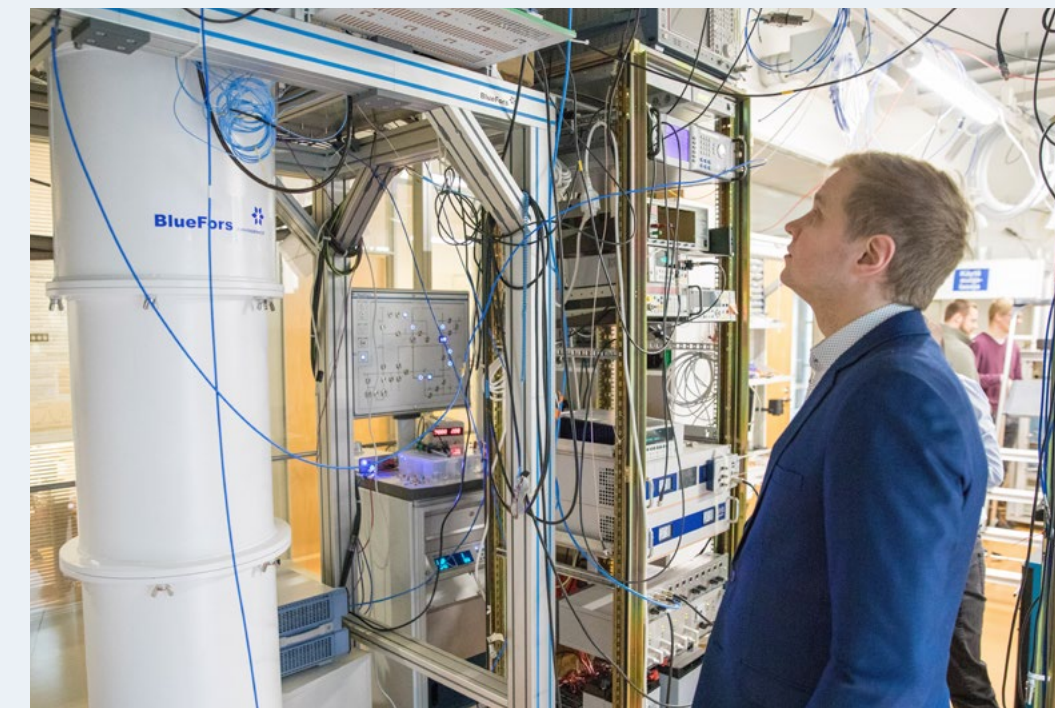


Photo: Aalto University / Mikko Raskinen

research projects. The main objective is to facilitate the market entry of research in quantum physics carried out in laboratories. The impact of quantum technology is also being researched at the Academy of Finland's Finnish Centre of Excellence in Quantum Technology. We aim to support the development of quantum technology and take it to the next level by fostering co-operation and applying research in practice.

In 2019, we organised a quantum technology opportunities seminar, where researchers and representatives of

the business world discussed the guidelines and co-operation opportunities for putting quantum technology into practice. Ph.D. (Technology), Docent Mikko Möttönen started as the Professor of Quantum Technology under a joint professorship of VTT and Aalto University in April. In his new position, Prof. Möttönen will promote research in quantum technology and co-operation within the field.

'A quantum computer may be able to simulate the universe'

VTT's expertise in superconducting circuits and photonics can be applied in the development of quantum technology's crown jewel – the quantum computer. IQM Finland, founded by Prof. Möttönen, intends to commercialise the joint research of Aalto University and VTT, i.e. to develop systems in Otaniemi for a quantum computer, which would also bring benefits beyond research.

[Read more](#) >

Customers and commercialisation

The uncertainty of the world economy affected customers' views on the short term and resulted in several RDI projects being postponed. At the same time, many customers continued to build growth with a long-term approach. Startups focusing on technological development made significant RDI investments.

We continued to develop VTT's customer work in order to maintain our status as a value adding business partner. We succeeded in supporting our customers with their key themes. As a result, our sales grew by 8% compared to the previous year. The value of sales opportunities at the end of 2019 was 20% higher than the previous year's highest value.

Our call to start solving global challenges under the theme of 'What an amazing time to be alive' was well received. Strong efforts will also continue to be put into sustainable business opportunities over the course of the coming decade.

Total number of customers*

1,420

Domestic private-sector customers*

825

International private-sector customers*

365

Domestic and international public-sector customers*

230

64

VTT's net promoter score (NPS)**

97%

Percentage of customers who experienced a boost in knowledge and competence thanks to co-operation with VTT**

* Parent company ** The figures are based on an independent customer impact survey commissioned by VTT.

CASE

TOWARDS FUELS OF THE FUTURE

St1 and VTT are searching for ways to mitigate climate change and improve the efficiency of industrial processes.

Many development and commercialisation projects for fuels have been implemented during VTT's long-term partnership with the energy group St1 Nordic Oy. One example of such projects is related to the use of enzymes as part of a biofuel production process. In 2019, the project reached the stage in which the next step is to develop a commercial application for the product.

'The project was launched in 2014 and an enzyme-producing strain has now been developed which, in our estimate, can be turned into a commercially good product at a reasonable cost. In my opinion, this is an excellent example of a long-term research project aimed at commercialisation, which is based on VTT's world-class competence and expertise in using enzymes in industrial processes,' says Senior Scientist **Tom Granström**, who works in St1's biorefining business segment.

VTT and St1 have together researched and identified routes for commercialising the biorefinery's various by-products, such as bio-oil and biocoal, as well as for producing new

types of lignin pellets from lignocellulose, i.e. mill residues.

These products can be further processed into biofuels, chemicals and bio-based materials for the circular economy. The objective also supports St1's strategy to produce advanced renewable fuels to replace imported fossil fuels. The company's vision is to be the leading producer and seller of 'CO₂ Good' energy.

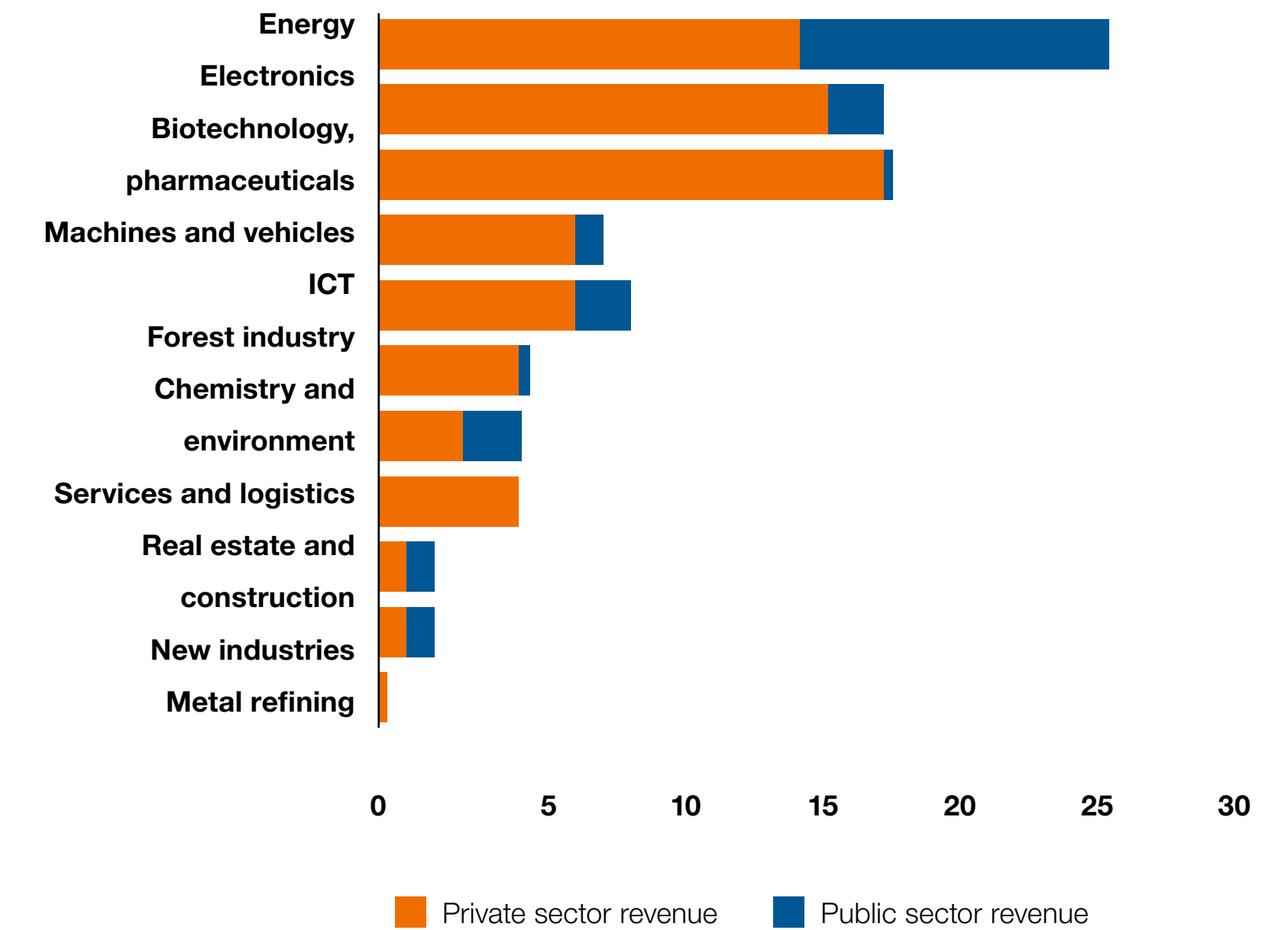
'We absolutely consider the use of carbon dioxide from different industrial processes as one of the components in fuel production to be a key part of our future as an energy company. The technology may still be in its early stages, but I would estimate that the commercial production of synthetic fuels will be started in less than ten years. There are quite a few operators in this area already around the world, so we are waiting for VTT to close the gap on the technological development side, and then we can move forward with our co-operation in this area as well,' Granström concludes, with a wish to the company's research partner.



'This is an excellent example of a long-term research project aimed at commercialisation, which is based on VTT's world-class competence'

Tom Granström
Senior Scientist, St1

Customer solutions sales revenue* (%)



* Parent company, classification according to VTT's customer segments.

Commercialisation of technologies and IPR protection

The income from the IP commercialisation of technologies developed at VTT in 2019 remained at the good level of previous years: IPR revenue totalled EUR 3.4 million. VTT submitted 63 priority patent applications to support the acquisition of customer projects and the building of new business potential for customers.

Active IPRs protect future innovations

In 2019, VTT received 215 invention disclosures and submitted 63 priority patent applications. VTT held 406 inventions protected by patents or patent applications, and the total number of pending patent applications and patents granted was over 1,500. VTT's investment in the protection of patents was significant – EUR 1.9 million.

Innovations as the basis for business

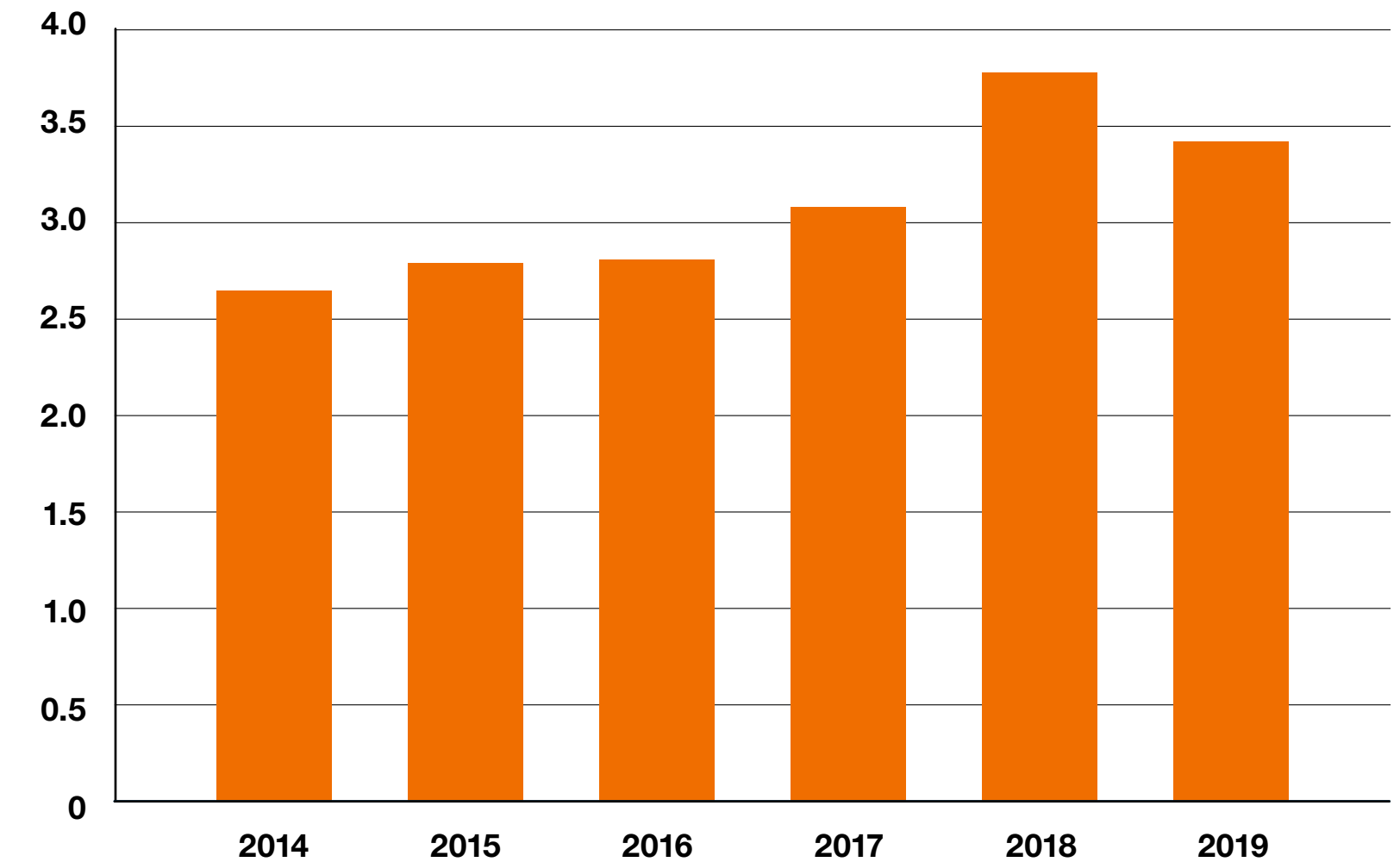
The income from IP commercialisation totalled EUR 3.4 million. The areas of technology with the highest revenues are health technology, process simulation software, optics, and spectroscopy. IPR creation improves the weighting of VTT in the acquisition of customer projects. VTT Ventures Oy sold its share in

FocalSpec Oy, a company specialising in the development and commercialisation of LCI technology, to TKH Group NV based in the Netherlands. FocalSpec Oy is a VTT spin-off, the holding in which was partly based on non-monetary IPR contributions.

Co-operation and non-monetary contributions boost IPR use

The impact of IPRs on VTT's customers was boosted in many ways in 2019. The sales organisation's role in IP commercialisation was made bigger, and IPR support for research-based business ideas developed in the VTT LaunchPad business incubator and Business Finland's projects under the 'New knowledge and business from research ideas' funding programme (TUTLI) was strengthened. Spin-off resulting from these business ideas contribute to the use of VTT's IPRs and innovations in society. The non-monetary IPR contribution model for VTT's spin-offs and other growth companies was revamped. The management of investments was also corporatised.

VTT's IPR revenue, MEUR



3.4

EUR million
in IPR revenue

63

priority patent
applications

406

patent families
in the portfolio

Research and innovation activities are promoted through co-operation

VTT's participation in various networks and the work that we do to develop research infrastructures and innovation ecosystems is aimed at solving the greatest challenges of our time as well as building a sustainable future.

We have an impact through networks

VTT has an impact on research, development and innovation activities and promotes them in a wide range of networks. VTT and our experts are members in various associations, partnerships, coalitions, expert groups, and initiatives, both nationally and internationally.

'VTT is the largest individual recipient of EU research funding in Finland'

We actively co-operate with businesses, universities, other research institutions, funding agencies, non-governmental organisations, and government

departments in Finland. We regularly engage in dialogue with international research institutions and other partners, and we participate in international projects. Our extensive networks also give our partners access to international know-how and competence.

Most of VTT's international public research co-operation is implemented through EU programmes. VTT plays a strong role in various European research and innovation initiatives. Through them, and especially through the initiatives made under the European Association of Research and Technology Organisations (EARTO), VTT participates in the making of European research and innovation policy.

VTT's international impact and the extent of its co-operation is reflected in our strong position in the EU Framework Programme for Research and Innovation. The EU's current Horizon 2020 programme is the world's largest research funding programme, and through it we have successfully applied for a total of EUR 179.6 million (Business Finland October 2019 stats) from all the collaborative project funds in Finland between 2014 and 2019. According to statistics published by the European Union and Business Finland, VTT is the largest individual recipient of the EU's research funding in Finland; approximately 17 percent of all the Horizon 2020 funding granted to Finland was received by VTT.

[Read more](#) >

Our research environments are for the entire development chain

The use of experimental research and technological infrastructure, demonstrations and piloting are central elements of research and innovation activities. VTT's unique research infrastructure and development environments are an important part of the Finnish national innovation infrastructure. VTT's research environments enable product development from basic research to piloting and even small-scale production. The majority



of our research environments – including Bioruukki, industrial biotechnology, the development environment for fibre-based products, the 5G test network, Micronova, Mikes, PrintoCent, Smart manufacturing and robotics (SMACC), materials technology, transport and energy systems, and the Centre for Nuclear Safety – are also engaged in networking at the EU level.

Investing in our pilot and research environments also continued in 2019 to ensure the continuous development of top talents. After the completion of the biomass centre and fibre spinning pilot facility, a piloting



platform for process chemistry is being constructed at VTT's piloting centre Bioruukki, located in Kivenlahti, Espoo. We also continued to invest in the hot chambers of our Centre for Nuclear Safety, located in Espoo. A major research infrastructure update was implemented as part of the Renewal of Finnish Electronics initiative in Micronova's cleanrooms in Espoo. Late 2019 also saw the deployment of the Circular Raw Materials Hub, established by VTT, Aalto University and Geological Survey Finland (GTK) in Otaniemi. At our facilities in Tampere, efforts were focused on research capabilities related to smart manufacturing, robotics and transport. The research infrastructure for electronics at the facilities in Oulu was also revamped and improved.

[Read more >](#)

New business and growth from innovation ecosystems

Innovation ecosystems provide an efficient infrastructure for tackling complex future challenges that require even more multifaceted and interdisciplinary expertise. In future solutions, parties will co-operate with the aim of overhauling entire systems. Innovation ecosystems enable a wide range of actors, including universities, universities of applied sciences, research institutions, and businesses, to engage in the goal-oriented development of these kinds of new, sustainable and systemic solutions, which also generates new business.

The co-development of innovation ecosystems with partners and customers is at the core of VTT's operations. VTT's role as an engine for innovation ecosystems comes naturally based on its impartiality, technological excellence and high-quality research infrastructures. After all, the innovation ecosystems are built on effective, high-quality research as well as development-based and pilot environments.

VTT is actively involved in international innovation ecosystems based on top-level expertise. Such ecosystems include smart energy (Smart Otaniemi), autonomous systems (RAAS), Food economy 4.0, synthetic biology (Synbio Powerhouse), smart bioproducts (Circular bioeconomy), smart health, smart industry (Industry beyond 4.0), electronics (PrintoCent and Micronova), and the ecosystem for the circular economy.

[Read more >](#)

Publications and open science

The number of peer-reviewed scientific articles published was 467, which remained at the previous year's level.

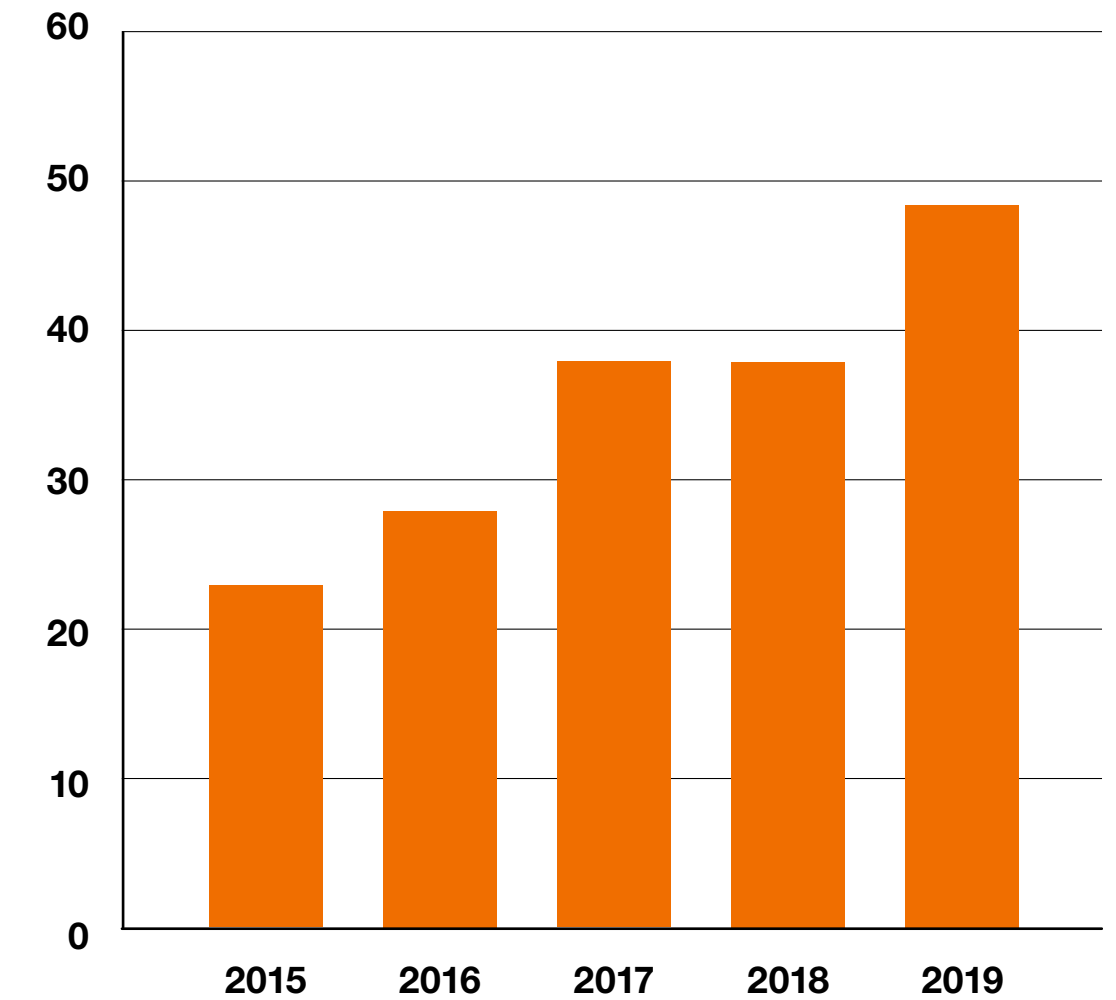
VTT prepared articles on topics that are meaningful to the positive development of society and business life. The quality of the publications improved, and a significant part of the publications are peer-reviewed scientific articles for top international publishers. Our other publications include conference presentations, books, and articles in trade magazines.

The objective of open science is to give everyone who is interested access to scientific data and documents, rather than limiting it to paid subscriptions. Most of the scientific materials used at VTT still require paying for the content, but the portion of open access in both read and published data and documents is growing every year.

In 2019, free access was provided for the first time to more than half of the scientific articles published by VTT.

The research data system covers all VTT's publications dating back more than 10 years. The database has information on VTT's experts and co-operation networks and links to all the open access publications.

Share of Open Access articles (%)



‘With its impartiality, technological excellence and high-quality research infrastructures, VTT is poised to be an engine for innovation ecosystems’

How do we measure the impact of our work?

VTT works for the benefit of the whole society. We look far into the future and conduct long-term research that helps generate new innovations and sustainable business for our customers. The set of indicators we apply is wider than usual to enable better visualisation of the versatile impact of a research institution's activities.

VTT strives to have an impact on the sustainable and positive development of society as a whole. That is why benefits to the society and to our customers are key strategic goals at VTT. Our other strategic goals are to further develop our scientific and technological excellence and to keep a balanced budget.

'Customer feedback remained at an excellent level'

VTT monitors the achievement of goals with a wide set of indicators that take the objectives of a research institution's activities better into account, compared to traditional gauges. A versatile KPI framework was created in accordance with the strategy in 2018, and some of the individual indicators were developed further in 2019.

In 2019, VTT's social development goal was concretised in ecosystems. Using the strategic indicators, the realisation of the goal was evaluated on the basis of the commercialisation of innovations, impact stories, and an external reputation survey. The results of the evaluation showed our relevance in the creation and dissemination of sustainable development values. We wrote impact stories to relate the relevance of our activities to others. The impact stories can be found on pages 25, 26 and 27. At VTT, the quality and quantity of scientific publications are key metrics of excellence. In 2019, the quality of publications improved considerably compared to the previous year. Our customer impact was also shown in the customer feedback, which remained at an excellent level.

[Read more](#) >



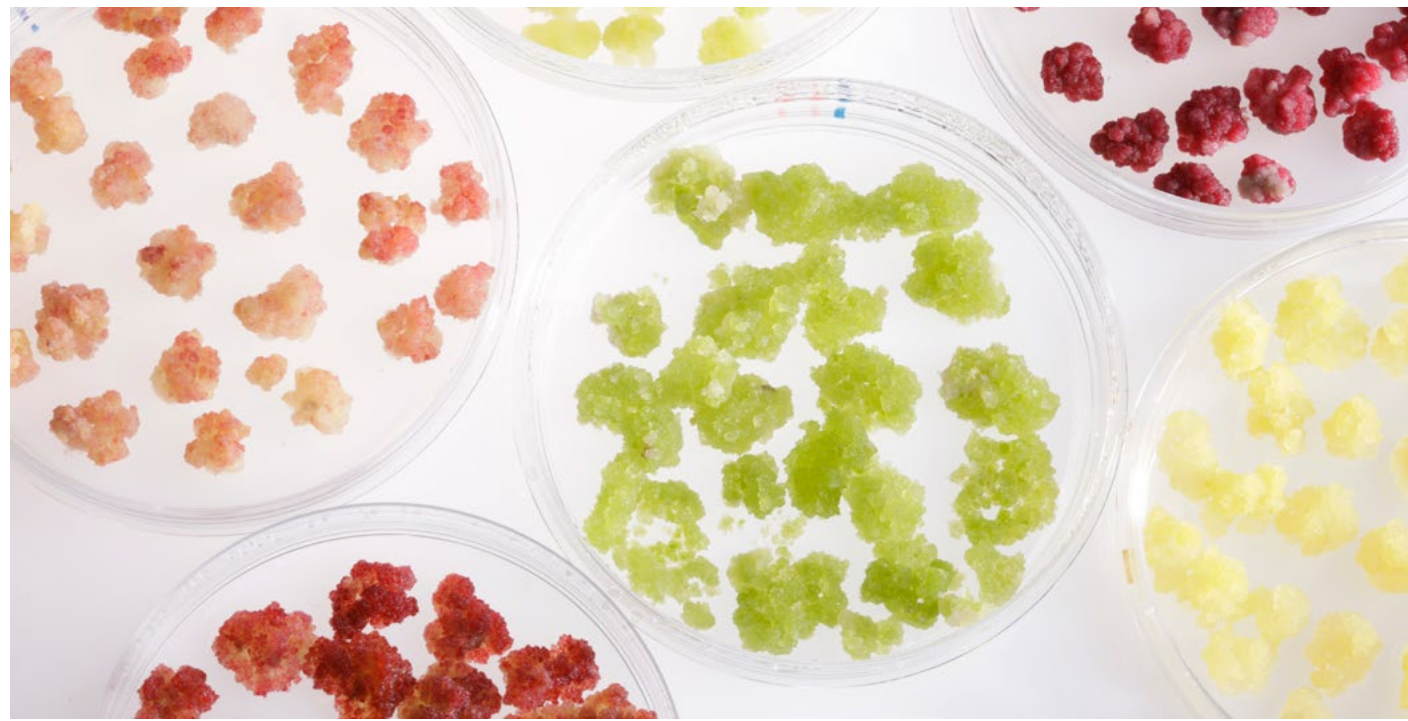


The new era of materials is here

Biomaterials can be used to replace plastics and other fossil raw materials, revamp business models, and reduce the amount of packaging and waste. Smart biomaterials can make buildings healthier, reshape waste fibres into new textile fibres, purifies drug residues from water – or even transmit information, light or energy. These and other similar solutions are being created in VTT’s research and through FinnCERES, which is an ecosystem for promoting bio-based solutions.

[Read more](#) >

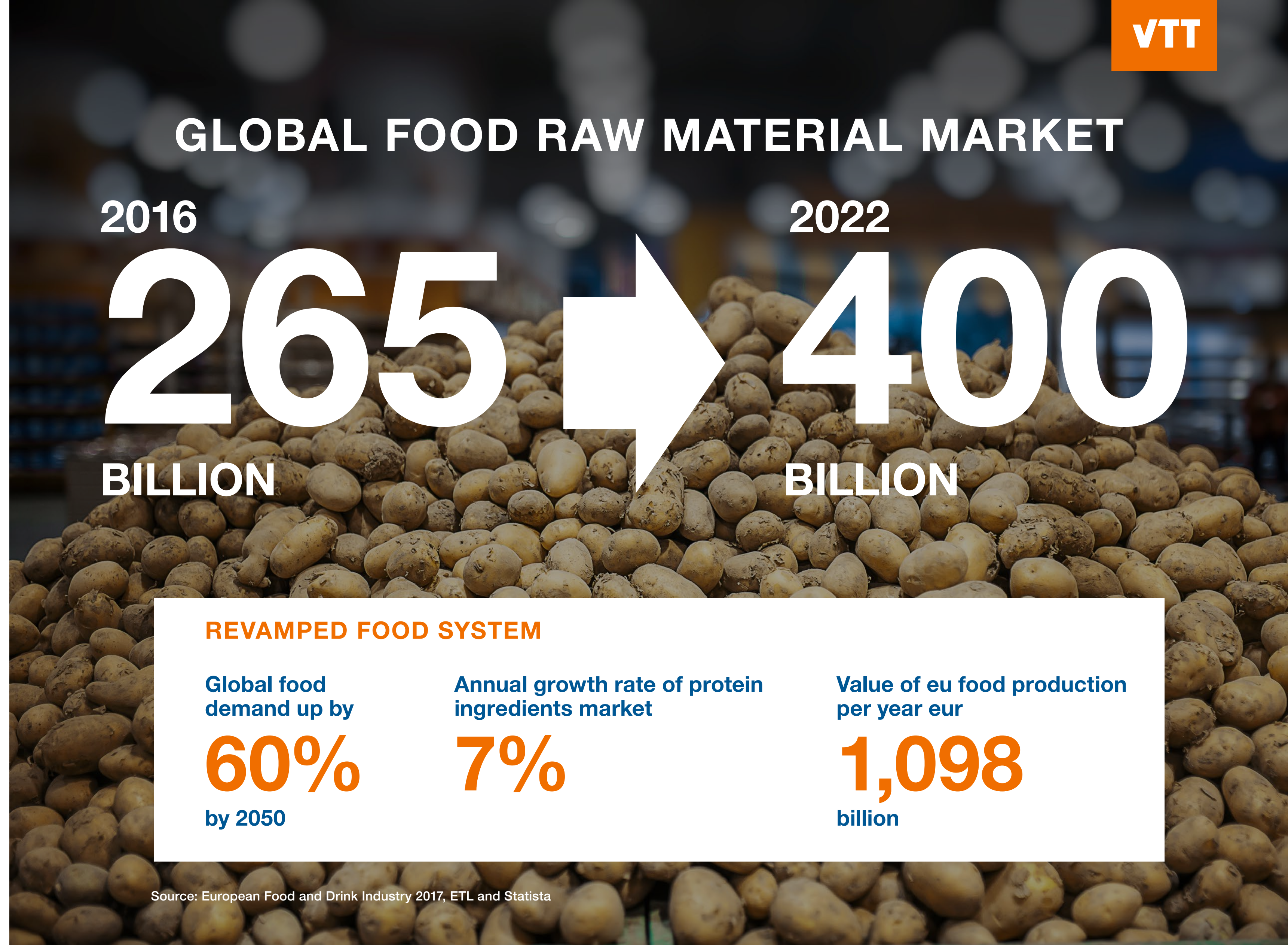




Towards a resource-wise food system

The demand for food will increase by 60% by the year 2050. To ensure that there will be enough healthy food for everyone, natural resources must be used in a sustainable manner – without generating more carbon dioxide emissions. VTT introduces four ways of achieving this: introducing new ways of using raw materials, developing new raw materials, generating less waste, and using microbes and cell factories to produce food without fields and animals. We are leading the way to a new era of food production.

[Read more](#) >





Finland is the leading developer of smart autonomous systems

Smart autonomous systems enable a safer, more efficient and lower-carbon future for transport, logistics and work machines. Work will be more meaningful – and the industry will be booming with new business. VTT is part of the on Research Alliance for Autonomous Systems (RAAS), which supports and accelerates advancements in the automation of maritime and road transport, aviation, and work machines.

[Read more](#) >

+15%

MORE LEADING EXPERTS IN AUTONOMOUS SYSTEMS BY 2023

BY 2023, RAAS WILL

<p>Engage 27 more global companies in development activities in finland</p> <p>27</p>	<p>Attract eur 10 million more of international research funding to finland</p> <p>10 EUR million</p>	<p>Create eur 30 million worth more research on autonomous systems</p> <p>30 EUR million</p>
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For a brighter future

First and foremost, our corporate responsibility is connected with research and innovations aimed at solving major challenges. We are building a brighter future.



VTT operates responsibly and develops sustainable solutions

VTT’s core mission is to develop sustainable solutions for our customers and society. We take the principles of sustainable development into account in our research and service activities, reporting, and internal operations.

Corporate social responsibility

VTT’s research focus areas – climate action, resource sufficiency, good life, safety and security, and industrial renewal – seek sustainable solutions to major social challenges. We formulate our research agenda based on a challenge-driven – outside-in – approach. This process is guided by outside signals rather than relying on our existing competencies.

‘The utilisation rate of our researchers’ findings is high.’

The challenges and future growth opportunities of our customers have a pronounced impact on our research agenda and competence development. According to studies, the utilisation rate of our researcher’s findings is extremely high. This attached great significance to VTT’s impact in promoting sustainable development. Our research results and experts are also widely called upon as a basis for public decision-making on the journey to a society founded on sustainable development.

VTT is a member of the FIBS corporate responsibility network. We apply the GRI guidelines to our corporate social responsibility reporting. Our researchers follow the Finnish National Board on Research Integrity’s

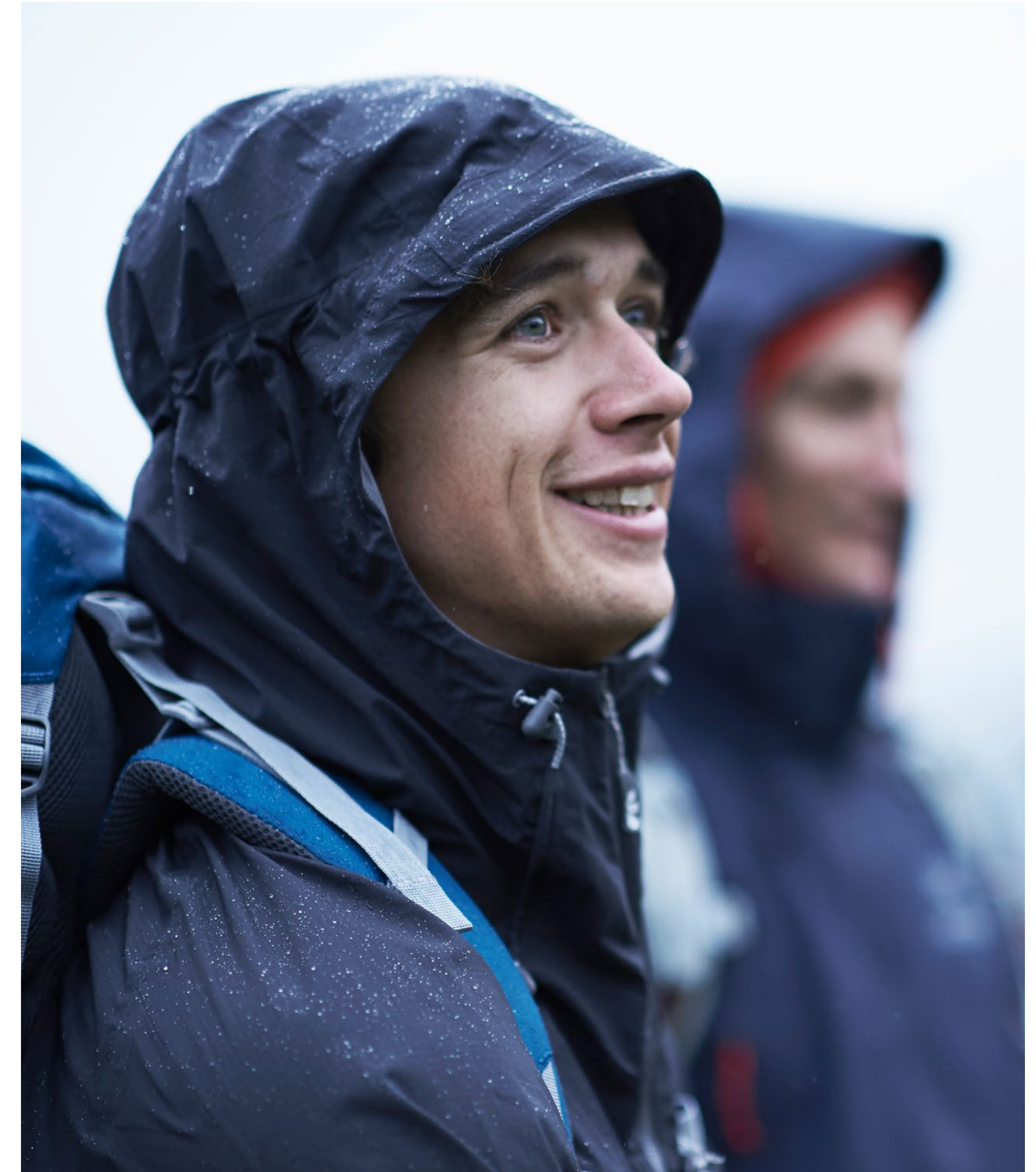
guidelines on good scientific practice, and all our employees have completed our online Code of Conduct training course.

Responsibility towards our staff

Our staff is what makes VTT, and we therefore look after our employees in many ways. You can read more about this in the annual report’s section on VTT employees. We pay special attention to safety. Our occupational health and safety policy is that we only accept a high level of safety in all our operations.

In short, our safety objective is that our staff comes to work healthy and leaves work healthy.

- 1) VTT offers meaningful work that factors in individuals’ capabilities, resources and weaknesses (physical, psychological and social stress).
- 2) VTT provides a healthy and safe working environment.
- 3) Taking risks, deviating from safe procedures and ignoring instructions are forbidden.



VTT is a member of the Zero Accidents forum. Our Zero Accident policy is not just about injuries but also, for example, the following:

- Zero occupational illnesses
- Zero tolerance for bullying
- Zero sick days resulting from work
- Zero unaddressed incidents of violence and harassment
- Zero burnouts
- Zero managers and staff who do not know about occupational health and safety

‘VTT had zero serious occupational accidents in 2017–2019’

According to our policy, anyone who works in VTT’s premises needs to have valid occupational health and safety certification. In the spirit of common workplace safety practices, the policy covers both VTT employees and anyone representing our partners. The requirement applies to all work, including people who work in offices or with terminals.

Calculated using the method of the Workers’ Compensation Centre, the Group-wide accident frequency was lower than ever at 0.55 per million working hours. The corresponding figure for the parent company was 0.55. No lost-time injuries were recorded in any of VTT’s subsidiaries.

The most common causes of injuries were physical impacts, slips and falls, and chemicals. Our KPI for the seriousness of injuries was 5.50 sick days per injury within the parent company (across VTT Group: 5.50).

We are especially pleased with the fact that no serious occupational accidents have occurred within the parent company in three years.

In 2019, we published VTT’s occupational safety principles, which contains all of VTT’s policies related to occupational safety. We have decided to continue the procedure for monthly safety observations for raising awareness of safety issues (one significant observation or several observations of the same issue). Safety observations were reported about, for example, mobility, chemicals and hazardous waste, lifting aids, and a common workplace. The individual who reports the featured incident wins a small prize.

Environmental responsibility

VTT has ISO 9001:2015 and ISO 14001:2015 certified management systems that are regularly audited by Inspecta Sertifiointi Oy. We want to empower VTT employees to make environmentally friendly choices. Our environmental policy was updated to reflect this view as follows:

- We create sustainable solutions for major societal challenges in our research projects.
- We support our customers’ environmentally friendly innovations.
- We encourage our staff towards sustainable choices.
- We comply with the statutory requirements and other binding obligations of our operations.
- We continuously improve our management system to enhance environmental performance.

VTT’s premises at Kemistintie 3 and Tietotie 3 in



Espoo were audited pursuant to the Finnish Energy Efficiency Act. Electricity consumption reduced by 7% on the previous year, and the quantity of purchased paper by 29%. The volume of air travel increased by 2% compared to 2018.

VTT is a member of the Climate Leadership Coalition. VTT bought and cancelled a quantity of emission allowances from its EU emissions trading quota equivalent to the CO₂ emissions of VTT’s rental cars in 2018, i.e. 58 tonnes.

VTT does not operate in areas where there are groundwater reserves, but our facilities in Espoo are located close to the Laajalahti Natura 2000 Nature Reserve. VTT researchers took part in eight parliamentary committee hearings on the subjects of energy and the environment, either as invited experts or by submitting a written statement.

Good leadership helps to succeed and enhances employee well-being

Our personnel development efforts focused on competence development, good leadership, and managerial skills. We revamped the new employee induction process, and our well-being themes were nutrition, exercise, and sleep.

Good leadership at VTT means openness, co-operation and trust

In VTT's culture, good leadership and managerial work are priorities that exert a strong impact on performance, development, and the well-being of VTT employees.

‘Our principles of well-being are leadership, health and safety.’

Our leadership principles emphasise co-operation, openness and trust. These aspects were also highlighted in the development of leadership and managerial work during 2019.

We continued to develop the leadership skills of our team managers with our internal Manager Toolbox coaching and the LEAP 2.0 coaching implemented with an external partner. In total, about 60 people participated in the coaching sessions.

We also started using the WorkPlaceBig5 workplace assessment and EQ-i2.0 self-assessment tools in leadership development. Assessments and the related discussions were carried out with approximately 240 people over the course of the year.

Competence development is the basis of our excellence

VTT's success is based on excellence and solid knowledge in its chosen core areas. In 2019, we put efforts into developing project management skills: in total, about 160 people participated in various coaching sessions and 39 people completed the IPMA C certification training.

In total, about 100 VTT employees participated in internal and external mentoring sessions either as a mentor or a mentee.

During the year, we piloted several new competence development programmes and forms of development. Approximately 180 VTT employees participated in the LinkedIn Learning pilot, 30 people in the Emotional Intelligence in Leadership training, and five people in the first pilot group on digital coaching.

In the autumn of 2019, we launched the ‘Commercial Excellence for Researchers’ coaching project,



VTT is the winner of the Kiertotalous Open 2019 Finnish baseball event.



Well-being is enhanced by doing things together. VTT employees exercising in the park in the summer of 2019.



Executive Assistants Pirjo Malinen (left) and Leena Tuuro at the EARTO Annual Conference Dinner.

Culture is an important part of new employee induction

The development of the induction process was a focus area in 2019. We revamped our induction practices and launched a new ‘Discover VTT’ induction package. In total, about 180 new employees received induction over the course of the year.

The results of the personnel survey called VTT Compass conducted in 2018 and the development needs identified in the survey were processed in teams during the spring of 2019. The KPI for organisational culture derived from the survey results was the same as in 2018: 3.76/5.

The well-being themes were nutrition, exercise and sleep

During 2019, three well-being campaigns were implemented in accordance with VTT’s principles of well-being: leadership, health and safety. The campaign themes – nutrition, exercise and sleep –

CASE

RESEARCHER NUDGES COMPANIES TOWARDS SUSTAINABLE GROWTH

Tiina Apilo’s work at VTT involves business innovations and foresight. She does research and development on bringing companies, researchers and end-users together in shared ecosystems to create new innovations and business.

‘My job is to examine, for example, the way digitalisation is changing business and ways of using data and AI in novel business models. One area where data is bringing completely new opportunities is the industrial service business,’ says Tiina Apilo, D.Sc. (Tech.), Senior Scientist at VTT.

Tiina Apilo researches the development of new business concepts in innovation ecosystems. Ecosystems are needed when trying to solve complex, systemic problems. For instance, no one can solve challenges related to climate change and the overconsumption of natural resources on their own. Customers, end-users and legal representatives, as well as research to create new information, are needed in addition to the companies that are developing solutions.

‘More understanding is needed of innovation ecosystems and ecosystemic business models. Innovation networks and ecosystems have been discussed at length, and now they are starting to be applied in practice. VTT helps companies to be among the first to seize the opportunities provided by ecosystems,’ says Tiina Apilo.

Solving global challenges has motivated Tiina Apilo to work at VTT for 25 years. According to her, continuous learning is the best and hardest part of the job.

‘I get to learn new things all the time with the customers and partners, and to see up close how solutions are developed together. At the same time, being in a continuous learning process feels uncomfortable, because it requires abandoning old beliefs,’ she explains. For Tiina Apilo, feedback from customers is one of the highlights of her job, because it verifies that the work is meaningful and creates added value to the customer.

‘When I started at VTT, I was motivated by the opportunity to help Finnish companies do things better and more efficiently. My current work involves innovation leadership and strategic development. Now I do more than just examine how things can be done more efficiently, I also check whether the companies are doing the right things,’ she says.

Tiina Apilo is excited about developing sustainable business.



‘VTT’s strategy is ambitious: in addition to the challenges faced by Finnish industries, we are also solving global problems. We are contributing to the creation of sustainable business. It’s easy to commit yourself to helping achieve goals such as this.

In 2020, part of VTT staff will move to new premises in Otaniemi, Espoo.

‘Moving to the VTT FutureHub means more than new walls, etc.; it will also bring changes to the way we work,’ Tiina Apilo explains.

‘I have taken part in developing new ways of doing things in, for example, workshops for analysing new ways of working and setting of goals. We have tried new ways of doing things in practice and then compared our experiences in groups. My view is that the change offers many opportunities, and I am looking forward to moving into the new premises.’



Principal Scientist Brian Gibson conducts research on the quality of beer, brewing yeasts and brewery fermentation at VTT's brewing laboratory.

were chosen based on the information obtained from occupational health care and the personnel survey. Focus was put on these themes to promote the well-being of VTT employees. The well-being team organised blood glucose level measurements, UKK walk tests, and Firstbeat stress analyses. In addition, opportunities were given to listen to expert lectures and learn about the themes chosen for VTT's own research through presentations from colleagues.

Individuals' ability to promote their own well-being was supported with the help of various apps and online services. Efforts were also put into internal and external communications related to well-being. During the year, occupational health care services were put out to tender, and co-operation with the new provider was launched nationally at the beginning of June.

An inspiring employer image of a believer in the future

With respect to the employer image, we finalised VTT's employer value proposition (EVP), which has the following three parts:

- 1) Join us in building a brighter future.
- 2) VTT is an encouraging and inspiring workplace community for top talent.
- 3) We focus on well-being.

We took part in Universum's annual employer branding surveys. Natural sciences students ranked us the 14th most attractive employer, and engineering students the 21st most attractive in a student survey in the spring. The results of the professional survey were published

'Recognition rewards were based on performance in promoting excellence.'

in the autumn. We were in the top ten in both natural sciences and engineering: we were ranked the sixth most attractive employer among natural sciences professionals, and the ninth most attractive employer among engineering professionals. In the summer of 2019, VTT participated in Oikotie's Responsible Summer Job survey, in which we were ranked fourth in the large company category among 64 companies.

Recognition rewards to 464 VTT employees

Rewards are a key leadership tool at VTT. As a whole, rewarding comprises competence development, occupational well-being, corporate culture, and financial rewards. The most important element of financial rewarding is our recognition reward. Recognition rewards were awarded on the basis of promoting excellence and the growth of impact with respect to VTT's goals. Recognition rewards were received by 464 VTT employees in total. Also in 2019, research teams were given a Customer Excellence award for excellent customer work.

GRI index

Standard	Indicator	Reported			Link or explanation
		fully ●	partly ◐	not included ○	
102	Organisational profile				AR = Annual Report 2019, CoC = Code of Conduct , MA = Management approach annex
102-1	Name of the organisation		●		Key facts of VTT
102-2	Activities, brands, products and services		●		Research results, AR 13–18, 20, 25–27 Key facts of VTT
102-3	Location of headquarters		●		Key facts of VTT
102-4	Location of operations		●		Key facts of VTT
102-5	Ownership and legal form		●		CoC 6
102-6	Markets served		●		AR 20
102-7	Scale of the organisation		●		AR 6–7, 19–21
102-8	Information of employees and other workers		●		Total number of employees by contract type and gender
102-9	Supply chain		◐		MA VTT uses Hansel's services in procurement. Responsibility.
102-10	Significant changes to the organization and its supply chain		●		Two new companies were established - VTT SenseWay Oy (9.10.2019) and VTT Holding Oy (4.11.2019).
102-11	Precautionary Principle or approach		●		The State owned bodies are following the precautionary approach although it is not any more explicitly mentioned.
102-12	External initiatives		●		CoC 6
102-13	Membership of associations		●		Because of corporatization VTT has joined to Palta ry.
102-14	Statement from senior decision-maker		●		AR 4
102-16	Values, principles, standards, and norms of behavior		●		CoC 3–6
102-18	Governance structure		●		Tax footprint, management and control annex (in Finnish) VTT's Corporate Governance The administration code of Finnish listed companies VTT's Board has audit and remuneration committees.
102-40	List of stakeholder groups		●		Stakeholders
102-41	Collective bargaining agreements		●		Essentially 100%, only top management is outside collective bargaining agreements.
102-42	Identifying and selecting stakeholders		◐		Stakeholders
102-43	Approach to stakeholder engagement		◐		Stakeholders
102-44	Key topics and concerns raised		◐		Stakeholders
102-45	Entities included in the consolidated financial statements		●		Annual Report 2019

Standard	Indicator	Reported			Link or explanation
		fully ●	partly ◐	not included ○	
102-46	Defining report content and topic Boundaries		●		MA Government ownership steering requires government-owned companies to submit reports in a specific format. Ownership policy (in Finnish)
102-47	List of material topics		●		201-1, 201-4, 203-1, 301-1, 302-1, 303-1, 305-1, 305-2, 305-3, 305-5, 306-1, 306-2, 306-3, 306-4, 307-1, 401-1, 403-1, 403-2, 404-1, 405-1, 406-1, 409-1, 415-1, 416-1
102-48	Restatements of information		●		No major changes.
102-49	Changes in reporting		○		
102-50	Reporting period		●		Calendar year 2019
102-51	Date of most recent report		●		5th April 2019
102-52	Reporting cycle		●		Annually, typically on March/April
102-53	Contact point for questions regarding the report		●		kirjaamo@vtt.fi
102-54	Claims of reporting in accordance with the GRI Standards		◐		This material references partly to Global Reporting Initiative GRI Standard 2016. The scope is 'Core'-option, however not all criteria are met. Those have been marked in this table as ◐.
102-55	GRI content index		●		This table
102-56	External assurance		○		There are identified non-conformities, no external assurance is used. Situation will be reconsidered each year.
200	Management approach				MA 1, 2
201-1	Direct economic value generated and distributed		●		AR 6–7
201-4	Financial assistance received from government		●		AR 7
203-1	Infrastructure investments and services supported		●		Annual Report 2019
300	Management approach				MA 1, 2–3
301-1	Materials used by weight or volume		◐		Amount of printings Consumption of paper reams Destruction of white paper
302-1	Energy consumption within the organization		◐		Consumption of electricity Consumption of heat
303-1	Water withdrawal by source		●		Consumption of water
305-1	Direct GHG emissions		◐		Total GHG emissions
305-2	Indirect GHG emissions from energy		◐		GHG emissions according to sources
305-3	Other indirect GHG emissions		◐		GHG emissions according to sources

Standard	Indicator	Reported			Link or explanation
		fully ●	partly ◐	not included ○	
305-5	Reduction of GHG emissions		●		VTT purchased CO ₂ -emission allowances from the European emission trading scheme corresponding the amount of VTT's car fleet CO ₂ -emission - 58 tonnes (2018), calculated based on car fleet's specific emission and kilometres driven. This amount has been eliminated from the quota.
306-1	Water discharge by quality and destination		●		No direct discharges into water. All waste water is conveyed through the sewer system to the municipal waste water treatment plants. An obligation to monitor the quality of water, pursuant to a permit for conveying waste water to the sewer system, is in force for Kaitoväylä 1, Oulu (21 May 2012)
306-2	Waste by type and disposal method		◐		Amount of waste
306-3	Significant spills		●		No significant spills. Earlier (2011) spill follow-up control proceeding into the phase where sample frequency is reduced to two times per year and suggested to be reduced to one time per year.
306-4	Transport of hazardous waste		●		Amount of waste Hazardous waste to Ekokem by road (ADR) No hazardous waste exported nor imported. No hazardous waste treated. No hazardous waste shipped internationally.
307-1	Non-compliance with environmental laws and regulations		●		No compliance breaches has been identified.
400	Management approach				MA 1, 3–4
401-1	New employee hires and employee turnover		◐		New employee hires by age group and gender (no screening by region)
403-1	Workers representation in formal joint management–worker health and safety committees		●		100 % represented formal joint management-worker health and safety committee
403-2	Types of injury and rates of injury, occupational diseases, lost days, and absenteeism, and number of work-related fatalities		◐		Frequency and gravity of accidents (no screening by gender)
404-1	Average hours of training per year per employee		◐		Training expenses and days (Education and training costs)
405-1	Diversity of governance bodies and employees		◐		Age structure and gender distribution Share of men and women In VTT's Board there are four women and three men.
406-1	Incidents of discrimination and corrective actions taken				No discrimination cases identified.
408-1	Operations and suppliers at significant risk for incidents of child labor		●	◐	MA 4
415-1	Political contributions				No contributions has been rendered
416-1	Assessment of the health and safety impacts of product and service categories		●	◐	Research concerning health technology and foodstuff, AR 15–16

