

VTT

Sustainable growth for the renewing industry with VTT's investments

beyond the obvious



Introduction

In 2023–2025, VTT will invest in five research entities that promote the green transition, resource wisdom and security of supply while accelerating the renewal and competitiveness of companies. We also promote the national initiative for the development of microelectronics and quantum technology.

The investments will enable the growth leap of companies, industrial renewal and the creation of new types of business.

The investments meet the needs identified together with the companies, for which they are also prepared to invest.

All research investments involve excellence that makes them unique.

Five research investments and a national initiative

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INVESTMENT TARGET 1:

Pure and reliable heat in cities:

Domestic district heating reactor operational in 2030

VTT has been developing the small modular reactor (SMR) LDR-50 for district heating since 2020. In addition to technical planning work, a network has been gathered around the project consisting of Finnish nuclear energy sector actors, energy end users and manufacturing industry companies. The aim of the development is to commercialise the technology by the end of this decade. A new industrial sector focusing on nuclear energy solutions will also be created in Finland.



VTT has invested EUR 5 million in the further development of the district heating reactor for 2023–2024. With the additional investment, the project will move to the next stage of development. The size of the reactor development team will be multiplied and co-operation with partner organisations will be intensified. The current environmental impacts of district heating production are significant. The reactor concept developed by VTT is suitable for district heating networks even in small cities and municipalities. Small-scale nuclear energy could replace district heat production based on the combustion of coal, peat or biomass. Small-scale reactors can be produced in series production, which means that the investment cost would be small and can be adjusted to the budget of several cities. In addition to Finland, the market area of the district heating reactor is the Baltic countries and Northern and Eastern Europe. 75 per cent of EU district heating plants operate with fossil fuels and need an emission-free replacement.

- **VTT invests in new competence.**

As the district heating reactor operates at a lower pressure and temperature than a nuclear power plant designed for power generation, lighter technology can be used in component manufacturing. The production of reactor components such as pressure vessels and heat exchangers, would be possible in domestic machinery workshops.

VTT's concept relies on technology used for decades and well-known solutions that are applied in a new way. The simplicity of the concept compared to large nuclear power plants enables faster construction time.

The first plant is designed to demonstrate the construction of the reactor and the supply chains of the components, after which the technology is prepared for series production. Heat would be delivered from the district heating reactor for decades. Its production cost is independent of fluctuations in electricity prices. The fuel needed by the reactor can be stored to last for years. There are several fuel suppliers in Europe, including Sweden and France.

LDR-50 safety design relies on passive technology. If the normal cooling functions are compromised, the reactor falls back to a

passive heat removal mode, which requires no electricity, automation or actions from the operating staff. VTT's SMR concept meets the emissions challenge of heat production that is otherwise difficult to solve. Many other SMRs developed worldwide, however, solve the needs of electricity production and industry, which requires a nuclear reactor operating at significantly higher temperatures.



INVESTMENT TARGET 2:

New piloting platform bringing solutions for the recycling of plastics and textiles

In the VTT Bioruukki pilot centre in Espoo, VTT is building a high-quality research and piloting platform that enables the development of advanced recycling technologies for hard-to-recycle plastic containing multi-materials.



Plastic packaging, mixed textiles and composite structures containing many different materials are almost always burned once discarded. The aim of the new piloting entity is to significantly reduce carbon dioxide emissions by converting the components of plastic containing hard-to-recycle materials into valuable raw materials for the process industry. The entity enables VTT and companies to demonstrate several new industrial recycling solutions for hard-to-recycle plastic and textile materials and thus support the realisation of a circular economy in industry and society.

The methods to be developed are energy-efficient, minimise material losses and enable the recycling of new materials that are difficult to recycle.

Challenge to be solved

Only about 10 per cent of plastic waste is recycled globally. It has been estimated that the current methods will increase carbon dioxide emissions from plastic production and the incineration of plastic waste by almost 30 million tonnes per year by 2050. Plastic packaging will be developed for

easier recycling, but multilayer materials will continue to be needed to reduce food waste, for example.

Over 2.2 million tonnes of textile waste is generated in the EU every year. Globally, the figure is tenfold, and the number is constantly increasing. The recycling and reuse of textiles has increased in recent years. About one fifth of the textile waste that comes from consumers is recycled, but often for lesser use than clothes. However, a large proportion of waste textiles still end up in incineration or landfills.

Due to their light weight and superior properties, plastic composite materials are widely used in the wind energy, aviation, automotive, construction and marine industries. New recycling solutions must also be found for these.

The EU has sought to address the waste challenge by increasing recycling obligations. This inevitably means that difficult to recycle composite materials that contain plastic need to be included in the recycling process more often.

- **VTT invests EUR 5.5 million in the research infrastructure**
- **The definition of the concept and the selection of priorities will be carried out in 2023.**
- **New equipment investments in 2023-2026 complement the existing equipment. New research projects will be started gradually in 2023.**
- **The investments support the objectives of the Business Finland Veturi programmes led by Borealis, Neste and Valmet.**



INVESTMENT TARGET 3:

Significant reduction of energy and water consumption in the forest industry and new product innovations

VTT is building an internationally unique piloting environment in Jyväskylä to accelerate the renewal of the forest industry and improve the resource efficiency of existing products.



The majority of the infrastructure investment is related to the equipment needed for dry fibre processing and continuous forming. At the centre of the investment is the new virtually waterless forming technology, which significantly reduces the energy and water consumption of the production line. The technology also enables the manufacture of new innovative fibre-based product and light-weighting of fibre-based materials, which means that more products can be produced from the same quantity of wood.

The objective is to develop new energy-efficient manufacturing processes whose water and energy intensity is significantly smaller than with current methods.

Challenge to be solved

The market for cardboard packaging, hygiene products, non-woven fabrics and other fibre-based products is growing rapidly. Bio-based materials can be used to replace oil-based products in use.

Sustainability is today one of the most important drivers of the packaging industry and

- **VTT invests EUR 4 million in the research infrastructure**
- **The aim is to start building a pilot environment in 2024, in which case the new pilot line will start in 2025.**

the production of fibre products. Consumer, dealer and brand focus are important strategic priorities for companies. In addition, EU recycling targets for plastic packaging and other regulations support the transition to fibre-based products.

However, the production of paper, cardboard, tissue paper and many new fibre products developed in recent years requires plenty of water using current methods, and the process requires a lot of energy to remove the water. Companies are looking for new ways to save energy and water and thus significantly reduce CO₂ emissions.



INVESTMENT TARGET 4:

New materials by natural means 10 times faster:

Digital development platform for biosynthetic materials

VTT's investment will build a digital platform and methods for the systematic development and optimisation of biosynthetic materials. This enables companies to replace fossil raw materials used in industrial production with renewable raw materials and to develop completely new materials produced sustainably.



The digital development platform for biosynthetic materials combines data, AI, biotechnology and synthetic biology. It will be used to design and develop up to ten times faster than before completely new materials with superior properties that are smart and responsive to different conditions.

The investment combines the AI-assisted prediction of the structure and functionality of computational materials, and these designed materials are then produced through biosynthesis using synthetic biology. An integrated platform is a testing and learning platform that combines digital design, development and experimental research.

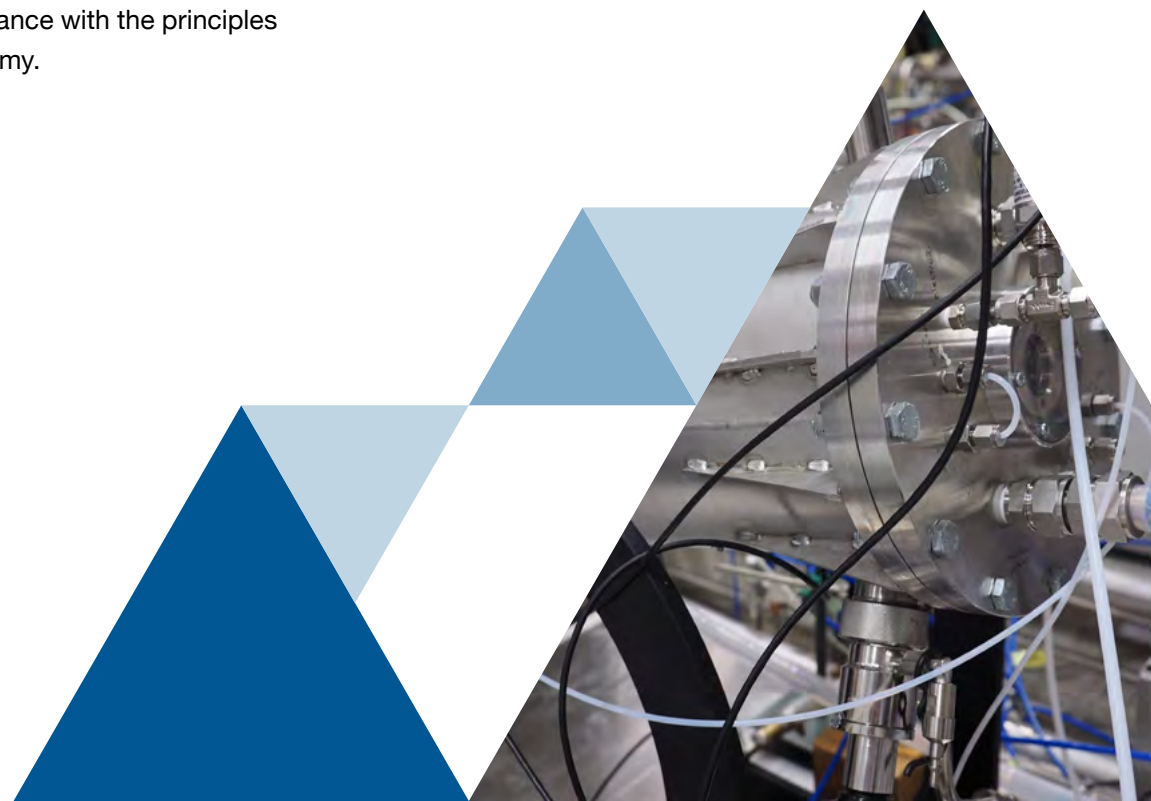
Artificial intelligence can be used to design for instance new bioplastics for packaging applications, which are chemically similar to existing plastics, but have better technical or operational properties than existing bioplastics. In addition, various protein-based elastic materials can be designed by learning from natural molecules such as silk.

Challenge to be solved

The development of new materials is essential for solving the global material challenge. Biotechnology and synthetic biology are expected to be one of the most important methods of materials production in the future.

Live cells can be harnessed to produce almost any material from various renewable feedstocks, industrial side streams and waste. In fact, the utilisation of properties of natural materials and their biotechnological production are still largely an unused opportunity to manufacture materials with new properties in accordance with the principles of the circular economy.

- **VTT invests EUR 2.5 million in the research infrastructure.**
- **Research projects and new investments will be launched in 2023.**
- **Key partners related to the research theme: Finnish Center for Artificial Intelligence FCAI, CSC - IT Center for Science and Aalto University.**



INVESTMENT TARGET 5:

Pilot environment to accelerate the development of medical devices

The investment is used to develop the research environment and manufacturing capabilities of VTT's Oulu office so that they enable the development of new innovative photonics-based medical devices and prototype manufacturing in a regulated manufacturing environment.



Photonics, the combination of optics and electronics, enables many medical applications from diagnostics to medical devices that can be used both in hospitals and at home.

More versatile, flexible and continuous monitoring of people's condition with improved user comfort can be obtained thanks to photonics-based technology breakthroughs. The increased amount of data will enable more personalised care and better resource-efficiency in healthcare system. This supports the renewal of conventionally reactive healthcare towards more proactive and resource-efficient direction.

The research facilities are particularly suitable for the development of photonics-based sensor solutions, such as smart patches, rapid diagnostics cartridges and their optical readers. The investment provides an opportunity to companies to develop new concepts in a pilot-scale fabrication environment that is compatible with the medical device compliant industrial production. This enables roughly one third faster time-to-market for the new product. The new environment will help to reduce the research and development costs of companies and to accelerate the commercialisation of photonics-based medical devices and diagnostic products.

Challenge to be solved

The Western population is ageing and the need for the health services is growing rapidly. On the one hand, medicine is developing at an enormous pace, so many diseases can be identified and treated better than before.

New treatments are expensive and may not be effective throughout the whole patient group. In healthcare, there is a growing need to target the treatments more individually and to allocate limited resources as productively as possible. This requires a change of mindset: Citizens' health profiles and risks of illness must be better known, and the effectiveness of the selected treatment measures must be monitored.

The new generation of technologies makes it possible to monitor the state of health and the risk of illness and to monitor the effectiveness of the selected treatment measures. With the help of information obtained from measurements, treatments can be personalised and resources better targeted. This enables healthcare reform to a more proactive and resource-efficient direction. VTT develops a new generation of technology in co-operation with health sector companies, thus promoting the growth of Finnish health technology business and exports.

- **VTT invests EUR 3.4 million in the research infrastructure.**
- **The investment will be implemented in 2023 and 2024, and the pilot environment will be fully operational in 2025.**
- **The investment will intensify the co-operation between research organisations and companies to speed up the commercialisation of research results.**
- **The practical co-operation model has been developed especially in the EU-funded MedPhab project, in which research institutes are represented in addition to VTT by CSEM (Switzerland), Joanneum Research (Austria), IMEC (Belgium) and Tyndall (Ireland).**
- **The industrial manufacturers of medical equipment in the project are Philips, Jabil and Screentec.**



INITIATIVE

**New piloting environment to
strengthen Finland's position as
the leading RDI hub in
microelectronics and
quantum technology**

A piloting environment that focuses on unique microelectronics and quantum technology in pre-commercial development is planned in Otaniemi, Espoo. Along with VTT, the City of Espoo, Aalto University and the industry members of the semiconductor industry group of Technology Industries of Finland develop the entity.



The new piloting environment expands the current world-class research infrastructure in Otaniemi and promotes Finland's status as one of the most important microelectronics and quantum technology centres in the EU. The purpose of the development environment is to further increase the sector's RDI activities in Finland, increase product and service exports, and attract new international experts, companies and investments.

A strong research base ensures excellent development opportunities for companies operating in the fields of microelectronics and quantum technology. In these areas, however, investment costs are high, which prevents the growth of small and medium-sized enterprises and the creation of new ones. A pre-commercial piloting environment based on open co-creation enables the growth of companies. It is used to develop new manufacturing processes and products and to scale from small serial manufacturing to a commercial production plant.

Finland's strength in microelectronics is based on decades of research. Finland is a pioneer in special microelectronics processes such as integrated photonics, MEMS

sensors, radio frequency communications, silicon-based detectors and quantum technology. The added value of these technologies comes from completely new functionalities that cannot be implemented with mainstream CMOS technology. Examples of new functionalities include radar and hyperspectral technologies as well as personal measurement technologies, all of which have very high growth potential.

Finland already has a strong ecosystem built around quantum technology expertise, in which quantum computing and software as well as quantum technologies are developed. If implemented, the new piloting environment would serve the development of quantum technologies in a versatile manner and enable innovation and further development of new technologies better than before.

Quantum technology is based on microelectronics, so the same clean room environment accelerates the growth of both the microelectronics and quantum technology ecosystem. Finland has the opportunity to create Europe's leading company cluster of micro- and quantum technologies.



Challenge to be solved

Finland's sustainable growth requires national investments in competence areas where we have special top expertise and competitive advantage. It is also a question of security of supply of know-how - as part of the EU, we are striving for strategic autonomy in critical technologies.

The rate of development of quantum technologies is enormous, and the upcoming quantum revolution will challenge the development of all sectors. Europe is working hard to create the next generation of disruptive technologies with a real impact on European society. The goal is supported, for example, by the 10-year Quantum Flagship project launched in 2018, which aims to strengthen and expand Europe's position as a scientific leader and expert in quantum technologies, to accelerate the emergence of a competitive European quantum technology industry, and to make Europe an attractive destination for innovative research, companies and investments in the field.

- **Companies committed to the research theme: Corporate members of the semiconductor sector group of the Technology Industries of Finland. Other partners: City of Espoo and Aalto University.**

The global semiconductor shortage has increased the EU's efforts towards independence from global value chains. The European Chips Act aims to double the European market share to 20 per cent by 2030, requiring new deep technology investments and increased manufacturing capacity.



VTT is a visionary research, development and innovation partner. We drive sustainable growth and tackle the biggest global challenges of our time and turn them into growth opportunities. We go beyond the obvious to help the society and companies to grow through technological innovations.

We have 80 years of experience of top-level research and science-based results. VTT is at the sweet spot where innovation and business come together.

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