How to take leaps in sustainability and create new growth for Europe

# Discovering exponential hope

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beyond the obvious

**“Some technological areas are capable of going beyond incremental improvement, to create entire paradigm shifts, leading to leaps in productivity and sustainability. These fields are just what we need to solve systemic problems and create sustainable growth.”**

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# Unique opportunities ahead

The 2020s represent a pivotal decade. To ensure our long-term well-being, and that of the economy and the environment, we need to create new solutions and systemic changes, and quickly. As an education superpower, with excellent technological expertise and the ability to adopt innovations quickly, Finland has to be part of solving the greatest problems of our age and enabling significant change for the better. However, the challenges cannot be solved by the actions of individual countries only. We require profound international cooperation.

We need to focus our energies on new sectors which can set off beneficial cycles in society. I call this endeavour **discovering exponential hope**. Investing in these sectors can create new opportunities for businesses, generate rapid economic growth and enable significant improvements and greater resilience in society. Finland, in cooperation with its European partners, should focus on taking the lead in these very sectors. To get started, the initial investment does not have to be immense. But it needs to be swift and focused. Now is the time to act.

The year 2020 can be seen as a watershed for a number of reasons. The Covid-19 crisis has shown us that global systems – and economic prosperity – can be disrupted at short notice. It has also shown that when there's the will to do so, societies are capable of acting rapidly. The question is: what next? Understandably, many are focused on the economy and upon our immediate survival. At the same time, the rapid economic halt and the rebuilding it will necessitate also offer opportunities for change that our systems are painfully in need of. Looming ahead are even deeper crises than the Covid-19 pandemic: climate change and the collapse of natural ecosystems. These crises require a prompt response.

It would be a great pity if, at this historic juncture, we are unable to imagine a better world than the one we had before this crisis. We should not seek to simply return to how everything was before. Because if we have the will, this moment can be used as a gateway to radical renewal: a disruption that will set our lives and the European economy on a new track towards sustainable growth. The future doesn't have to be grimmer than the present. It is possible to mitigate climate change and support economic growth and well-being at the same time. And it's not just possible – it's essential. Our problems should be solved in ways that simultaneously create opportunities for work, income, sustainable business growth and happiness.

We have to look far ahead into the future, and seize opportunities that will continue to support well-being decades from now. Science, technology and innovation open up numerous paths for us, as long as we dare to take them. The road to radical change and sustained well-being requires research and experimentation; trial, error and learning.

In this paper, I name five sectors that offer Finland and Europe unique opportunities to start the aforementioned beneficial cycles that will lead to sustainable growth. They are fields in which we should invest now. If we get stuck in our old ways, we will miss the opportunity of a century, so let's begin today.

## Discovering exponential growth

I have the privilege of leading a research organisation composed of two thousand experts, who work every day on finding solutions to systemic problems through deep technology. Systemic problems are the challenge that spurs VTT forward. Innovative solutions to these problems are what we strive to accomplish. Every day, VTT researchers at their offices, labs, test environments and pilot factories – together with partner companies and universities – strive to create disruptive technologies to meet global challenges and give rise to sustainable economic growth.

I call these technologies, and the growth they enable, areas of **exponential hope**. This is for two key reasons, which also set the criteria for inclusion on my list:

1. **Exponential** means that the sector enables fundamental change and exponential growth. The field is based on technologies, which do not just create incremental change – small improvements to existing systems – but deep structural changes, that can lead to real productivity and sustainability leaps. These changes are just what we need to solve systemic problems and create new growth.
2. **Hope** means that the industry can help humanity tackle global challenges, and simultaneously give rise to new high-growth areas of competence in Europe, because we, in Finland and in Europe, have specific strengths for creating innovation in this sector. Climate change, making the Earth's resources last, well-being for a growing global population: these are issues that will decide the fate of humanity in the 2020s and beyond. Europe needs to invest in developing expertise that is a) essential to meeting these global challenges and b) based on technology sectors where we have a real chance of becoming world leaders. Therein lies our hope.

The following areas of exponential hope are ones in which Finnish and European companies have excellent resources to become world leaders. By focusing on these areas, Europe can become an even better place to live in during this century. At the same time, we will help the whole world to meet the challenges ahead. The areas of exponential hope are:

**1. Biotechnology in food production**
**2. Quantum technology**
**3. Small nuclear reactors**
**4. Chemical plastics recycling**
**5. Optimising the use of materials**

# 1

# Biotechnology in food production enables sustainable disruption in the food system

## What makes the field disruptive?

Food production methods need to change radically to ensure that there is enough food for a growing global population and to bring the negative environmental impact of food production under control.

Biotechnology, in this context, means harnessing microbes and algae, as well as animal and plant cells, for food production. This enables the decoupling of aspects of food production from traditional agriculture: instead of rearing animals and farming fields we can produce food in cell factories. This lowers the environmental burden of food production and helps ensure food security despite the environmental effects brought on by climate change. The disruptive change that cellular agriculture brings about can be compared to the agricultural revolution that took place between the 1700s and 1900s.

In the cell factories of the future, microbes will be used to produce food ingredients. For instance, egg white without chickens or milk proteins without cows. Initial calculations show that producing, for example, egg-white protein in a cell factory generates 74% less greenhouse gases and uses 90% less land than rearing chickens. With biotechnology agricultural expansion can happen vertically, instead of horizontally, which frees up land to be returned to a natural state or to be used for non-agricultural uses.

Biotechnology in food production also allows a completely new type of business to emerge. The food production and distribution chain is disrupted, which opens the doors for new types of food producers.

## What are Europe's strengths?

European countries have high-tech industries in terms of food production. There are already world-leading companies in sustainable food in Europe. For instance, Finnish oat and plant protein-based innovations are increasingly exported to international markets. We can therefore pioneer industrial biotechnology solutions and show the way to creative disruption in food production. Finnish consumers are fairly open to trying new food products, which makes Finland a great testing bed for food innovations that aim for global markets. Europe as a whole has already created high-level biotechnology expertise in food production through universities, research institutes, food companies and start-ups.

The use of microbes in food production is currently being developed from two angles. First, cell factories can produce edible microbial biomass to be used as an ingredient in the food industry. For instance, the Quorn product family, made of mycoprotein derived from fungi, is already on the market. Second, microbes can be harnessed to produce specific ingredients, such as animal proteins or fats. Solar Foods, a start-up which originated in VTT, produces edible microbial biomass protein from carbon dioxide, water and solar energy. Consumers are discovering how not only microbes, but also plant cells, can be used in sustainable food production. These new methods enable good nutrition and minimise environmental effects. In the future, it may be possible, for example, to produce avocado ethically, year-round, by using plant-cell-culture technologies.

## What should be done in practice?

**Step 1: Scale up the production processes**
First, we need national, European and international research institutes and industries to start research and development on 1) scaling up biotechnology in food production, and 2) identify how biotech is used as part of sustainable food production. For instance, we need to discover ways to produce the food feedstocks for cell factories from bioindustry side streams – efficiently and sustainably. And we need to find ways to integrate existing food production systems into cell-factory processes as well as formulate new cell-factory products that can be utilized as ingredients in various foods.

**Step 2: Remove legal obstacles**
The legal debate in the European Union should be led wisely. We need to take a broad perspective on biotechnology in food production, instead of drawing a direct line from existing legislation on genetic modification. The current EU legislation on genetic modification is hopelessly outdated and is slowing down our ability to harness new biotechnologies that are scientifically proven to be safe in food-production processes. It is important to understand that, for example, milk protein produced from microbes is not itself genetically modified. It is identical to the milk protein produced by animals, though the microbe that produces it may be modified using (proven-to-be-safe) gene editing technology.

**Step 3: Involve consumers**
Stakeholders, including consumers, must be actively involved in the debate and development work of biotechnical food production so that we can become a society of early adopters of this disruptive technology. Although at first, ordinary citizens may find the idea of food produced in cell factories strange, microbes have been used for generations to produce food such as yoghurt and sourdough bread. Some food ingredients and additives in use today are already produced in cell factories. Harnessing biotechnology more extensively can offer delicious, healthy and safe food products, with a lower environmental impact. This change is a natural part of food production development, and involving consumers in creating this future is crucial.

**"In the cell factories of the future, microbes will be used to produce staple food ingredients: for instance, egg white without chickens or milk protein without cows."**

# 2

# Quantum technology can cause astonishing leaps in productivity

## What makes the field disruptive?

In the last few decades, digitalisation has disrupted almost every traditional industrial sector. Digitalisation is based on increased computing power. The next step in accelerating computing power is quantum technology, one of the most interesting and disruptive scientific fields of the 2020s.

Whereas an ordinary computer calculates using bits, or ones and zeros, a quantum computer uses qubits, which can be ones, zeros or superpositions of both, each with their own "weight". The large number of possible states and a phenomenon called entanglement allow quantum computers to achieve an astonishing computing power in certain computational tasks – provided that the qubits perform reliably. During this decade, quantum technologies are making the breakthrough from research laboratories to more extensive commercial use.

Quantum computer power could enable, for instance, the extraordinarily rapid development of medicines and vaccines – disrupting healthcare worldwide. Modelling complex molecules, such as protein and drug molecules, is traditionally difficult due to their large size and complex interactions. Even today's supercomputers cannot create precise molecular simulations. But as molecular structures are determined by the laws of quantum mechanics, it has been proposed that a large quantum computer could model the structure and activity of these molecules more precisely and rapidly.

In the future, we could also use large quantum computers to solve huge systemic problems. For instance, they could help find new ways to produce sustainable energy or develop sustainable materials. Thus, quantum computing may help us meet the challenges of climate change and resource scarcity with unbelievable efficiency.

## What are Europe's strengths?

If Europe gains a foothold in quantum industrial development, we can grow a new branch of the tech industry worth billions of euros, employing thousands of people and serving the needs of the whole world. There are several aspects of quantum technology in which European countries are highly advanced. Finland, for instance, has profound expertise in developing electronics, superconducting circuits and sensors. This expertise has deepened over decades in quantum and low-temperature physics laboratories, and we already have successful quantum technology companies.

In Finland, we're taking the first steps already. VTT and Aalto University are currently developing Finland's first quantum computer. In the first phase, we are concentrating on expanding the technical capabilities: our aim is a functioning five-qubit quantum computer which will demonstrate our expertise in building quantum computers. The overall goal of the project is to build a much larger, 50-qubit device, by around 2024. We can use this computer to develop new quantum algorithms which can be applied to solve demanding problems in the future. Besides developing a quantum computer, it is important to strengthen quantum technological expertise across the board, from building the computer itself to applying algorithms and quantum computing to solve practical problems. This development will also be supported by the Finnish IT Centre for Science's (CSC) quantum computing simulator.

## What should be done in practice?

The 20–25 million euros invested in Finland to build a quantum computer is only the beginning. In addition to the first quantum computers, we should remember other areas of application: quantum technology sensors are becoming important tools in fields like medical imaging and diagnostics, and quantum technology and quantum-encryption algorithms can be used to protect information networks.

In order to benefit from all this, we need to invest in the best production and research infrastructures. We also need to generate new infrastructures and expertise in quantum algorithms to support quantum computing. In Finland, a national quantum technology research, development and innovation programme should be developed, so that the key data communication and sensor sectors and companies can take advantage of breakthroughs in quantum technology.

**Step 1: Start using quantum computing**
2020–2025: European countries invest in developing and using functional quantum computers. Investment in quantum technology comes from both the private and public sectors. European-level cooperation between centres for research, development and innovation in quantum data communication and sensors is strengthened.

**"If Europe gains a foothold in quantum industrial development, we can grow a new branch of the tech industries worth billions of euros."**

**Step 2: Use it more widely**
2026–2030: quantum computers approach quantum dominance in certain applications. Quantum computers start to be used more widely in various fields of industry. Work on developing quantum data communication and sensors starts to bear fruit: quantum sensors enable new applications, for example, in medical and autonomous machine imaging. Data communications starts to make use of long-range communications protected by quantum technology.

**Step 3: Make Europe a world leader in quantum technology**
In the 2030s, quantum computers are in general use, enabling efficiency savings in production processes for selected tasks such as drug development. Learning from the experience gained in the 2020s, European companies create sufficient expertise in creating quantum technology, and start exporting quantum machines, sensors, data communication components and parts, and collaborating with other international leaders in the field.

By the 2040s, we will be doing such amazing things with quantum computing that they are impossible to predict from where we stand today. I believe, however, that exponential computing power can lead to an exponential leap in productivity, which will enable us to apply the Earth's resources to benefit the well-being of a growing global population. This also means economic growth for Finland and Europe at large, if we manage to create global players on the quantum technology market.

# 3

# Small nuclear reactors make industry carbon neutral

## What makes the field disruptive?

Industrial enterprises are large-scale energy consumers. With existing technologies, it is difficult to produce enough energy for factories without fossil fuels or burning large amounts of biomass. If we want to create carbon-neutral industry, we need new low-emission energy sources. Small modular nuclear reactors are one of the most significant innovations to enable this change.

Small, next-generation nuclear reactors could produce the high-temperature heat that industrial processes demand, without greenhouse gas emissions. Connected to an industrial plant, a small reactor would generate secure, cost-effective, low-emission energy and save precious raw materials which are now burned to provide process heat. Unlike large nuclear power stations, these small reactors could be mass produced. Their smaller size would both help ensure nuclear safety more easily and create completely new applications for nuclear energy.

In addition to direct heat generation, small nuclear reactors can also be used to produce hydrogen, utilising the heat generated in the nuclear reaction. Hydrogen can be produced from pure water using a variety of technologies, and with high-temperature steam, hydrogen cells can be used to produce hydrogen more efficiently than by traditional electrolysis. There is a market for low-emission hydrogen in, for instance in biofuel, fertiliser and steel production, so a cleaner production process will have a significant impact on global greenhouse gas emissions. Using nuclear energy to produce hydrogen locally could be a suitable solution for many large-scale industrial processes.

## Where are Europe's strengths?

Some European countries, such as Finland, have long traditions in using nuclear energy responsibly and safely and with a high level of social acceptance. In Finland the whole life cycle of a nuclear power plant – from the building to the decommissioning of a plant as well as the disposal of nuclear waste – is managed responsibly. European countries also want to find new solutions to make societies carbon neutral and, furthermore, carbon negative in the near future. To achieve these goals, European industry needs secure, cost-effective sources of low-emission energy. In developing solutions for our own industrial needs, we will also develop industrial competence that are valuable on global markets.

The EU has set ambitious environmental targets, and we understand the need for new sustainable solutions. Nuclear energy can be a part of these future solutions, and Europe has the world's most advanced areas in terms of enabling small nuclear reactors. In Finland, The Ministry of Economic Affairs and Employment has a working group to identify the needs for statutory reform, and the Finnish Radiation and Nuclear Safety Authority is preparing its competences to be able to license new types of nuclear reactors. VTT is collaborating with LUT University and Finnish partners to set up a network to develop business related to small modular reactors. The possibility of using nuclear energy in district heating has been under consideration for a few years, and we have kick-started a project to conceptualise a district heating reactor. The aim is to design a district heating reactor, which could be produced by Finnish industrial companies.

While a nuclear reactor generating district heating is possible based on tried and tested solutions, many industrial applications demand higher temperatures, the redesigning industrial processes or large amounts of low-emission hydrogen. Finnish industry has extensive industrial-process expertise and experience in developing high-temperature electrolysis. Combining components of different technologies and making them commercially viable with our industrial partners in industry, we can develop solutions that work to meet industry needs for a low-emission future.

> **"Small, next-generation nuclear reactors could produce the high-temperature heat energy that industrial processes demand, without greenhouse gas emissions."**

## What should be done in practice?

**Step 1: Generate business**
The first step is to generate heat-application nuclear reactor business in practice. Small reactor technology to create district heating is based on existing technology used at nuclear power plants, and represents the low-hanging fruit in new applications of nuclear energy. Using nuclear energy to provide clean district heating is one of the first concrete ways in which we can apply nuclear energy expertise to create new industrial capabilities and low-carbon solutions.

**Step 2: Develop expertise and technologies**
For industrial applications, we need to develop new expertise and technologies such as high-temperature reactors and industrial-scale clean hydrogen production. This is part of the first step towards developing and integrating innovations into a new whole.

**Step 3: Bring it all together**
With the technological expertise needed for industrial production and applications using heat reactors, we can provide sustainable and low-emission solutions to the energy-intensive industrial challenges of the future. By demonstrating how industrial processes are cleaner using small reactors, we can create an export industry for heavy industrial needs.

# 4

# Chemical plastics recycling helps solve one of the world's most severe environmental problems

## What makes the field disruptive?

Every year, around 300 million tonnes of plastic is produced globally, and this number is set to double by 2030. Worldwide, only about 10% of plastic is recycled. A significant proportion of plastic ends up in landfills and the natural environment. This is an enormous global environmental challenge – plastic waste is destroying the world's vital ecosystems. Most countries are still a long way from the EU recycling goal: by 2025, 50%, and by 2030, 55% of plastic should be recycled.

Currently, the majority of plastic recycling is done mechanically, that is, the plastic is recycled as material for new plastic. However, the majority of used plastics is not suitable for mechanical recycling, because a mix of different plastics and the reprocessing through melting creates a low-value product. In addition, the quality of the plastic is weakened through several recycling loops. Therefore, if we want to solve one of the biggest environmental challenges in the world, we also need chemical recycling, a process in which the plastic is broken down into its molecular building blocks. Chemical recycling enables the use of plastic streams which cannot be recycled using existing technology. This helps achieve high plastic-recycling rates and significantly reduces greenhouse gas emissions, as virgin plastic is replaced with recycled plastic.

## What are Europe's strengths?

There are several technologies which can potentially be adapted to chemical plastics recycling. They all break down the polymers that make up the plastic into smaller structural units which can be used to construct new plastic polymers. Two of these highly applicable technologies are biotechnology and thermochemistry – both technologies that are already at an advanced level in parts of Europe.

Using enzymes to break down plastic is an extremely rapidly growing field of research and development worldwide. In Finland, we have decades of experience and expertise in producing enzymes and exploiting them in industrial processes, and we have already used this expertise to break plastic down for chemical recycling.

The same is true of thermochemical processes. Within European research institutes and companies, you can find world-class expertise, experimental capacities and the necessary industrial references from gasification and pyrolysis processes which are ideally suited to chemical plastics recycling. The strength of thermochemical processes is that the input quality can vary and the product – gas or oil – can be refined into a wide range of end products. Europe has the expertise and providers for all these technologies, so this is the perfect place to gain access to a large, global market.

## What should we do in practice?

**Step 1: Improve the performance of technologies**

1. Improve the capability of recycling technologies to handle different feedstocks and turn them into products.
2. Improve the economic viability (investment and implementation costs) and energy efficiency of the technologies to minimise emissions.

**Step 2: Demonstrate**

Work with suppliers in the plastic value chain, to demonstrate the function, product quality and reliability of various technologies. Only then can we prove that these solutions work beyond laboratories and pilot plants and enable the closing of the plastics loop.

**Step 3: Close the plastics loop**

Construct a complete plastics recycling system comprising both mechanical and chemical recycling. In the future, carbon capture technologies can be added to the system, to convert carbon dioxide into a key raw material for plastic.

**"We have particular expertise in two of these highly applicable technologies of chemical recycling: biotechnology and thermochemistry."**

# 5

# Optimising material usage enables sustainable resource consumption

## What makes the field disruptive?

Materials enable all technological development – which is why breakthroughs in materials science resonate throughout industry and society. Materials are the key to developing and implementing a sustainable circular economy.

The problem lies in contemporary materials technology: the biggest breakthroughs in materials have often been made “by accident,” such as an error in the lab leading to the creation of a new material. In addition, it often takes decades for new materials to move from the laboratory to industrial applications. This is too slow if we want to ensure that the Earth’s resources can sustain a growing population and mitigate climate change.

But what if materials development didn’t have to happen through trial and error? The solution is materials digitalisation. We can use digital twins, virtual testing and optimisation to design the materials of the future to be both sustainable (including materials substitution) and high performing at a competitive cost. We used to have to take materials as they were manufactured; in the future, we will optimise them to do what we want them to.

Optimising materials throughout their entire life cycle can be achieved by developing computational materials technology to meet the demands of circular economy. In this way, we can minimise both waste and the use of materials, and maximise product performance, properties and durability. Digital materials development can be used to make the circular economy profitable.

## What are Europe’s strengths?

Why should European countries have the opportunities, the hope, to disrupt our way of working with materials and the circular economy? Traditionally, new materials were developed slowly, which demanded big investments and risks.

The answer is in the transformation of the materials sector; we can be pioneers here, if we act now. Computational technologies are changing our way of developing and researching materials completely. A technologically advanced region that has digitalised early can be one of the best in exploiting the transformation of digital materials for commercial research and development. We have rock-solid expertise in materials science and technology. If we develop and use methods of digitalisation in collaboration with businesses, we can ensure that we are researching relevant fields and that the research will genuinely and rapidly be put to commercial use.

This transformation is giving us computational technologies such as new ways of analysing materials in a multiscale manner and the development of AI-based solutions. Combining physics-based modelling and artificial intelligence makes it possible to discover (yes, discover) new materials and optimise them systematically. In the future, we will improve materials performance and speed up the related R&D processes significantly through digitalisation; this doesn’t just mean ten-percent improvements but improvements in orders of magnitude. We will see breakthroughs in autonomous materials research, combined with and guided by artificial intelligence. Materials manufacturing and testing will then be automated, physical and computational R&D will be combined, so that we can select the best methods to support optimisation, problem-solving and decision-making for real-world problems.

These are all sectors in which Europe currently excels. Because we believe we can collaborate better than our competitors, which is a necessity in future materials science and technology, we are in a good position to lead the materials revolution.

## What should we do in practice?

**Step 1: Make the circular economy systemic**
2020–2025: Europe becomes the leading region to create and utilise digital twins suitable for describing the entire life cycle of materials and products for use in the circular economy. Materials design, its properties, substitution of raw materials, product design, use and lifespan, product reuse, repair, re-manufacture and recycling are all linked on the same digital solution. This enables not only sustainable material solutions, but also systemic exploitation of business potential of the circular economy, giving by industry while integrating R&D competencies extensively. Compared to the current situation, this demands more targeted and ambitious efforts to fully digitalise the materials sector.

**“We used to have to take materials as they were manufactured; in the future, we will optimise them to do what we want them to.”**

**Step 2: Use AI in materials technology**
2025–2030: machine learning using data-based and traditional materials science fuse into a hybrid. AI is used to optimise and discover new materials solutions to meet high performance demands and constraints. Product-targeted materials design becomes routine. The opportunities created by the circular economy will begin to drive businesses forward. Sustainability, materials and product performance and cost are no longer mutually exclusive or contradictory values, but with AI we will identify optimal solutions and completely new alternatives from vast design spaces.

**Step 3: Create materials autonomously**
From 2030 onward: a systemic circular economy and AI-based materials technology are combined with autonomous materials research solutions. We use AI to seamlessly guide the modelling, testing and manufacturing of materials. Physical and computational processes communicate autonomously, maximising the speed of R&D, and enhancing our ability to create new materials knowledge.

# How to accelerate exponential hope

In driving innovation, investors and decision-makers need to take the long view. If we want to create a more hopeful future, we can't just develop what already exists – instead, we need to direct funds into new technology fields that are already starting to show potential. All the aforementioned areas are set to experience radical growth worldwide, even if we don't know when exactly this will happen or who will take the lead in this growth. It is our task to ensure that we seize these opportunities in time and share the benefits from this growth.

Therefore, I propose that we focus on these areas of exponential hope and place them at the heart of national and European innovation policy. This means that we will begin to systematically and decisively build new innovations and business activity in these sectors. And when I say build, I mean it also literally. Developing new technologies requires space and investment: laboratories, pilot plants, experimental facilities – research environments which European companies can use to develop and scale up new innovations. Additionally, in many sectors such as plastics recycling and food biotechnology, we need to cut through legal red tape.

Thus, I hope that at this historic juncture our decision-makers invest not only in stimulus packages that help existing industries and structures recover, but also in accelerating these new areas of exponential hope. Some investments have of course already been made, and they are a great start. But we need more to generate new start-ups and growth businesses in all of these sectors. A completely new way of doing business and research requires governments to share the risk and help companies make the necessary investments. The price tag does not need to be huge, especially if you take into consideration that investing in these fields can lead to exponential profits.

Whether in forestry innovations or electronics, Finland's success has always been founded in high-level expertise and exploiting new technology fast. The same goes for Europe as a region. Now, we should use the momentum to find new areas that play to our strengths and create long-term well-being. We've disrupted the world before. We can do it again. Let's start today.

**Antti Vasara**
President and CEO, VTT

**VTT's President and CEO Antti Vasara has decades of experience in leading Finnish technology companies such as Nokia and Tieto. He holds a Doctor of Technology (Technical Physics) degree from Helsinki University of Technology.**

VTT is a visionary research, development and innovation partner. We tackle global challenges and turn them into opportunities for sustainable growth. We help society to develop and business to grow using technological innovations – we think beyond the obvious. We have almost eighty years of experience in cutting-edge research and science-based results. VTT is at the sweet spot where innovation and business come together.

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**Acknowledgements:** Huomo Tua, Laukkanen Anssi, Manninen Jussi, Nordlund Emilia, Paakkari Jussi, Pursula Pekka, Turunen Erja, Tulkki Ville

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