



# VTT Review 2013



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The research examples presented in this review represent only a small fraction of VTT's activities, although they do provide some idea of the many and varied ways in which VTT's know-how influences technical development in Finland.

# President & CEO's review



**MAJOR STRUCTURAL CHANGE  
IN BUSINESS LIFE CALLS  
FOR AGILE INNOVATION.**

A number of challenges confront Finland's research and innovation policy. Powerful structural change in key areas of our business life is demanding agility, wisdom and impact from our innovation activities. One thing is clear: measures taken by the public sector alone will not be enough to secure the competitiveness of our industry. While acknowledging that various policy actions will have a role to play, development must involve symbiotic interaction between training, research and innovation activities and the companies concerned. Regrettably, the cuts in public sector costs are threatening investment in innovation. This may compromise any improvement in our competitiveness.

Political decisions to cut technological research activity reveal a change in thinking over the past ten years. The changes to industry structure have dented belief in the impact of innovation activity. Why should we invest taxpayer's money in something that is anyway unable to prevent our export industry from disintegrating? Why doesn't the large additional investment in university reform in recent years produce quality results? These are justified questions. The world of research must find answers to them.

VTT is ready for the challenge. The reform of our organisation that came into effect at the start of this year is an excellent response to the new way of thinking demanded by the change. The Horizon 2020 programme, with its broad aim at the future development of all EU industry, presents VTT with an outstanding opportunity. What we need now is even more systematic thinking, more innovative combinations of different competences, to make

sure we make an impact. Top research and scientific publications won't take business competitiveness forward by themselves – emphasis more than ever must be on cooperation between VTT and the universities.

The hard times of recent years have also been felt at VTT. These are not the temporary economic fluctuations of earlier times, when the natural response would have been to invest in the future. This time, the difficulties are not going away so easily, and we seem to be losing heart. Too many of our entrepreneurs harbour doubts about the future – we see this in the lack of enthusiasm for developing future competitiveness. It is time for VTT to react, and this we have done, by focusing on our own operations. Our view of the future is nonetheless positive. Our cooperation with the world of business will help little Finland to rise again! We intend to reignite belief and enthusiasm in innovation, among companies and decision-makers alike.

VTT's renewal will continue. This year will see the conclusion of VTT's corporatisation as a fully state-owned, not-for-profit limited company with special duties. There will be a significant improvement in our operational dynamics, and this will help us to react to changing global challenges.

VTT's success is founded on its competent, motivated and inspired personnel. Our objectives would remain out of reach, however, without our cooperation partners. I would like to thank all of you for your contribution to VTT's continuing success!

Erkki KM Leppävuori  
President & CEO

# Technology for business



**36%** OF FINNISH  
INNOVATIONS INCLUDE VTT  
EXPERTISE. (\*)

**50%** OF THE MOST DEMANDING  
INNOVATIONS IN FINLAND INCLUDE  
VTT EXPERTISE. (\*)

\*) SOURCE: ROLES, EFFECTIVENESS, AND IMPACT OF VTT, VTT +  
TECHNOPOLIS GROUP, 2013.

VTT is helping to shape the future by creating smart technologies, profitable solutions and innovative services. We are pointing the way to greater efficiency and productivity through new technologies. Our world-class research provides solutions for current and future business needs, supports structural change in industry and responds to the great challenges facing the whole of society.

VTT's research is driven by three key areas of Finnish business life: the digital world, natural resources and manufacturing industry. Our research focuses on bioeconomy, cleantech, low-carbon economy, resource-efficient production, health and well-being solutions and the smart products and services made possible by digitalisation. These focus

areas also offer our customers a host of new business opportunities.

Our service covers the entire innovation process, from idea through to commercialisation. Technology and business foresight services help to identify and manage future directions and challenges and to target development resources. Strategic research helps us to create the platform for a company's new products, services and business operations and to ensure that the technologies are compatible. Our customers can also complement their technology portfolios with ready-made intellectual property and obtain unique competitive advantage with applications based on protected technologies. Assessments, testing, inspections



# VTT IMPACT: CLEAN WORLD, SUSTAINABLE ECONOMY, GOOD LIFE.



and certification ensure that production, products and processes are suitable for the intended markets, users and authorities. If required, our experts will also participate as partners in technology and innovation management.

Extensive national and international cooperation and networking helps us to ensure the efficient transfer and utilisation of information and technology.

According to the 2013 customer survey, our customers were successful in attaining their objectives through their VTT projects: 78% said that the project results generated new or improved products, services or processes; 57% adopted an entirely new technology as a result of the project.

## **Mission**

VTT produces research services that enhance the international competitiveness of companies, society and other customers at the most important stages of their innovation process, and thereby creates the prerequisites for growth, employment and well-being.

## **Core values**

- Together for the client
- One step ahead
- Passion for innovation
- Support and respect to the core

# ICT, electronics

Mobile phones sold in 2013 totalled 1.8 billion units, 3.5% up on last year, with smart phones accounting for 53% • Samsung led the way with a market share of 22%, followed by Nokia at 19% and Apple at 8% • Delivery of tablet computers was expected to increase by 38% over last year to 200 million units in 2013 • The production value of flexible displays was estimated to increase to USD 36.8 billion by 2020 • Yields for the global semiconductor industry were anticipated to rise more than 6% in 2013 to over USD 320 billion.



# IOT - UNITING THE PHYSICAL AND VIRTUAL

"BEAUTIFUL DAY" ANNA THOUGHT TO HERSELF, BARELY AWAKE, FEELING THE LIGHT THROUGH HER EYELIDS. SHE OPENED HER EYES TO A ROOM ABLAZE WITH SUNSHINE, REFLECTIONS FROM THE NEARBY LAKE, GREEN GRASS, AND BLUE SKY. SHE SENSED A SMALL CLOUD MOMENTARILY HIDE THE SUN, BUT THEN PASS, LETTING WARMTH AND LIGHT FILL THE ROOM AGAIN. THE WAVES ON THE WATER AND THE MOVEMENT OF THE LEAVES AND GRASS IN THE WIND KEPT THE LIGHT ALIVE. "WHAT'S UP?" SHE ASKED. THE SUN SEEMED TO MORPH BACK INTO A CLOUD AND NEWS HEADLINES APPEARED ON THE WALL. "MORE SNOW?" SHE THOUGHT. "ENOUGH", SHE SAYS. "WHO'S UP?"

SHE GAZES AT SOME BLOBS OF PURPLE LIGHT ON THE FLOOR TOWARDS THE LIVING ROOM AND, AFTER LISTENING FOR A WHILE, HEARS HER DAUGHTER MOVING DOWNSTAIRS. PURPLE IS HER DAUGHTER'S FAVOURITE COLOUR, NOW THAT PINK IS NO LONGER "IN". TURNING HER HEAD SHE SEES A WARM BLUE GLOW ON THE DESK. "OH, PETER'S STILL AWAKE."

SHE REACHES FOR HER PHONE AND ASKS IT TO PLACE A CALL TO HER HUSBAND. PETER'S FACE APPEARS ON THE WALL. A BEAUTIFUL CALIFORNIAN SUNSET FILLS THE ROOM. "HELLO DARLING. HOW WAS THE CONFERENCE?"







## KEEPING IMAGES MOBILE WITH INTOUCH

VTT has developed a technology whereby a ring, artificial fingernail or wristband acts as a user interface, allowing files to be transferred directly from one screen to another by touch. The new technical solution is the first step towards the interactivity of various objects and jewellery through a cloud service.

The solution developed by VTT allows files to be received, sent and shared more easily than before. You can touch a file on one screen, for example, with an add-on fingernail and transfer it through the nail to your friend's cellphone. This emphasises intuitiveness and interactivity. Consumers will find the new InTouch user interfaces easy to use and interoperable in the world of digital devices and objects.

The new concept also enables entirely new kinds of interactive devices and product categories and generations, giving rise to new business opportunities. Areas of application might include digital devices, cars, the manufacturing industry, logistics and health care. A patent application has been submitted.

The bulk of data transfer between devices is currently handled using memory sticks, short-range point-to-point connections (Bluetooth, for example) or the cloud (sharing services).

The InTouch user interface operates with touch screens and conforms to the NFC standard. InTouch allows file transfer either directly or via a cloud service.

Security and privacy are retained through the integrated security functionality.

### Further information

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## TURNING DEVICES INTO HELPERS WITH SMART INTERFACES

VTT recently coordinated the pan-European initiative SMARCOS, which focused on developing technology based on internet sharing between devices. The technology allows the interfaces of various smart devices to follow consumers' actions and react instantly to their needs. In the kitchen, for example, a smart stove, saucepans, spice rack, ingredient containers and a smart recipe service are able to follow and predict the consumer's actions and needs and help him or her to choose the right ingredients and cooking processes.

The European SMARCOS (Smart Composite Human Computer Interfaces) project developed technology based on internet sharing between devices, which allows the interfaces and features of various digital devices to operate seamlessly together in smart ecosystems.

The physical interface remains unchanged, but there is improvement in the intelligence and functionality of the user interface level. The functions of an interface respond more accurately to users' needs when devices, services and applications are able to follow and predict the users' actions. This can be used, for example, to help elderly people lead more independent lives and cope with daily household chores in their own homes.

Interfaces can be distributed among devices and surfaces and therefore help users to run their households more efficiently. An example of a system already up and running is a smart recipe service for the kitchen. The service is linked to kitchen appliances, tableware and containers of ingredients equipped with simple interactive technology. A minimalist interface prototype for controlling household energy consumption was developed with Offcode Oy.

Another example is the healthy living service operating on all the user's digital devices (mobile devices, TVs, car, computers, activity monitors). A real-time behaviour monitoring service controls when and through which device the user can be given information, reminders and

encouragement. The service interacts with systems that encourage consumers to exercise, remind them to take their medication and help them to educate themselves.

In addition to VTT, other Finnish SMARCOS partners included Valve, IXONOS, Offcode, Nemein and Nokia. Foreign partners included Barco (BE), SIRRIS (BE), Human Interface Group (BE), Philips (NL), TP-Vision (NL), University of Twente (NL), EVALAN (NL), Phi-I (NL), Indra Sistemas (ES), ESI (ES), Honeywell (CZ), Fjord (UK), Intecs (IT) and CNR (IT). The project budget was approximately EUR 14.2 million, financed by the ARTEMIS Joint Undertaking and local public sector funding.

Watch the VIDEO Context and task monitoring assisted cooking: [http://ca.vtt.fi/resource\\_center.html](http://ca.vtt.fi/resource_center.html)

#### Further information

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### SYSTEM TO DETECT SLIP

**An automatic road grip detection system developed by VTT helps drivers avoid personal injuries and damage to vehicles in slippery road conditions. The system ensures that the vehicle receives rapid advance information about the actual level of surface grip, and gives immediate warning to other vehicles arriving in the area.**

Information to be relayed to vehicles concerning low road grip has previously been tested using SMS, for example, with warnings based on estimations derived from



meteorological information and other sources. The new system allows direct observations of surface grip levels in real time.

Road grip detection is based on a method developed and patented by VTT, in which detection of real-time changes in the level of grip are based on measurement information supplied by the vehicle's own sensors. The system is able to determine low levels of grip after a distance of a few kilometres and to relay the information to the driver, often before he or she is aware of any change in road conditions.

All observations, including coordinates, collected from vehicles are relayed wirelessly to a back-end system that maintains a real-time road grip map and generates an overall picture of the grip levels in the road network. Packages of road grip information, tailored to each vehicle, are produced and relayed by the back-end system to all vehicles connected to the system. This allows drivers to prepare themselves for slippery stretches of road ahead.

The system developed by VTT is suitable for all makes of vehicles. Up to now the system has been applied to heavy goods vehicles, but is also directly applicable to other types of heavy vehicle, and in future also to private cars. Later on, the system can be extended to benefit from road grip observations collected from private cars.

The functionality of the method has been verified in field trials with Itella Logistics (formerly VR Transpoint groupage logistics), EC-Tools Oy and Nokian Tyres plc. VTT is currently negotiating commercialisation of the system.

#### Further information

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### ONLINE SENSE OF SNOW

**VTT's sensor solutions can be used to follow the build-up of snow on power lines in real time. Considerable cost savings and improved reliability are expected, as problems can be anticipated and remedial measures taken in a systematic manner.**

Monitoring of the build-up of snow loads was previously carried out using helicopters. Efficient forecasting of maintenance needs can now be achieved by placing sensors at critical points along power lines. Snow load build-up can be monitored in real time through a web-based service.





Benefits include more systematic targeting of corrective measures, reduced line damage and prevention of cuts in the electricity supply.

The sensors are based on a new technology patented by VTT in Russia, Canada and the United States, as well as in the EU. The method combines wireless data transfer, energy self-sufficiency measurement and real-time online data transfer, in a compact and easily installed package. The device is built in to the aerial marker ball generally used with power lines, which means that installation engineers already possess the necessary tools and installation method.

The solution is now being tested by E.ON Kainuun Sähköverkko Oy in the Kajaani area.

#### Further information

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## GAS SENSORS ON THE MOVE

**Gas sensors developed in a European project now enable industry to produce considerably cheaper and smaller measuring devices. Speed and sensitivity are as good or even better than that of current laboratory-grade devices.**

Sensitive, portable measuring devices can be used to detect trace gas in the environment. There are a number of potential applications for the technology, for example in health care and air pollution monitoring. The technology can be used in the security sector for preventing terrorism and monitoring workspaces.

Two devices were constructed under the MINIGAS project, one capable of detecting extremely low levels of methane in the air, and the other of measuring rapid changes in carbon dioxide and water vapour levels as part of challenging research into climate change. The performance of these portable measuring devices matches that of existing laboratory-grade products.

VTT's role in the project was to develop LTCC packaging and integration technologies suitable for miniature optical sensors.

Several measurement technology companies are preparing to start production based on the new technology. Furthest advanced is Finnish-based Gasera Ltd, which already uses the parts developed in the project in its current gas sensors. The company hopes to be selling new products based on the technology within three years. Measurement device suppliers Selex (Italy) and Dräger (Germany) and LED component developer and manufacturer IOFFE (Russia) are also planning to launch new products in the next few years.

#### Further information

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# Forest, energy, chemistry, environment

At the end of 2012, 14% of the production capacity for electricity in the USA was based on renewable energy, while renewables already account for 56% of all new capacity • Annual global production of paper in 2012 equated to 400 million tonnes, with 23% produced in Europe • Energy costs include 16% paper industry costs, with 56% of paper industry energy formed of bioenergy • Paper fibre in Europe is recycled 3.5 times, while recycling of paper and cardboard packaging reaches 81%.



# PAVING WAY FOR THE BIOECONOMY AND SUSTAINABILITY

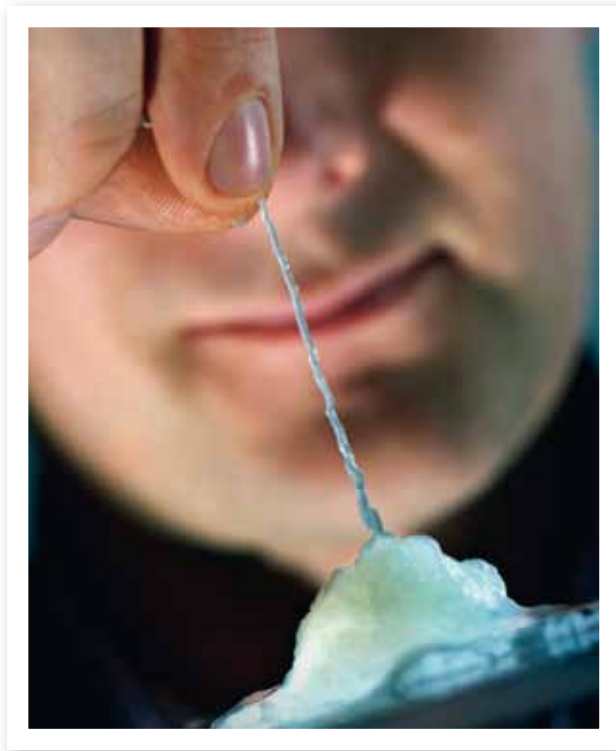
MIKE AND MARIA ARE LOOKING FOR A NEW HOUSE. THE VIRTUAL AGENT HELPS THEM FIND A CONVENIENTLY LOCATED HOUSE, ALLOWING THEM TO USE PUBLIC TRANSPORTATION WHEN COMMUTING BETWEEN THEIR HOME AND THE OFFICE.



THE AGENT ALSO PROVIDES DETAILS OF THE ENERGY RATING AND EMISSIONS OF THE BUILDING, AFFECTING THE LEVEL OF THE SUSTAINABILITY PROMOTION TAX THAT WAS PASSED BY PARLIAMENT A FEW YEARS EARLIER TO PROMOTE ENERGY-EFFICIENCY AND THE USE OF RENEWABLE ENERGY IN THE COUNTRY.

THE HOUSE IS EQUIPPED WITH ELECTRIC HEATING, BUT THE AGENT PROVIDES MUCH INFORMATION ON ALTERNATIVE ENERGY SYSTEMS, SUCH AS HEAT PUMPS, WOOD, AND SOLAR AND GEOTHERMAL ENERGY, THAT COULD ALSO BE USED FOR HEATING AND LIGHTING. THERE IS EVEN A VIRTUAL ENVIRONMENT CREATED AROUND AN EXERCISE BIKE. THE BIKE ALSO GENERATES THE ELECTRICITY FOR THE SYSTEM. FURTHER ELECTRICITY CAN BE STORED AND USED TO POWER OTHER HOUSEHOLD DEVICES.





## FINLAND A FORERUNNER IN CELLULOSE-BASED DESIGN PRODUCTS

The combination of strong design competence and cutting-edge cellulose-based technologies could soon result in new commercially successful brands. VTT, Aalto University and Tampere University of Technology have launched an extensive cellulose-based design product research project aiming to create new business models and commercial ecosystems in Finland.

The joint research project is called Design Driven Value Chains in the World of Cellulose (DWoC). The objective is to develop cellulose-based products suitable for technical textiles and consumer products. The technology could also find use in the pharmaceutical, food and automotive industries. Another objective is to build a new business ecosystem and promote spin-offs.

The project combines Finnish design competence with cutting-edge technological development, and makes use of the special characteristics of cellulose to create prod-

ucts that incorporate the best qualities of materials such as cotton and polyester. Product characteristics, achieved by using new manufacturing technologies and nanocellulose as a structural fibre element, include recyclability and one-off production.

VTT has developed an industrial process that produces yarn from cellulose fibres without the spinning process, as well as efficient applications of the foam forming method for manufacturing materials that resemble fabric. A future combination of these methods will enable the efficient production of individual fibre structures and textile products, even with 3D printing.

Projects are currently under way with the objective of replacing wet spinning with extrusion technology. The purpose is to develop fabric manufacturing methods that replace several stages of weaving and knitting without losing key characteristics, such as the way the textile hangs.

The current share of textile industry raw material taken by regenerated cellulose fibres is a meagre six per cent. By regenerating Finland's current logging surplus (25–30 million cubic metres/year) into fibre, equating to approximately 5–6 million tons, it would be possible to replace 20% of the world's cotton. A corresponding fall in cotton production would reduce carbon dioxide emissions by 120–150 million tons, and free farming land to grow enough food to feed 18–25 million people. Desertification would also be decreased by approximately 10 per cent.

### Further information

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## ETHANOL TECHNOLOGY TO BRAZIL

**VTT exports its expertise as a developer of biomass processing technology to Brazil. Odebrecht, a conglomerate and one of the southern hemisphere's largest enterprises, is making preparations for second generation ethanol production, and plans to construct a demonstration plant.**

VTT makes use of its experience in biomass processing technology in developing the Brazilian sugar cane biomass processing industry. VTT's research centre in Brazil has been granted BRL 10 million (about EUR 3.8 million) in funding by the PAISS programme, for the development of technology for Odebrecht's demonstration-scale plant.

The development project aims at combining cellulose-based second generation ethanol production with first generation ethanol production, and integrating these with the production of electricity.

PAISS, the funding provider, is a programme established by the Brazilian Development Bank BNDES and Studies and Projects Finance Organisation FINEP to stimulate the reform of the sugar-based energy and chemical sectors.

Established in 2010, VTT's Brazilian research centre cooperates with local companies and universities, and with Finnish companies operating in Brazil, in the use of biomass as a resource for the production of chemicals, energy and cellulose-based products.

#### Further information

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## FORESTRY RESIDUE NOT FOR WASTING

**Research by VTT shows that lignocellulosic biomass can be used in the production of high-quality biofuels for the price of less than one euro per litre. New technologies developed in Finland allow transfer of more than half the energy of wood raw materials to the end-product.**

Transport fuel can be produced efficiently from forestry residue using a method developed in Finland based on pressurised fluidised-bed gasification. Production of renewable biofuels from lignocellulosic biomass, mainly forestry residue derived from regeneration felling and thinning, could achieve an energy-efficiency rate of 50–67%, depending on the end-product and process conditions. Should the thermal energy produced as a by-product be exploited for district heat or industrial steam, for example, the total efficiency rate of biomass use could reach 74–80%. Besides oxygen gasification technology for big production plants, VTT is developing a new more cost-efficient process suitable also for smaller production plants. This will help the commercialisation and introduction of the new technology into industrial use.

In addition to gasification methods, VTT has developed pyrolysis technology for production of biofuels. VTT and the US firm PNNL (Pacific Northwest National Laboratory)

have joined forces to seek solutions to the biggest processing challenges: high hydrogen consumption and catalyst deactivation. Hydrogen consumption and production costs are reduced throughout the production chain with the aid of AspenPlus™ simulation software and through development of the hydrogenation process.

The process involves bio-oil, produced using boilers in the forest industry or in district heating, being transported to an oil refinery to be processed alongside other oil types. The particular advantage of the new gasification method lies in allowing phased growth of production capacity, reducing the risk for entrepreneurs investing in the value chain.

Finland is a forerunner in the commercialisation of lignocellulosic biomass pyrolysis technology. Metso built a plant for Fortum at Joensuu which will have an annual bio-oil production of 50,000 tonnes. Metso, UPM and VTT cooperated in developing the new technology, the research forming part of Tekes' Biorefine programme. During the first phase, the bio-oil will be used in district heating boilers to replace fossil fuels.

Fortum received the international Special Award for Innovation at the Global District Energy Climate Awards Gala for its plans for combining the bio-oil plant under construction at Joensuu with the existing CHP system and district heating network.

VTT was awarded by EARTO, the European Association of Research and Technology Organisations, for the breakthrough work in the development of technology combining pyrolysis and fluidised-bed gasification in 2012.

#### Further information

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## WOOD-BASED DIESEL HITS THE ROAD

**In the spring of 2013, UPM, VTT and VV-Auto Group began the first field tests of wood-based renewable diesel. The biofuel is produced by UPM, fleet tests run by VTT and the cars provided by VV-Auto Group.**

UPM BioVerno diesel has previously been studied in short-duration engine and vehicle tests conducted by VTT and others. The field tests are carried out to determine the longer-term effects of UPM's renewable diesel on the car's engine, emissions and fuel consumption.

The field tests are a part of a larger project coordinated by VTT. The goal of this project is to encourage companies to commercialise renewable energy solutions for transport.

The car chosen for the tests is the Volkswagen Golf 1.6 TDI equipped with DSG automatic transmission.

VTT's experienced test drivers drive UPM BioVerno cars mostly within the Helsinki metropolitan area and collect data for analysis over a distance of approximately 20,000 kilometres.

A long-duration material test involving fuel system specific materials is also part of the project to ensure compatibility of the fuel with cars and refuelling equipment.

UPM's renewable diesel, known as UPM BioVerno, is an innovation that will reduce traffic-induced greenhouse gas emissions by up to 80% compared to fossil fuels.

This high-quality biofuel is produced from forest industry residues, and excludes materials that would otherwise be available for food production. UPM BioVerno is suitable for all diesel-powered vehicles.

In 2012, UPM began construction in Lappeenranta of the first biorefinery in the world to produce wood-based renewable diesel. Due for completion in 2014, the refinery's annual production capacity will be 100,000 tonnes, equating to 120 million litres of renewable diesel.

### Further information

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## ENZYMES CREATE ETHANOL FROM HARVEST RESIDUE

**Coordinated by VTT, the DISCO project has developed powerful enzymes that accelerate plant biomass conversion into sugars, and further into products such as bioethanol.**

Results of the mainly EU-funded DISCO project include lignin-tolerant enzymes and enzyme cocktails for processing spruce, straw, corn cob and wheat bran.

The project produced new knowledge on the inactivating property of lignin, helping scientists to develop enzymes with better lignin tolerance. New information on enzymes and activities that break down hemicellulose – vital for the efficient exploitation of plant biomass – was also obtained during the project.

British scientists participating in the project determined the structural characteristics of various raw materials. This information can be used to select appropriate enzyme cocktails for raw materials when upgrading plant biomass.

VTT's scientific role related to discovering and developing enzymes from environmental samples and culture collections.

The Dutch company Dyadic is currently commercialising the enzymes developed in the project.

### Further information

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# Well-being, food, pharmaceuticals

R&D costs in the European pharmaceutical industry were estimated at approximately EUR 30 billion in 2012 • The USA's share of global pharmaceutical sales in 2012 was approximately 41%, with Europe taking 27% • Development costs for a single new chemical or biological component were estimated to be approximately EUR 1.1 billion • Profits for electronic services in the USA's health and well-being markets were expected to grow from the present level of USD 2 billion to USD 8 billion by 2018.



# HEALTHCARE AND SERVICES UP, CLOSE AND PERSONAL

THE YEAR IS 2020, AND LEILA IS A TYPICAL 70-YEAR-OLD. SHE HAS LIVED WITH TYPE 2 DIABETES AND HIGH BLOOD PRESSURE FOR THE LAST TEN YEARS. WITH LIFESTYLE CHANGES AND MEDICATION SHE HAS ATTAINED A GOOD BALANCE OF TREATMENT WITH HER CHRONIC DISEASES AND LOST 15 KILOS IN WEIGHT.

SHE FEELS EMPOWERED BY THE NEW MUNICIPAL HEALTH CARE SYSTEM, WHICH PROVIDES PATIENTS WITH TOOLS TO MONITOR THEIR WEIGHT, PHYSICAL ACTIVITY, SLEEP, NUTRITIONAL LEVEL, MEDICATION, BLOOD PRESSURE AND GLUCOSE LEVELS. VARIOUS EMBEDDED SENSORS ENABLE THE COLLECTION OF DATA, WHICH IS STORED IN AN INTEROPERABLE DATABASE. THE SERVICE, MY HEALTH TIMELINE, COLLECTS INFORMATION AND GIVES MOTIVATING ON-LINE FEEDBACK AND TIPS FOR PATIENTS' HEALTH MANAGEMENT.

LEILA CAN KEEP IN SECURE CONTACT WITH HER NURSES, DOCTORS AND SUPPORT PEER GROUP VIA THE SERVICE. SHE CONTRIBUTES 10 EUROS PER MONTH TOWARDS THE SERVICE AND THE REMAINING COSTS ARE COVERED BY HER HOME TOWN.



## BIOMASS TO FEED THE FOOD FACTORY OF THE FUTURE

**Further progress in bioeconomy – the sustainable use of renewable natural resources – requires the food industry to re-evaluate the way it uses raw materials and to network with other industries. A sizeable portion of prime food ingredients currently ends up as animal feed or landfill.**

Sustainable use of renewable natural resources, and the manufacture of high added value products such as food, forms the core task on the road to bioeconomy. Changes relating to bioeconomy are given high priority in the objectives of both Finland and Europe.

Bioeconomy concerns the birth of a future industry created out of biomass processing. Resource efficiency, maximisation of value added, recycling, tight integration with energy



production, and a capacity for cross-sector innovation, are all characteristic of the sector.

Bioeconomy presents a challenge to cross-technological cooperation within industry. New kinds of value network will be generated through the blurring of industry borders, with companies in the food industry intensifying their cooperation with machinery manufacturers, chemical companies, energy and logistics experts, and others.

General obesity and lifestyle diseases demand a re-evaluation of the raw materials that make up food. A sizeable portion of prime food ingredients currently ends up as animal feed or landfill. With food, we have learnt over previous centuries to clean the raw materials of several of their constituents, but in doing so have removed many that are vital for our health.

Food industry development work on new value chains, business models and production processes forms part of VTT's Bioeconomy Transformation spearhead programme. Research focuses on development of plant-based foods, new fibre-rich products, biochemicals and packaging materials.

### Further information

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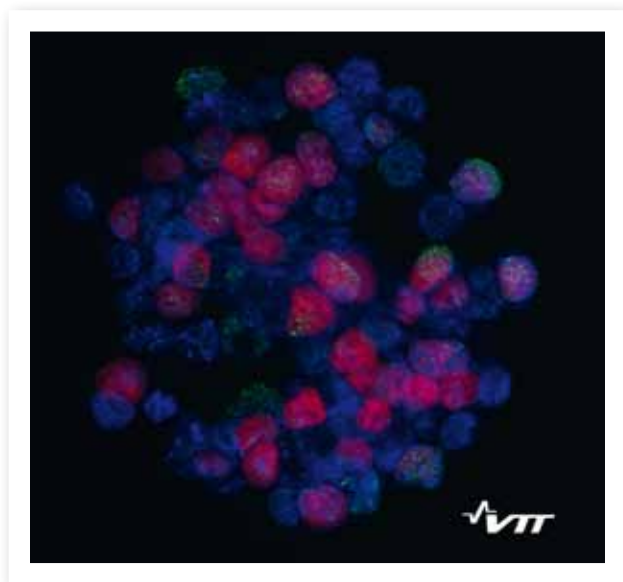
## NEW APPROACH TO CANCER CELLS

**Cancer cells have an exceptional ability to repair damage to their DNA caused by uncontrolled cell division. These findings result from application of a cell micro-array screening method developed by a VTT research scientist.**

Research scientists have now unveiled the mystery of the cancer cell DNA repair mechanism that explains the mechanistic changes in the genetic code of cancer cells. The new findings explain why cancer cells, unlike normal cells, fail to die as a result of DNA damage, and how this mechanism causes new genetic mutations in cancer cells. This new information directly benefits cancer research. In understanding the repair mechanism, scientists are now better equipped to develop drug therapies that stop the spread of cancer.

The genes that participate in the DNA repair mechanism were discovered by Juha Rantala, Senior Scientist at





VTT, and Thanos Halazonetis, Coordinator of the EU-funded GENICA (Genomic instability in cancer and pre-cancer) project, using the cell microchip screening method developed by Rantala in 2010. Based on gene silencing, the method allows a single microchip to screen simultaneously the functions of tens of thousands of genes. The research, with its notable impact on cancer drug development, was published in Science magazine in December 2013.

#### Further information

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## SELF-CARE WITH A SMARTPHONE

**The Oiva smartphone intervention programme, developed by VTT and the University of Jyväskylä, alleviates stress and improves the quality of life. Electrical aids also assist in the care of diabetes patients.**

The Oiva intervention programme is designed for use on smartphones and based on Acceptance and Commitment Therapy (ACT) that has proven effective in cases of work stress and depression. Oiva is the first smartphone application to be based on ACT. The 46 exercises in Oiva are selected from ACT programmes and modified so that most last just 2–3 minutes and fit easily into the daily routine.

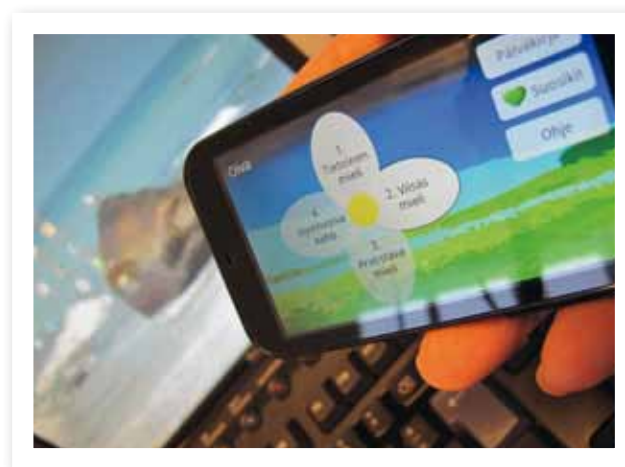
Oiva's methods target improved mental well-being, and are therefore widely applicable, for example in alleviating symptoms of stress, mild depression or anxiety, or difficulty in sleeping, and for effecting changes in exercise or eating habits. The programme offers its users four intervention modules or 'paths' that teach awareness, acceptance of thoughts, recognition of personal values, and skills relating to physical activity and relaxation. Users can either read or listen to the exercises.

Oiva's specification benefited from VTT's expertise in mobile and wellness technologies. VTT led the design of the user interface and implemented the application, and is also responsible for research on user experience. The University of Jyväskylä's Department of Psychology is responsible for research into the application's impact on psychological well-being.

Sipoo Health Centre has experienced good results under the Care4Me project with regard to self-care among patients with Type 2 diabetes, in which VTT led research into self-care assisted by electrical aids. Patients took measurements at home and used their mobile phones to enter the results in the patient record system. Self-care and monitoring appears to work well for patients with access to professional help, an electronic self-care account, automatic reminders and a mobile phone.

#### Further information

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# Machines, vehicles, materials

Sales of cameras for industrial computer vision applications totalled 1.2 million in 2012, with the sales value expected to rise to USD 2 billion by 2018 • Industrial machine-to-machine communications is forecast to grow at an annual rate of 22% to reach USD 18 billion by 2022 • Over 60% of the world's icebreakers are built in Finland, along with approximately 40% of vehicle ferries • Sales of electric vehicles in the USA practically doubled in 2013 – 96,000 vehicles – compared to the previous year.



# ECO-EFFICIENT MACHINES AND RESOURCE-EFFICIENT PRODUCTION

PETER HAS HAD A LONG CAREER. AS AN OLDER PROFESSIONAL, PETER IS A GOOD REPRESENTATIVE OF THE AGEING EUROPE. HE IS STILL WORKING ALTHOUGH HE HAS ALREADY TURNED 65. PETER WORKS FOR EUROMAN, A GLOBALLY OPERATING MANUFACTURING COMPANY HEADQUARTERED IN ITALY.

IT MANUFACTURES AND SELLS HIGH-END DRILLING MACHINES FOR THE MINING AND EXCAVATION INDUSTRY, AND IT ALSO PROVIDES A RANGE OF SERVICES FROM REPAIRS TO OPERATION SUPPORT. PETER CAN DO THE SERVICE WORK REMOTELY BY CONTROLLING MAINTENANCE ROBOTS FROM HIS HOME OR OFFICE.

THEY USE, FOR EXAMPLE, REMOTE DIAGNOSTICS, ARTIFICIAL INTELLIGENCE BASED ON NEURAL NETWORKS, AUGMENTED REALITY, LIGHTWEIGHT HEADMOUNTED DISPLAYS, AND DATA GLOVES. KNOWLEDGEABLE WORKERS, STATE-OF-THE ART PRODUCTS, EFFECTIVE TOOLS AND PROCESSES, AND A PROFOUND UNDERSTANDING OF THEIR CUSTOMERS' BUSINESS ENVIRONMENT HAVE ENABLED WORLD-CLASS SERVICE BUSINESS THAT HAS MADE EUROMAN A MARKET LEADER IN ITS FIELD - AND NOT ONLY THE MARKET LEADER BUT ALSO SUSTAINABLE.





## GRAPHENE – A STRONG AND FLEXIBLE ALL-ROUNDER

The graphene initiative coordinated by Sweden's Chalmers University of Technology has been chosen as the second of the EU's FET flagship projects. The graphene flagship has been allocated funding of one billion euros over ten years. VTT has a significant role in a work package concentrating on development of flexible electronics.

Graphene, a layer of carbon the thickness of one atom, is one of the hottest topics in material science, and the subject of intensive investment by the EU through its flagship scheme. The main aim of the project is to transfer graphene from the research laboratory to the commercial product. The research effort covers the entire value chain from materials production to components and system integration.

VTT's focus in the project is on graphene processing, device development and characterisation, and on implementation of demonstrators. Development work also covers graphene-based flexible energy solutions, antennas, sensors, transparent conductors and energy storage components. VTT's partners in the work package are Nokia, STM, LETI, CNR, Graphenea, Varta, the University of Cambridge and the University of Lille.

The existence of graphene was scientifically proven in 2004 and research into the material is just taking its first steps. Graphene's characteristics are top notch: extremely strong, flexible, thin and transparent, and electrically highly conductive. With a palette this generous, the sky is the limit when it comes to application development. The first graphene-related products on the market are estimated to be sensors, sports equipment and flexible electronics. A few decades of development work may even see graphene replacing silicon.

### Further information

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## 3D-PRINTABLE PRODUCTS GO OUT INTO THE WORLD IN BITS

3D printing is moving forward in leaps and bounds, and changing the world with its new applications. Major beneficiaries are the consumer products, aircraft and car industries, accompanied by widespread medical applications. VTT is testing with Sandvik and other companies 3D printing of equipment parts.

VTT is convinced by the business opportunities offered by 3D printing. The technological benefits are most obvious in small series manufacturing. Countries with industry of this type, such as Finland, are well placed to benefit from adopting the new technology. 3D printing allows considerable freedom in component design, enabling a completely new kind of products that are lighter and more effective.

The advantages of 3D printing are delivery of customised products that match the customer's needs, lighter structures, and the manufacture of even near-impossible objects at no extra cost. The technology allows spare parts for broken machinery and production equipment to be printed out on the other side of the world if required. The logistics chain after the design stage consists largely of a bit transmission at the very time the object is needed, bringing consequent savings in transport and warehousing.

The size of the printable objects depends on the methods and materials used, but above all on the needs of the customer. Printing occurs layer by layer, controlled by a digital model. The current maximum size of an object printed with the directed energy deposition technique is



0.9 x 1.5 x 0.9 metres, for example. Development of the technology aims at the printing of ever larger objects, with entire houses in view at some point in the future.

#### Further information

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## FROM PEAT FIBRE TO BIOCOMPOSITE

VTT has developed methods for processing the most rapidly renewable surface layer of peat, instead of using it for energy production. Bio-based composite materials containing peat fibre, for example in the manufacture of consumer products and construction materials, can replace the use of oil-based raw materials.

The advantages of products containing peat fibre are bio base, low cost, water resistance, impact strength, excellent fire endurance characteristics and biodegradability.

Through its various projects, VTT has developed materials containing thermoplastic and panel-form peat fibre, as well as fibre-suitable preprocessing methods. Milled peat can be used as peat fibre because it contains several peat fractions. Ideally it should contain long, less-decomposed fibres enabling it to function both as filling material and as reinforcing material in composite structures.

The amount of raw material necessary for composite products would be a fraction of current peat production, which is something that supports its use in ecological products. Composite production is also an alternative to peat burning, and would preserve jobs in the peat industry.

Materials containing peat fibre are suitable for processing with normal plastic processing methods, including compounding, extrusion and injection moulding. Currently no company in Finland is producing or exploiting these kinds of peat composite materials.

Material solutions containing peat fibre can be used in construction (boards, moulding, profiles, plate structures), product applications in horticulture and agriculture and forestry (seedling guards, planters, peat-coloured wall structures, plant supports), consumer products (golf tees, ornaments), biodegradable packaging, earth-moving (erosion protectors, biodegradable support structures) and funerary products.

VTT currently has three patent applications pending related to peat-containing biocomposites. Development work has been funded in part by the Tekes TULI project.

#### Further information

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## HARD METAL NEWCOMER TO REPLACE TUNGSTEN CARBIDE

A new hard metal developed by VTT and Finnish-based Exote Ltd can be used to replace tungsten carbide (WC), the hard metal widely used in industry today but with increasingly critical global availability. The new metal can even be used in bullet proofing.

The hard metal known as WC Co – used universally in industrial applications demanding strength and durability – contains tungsten carbide and cobalt, both defined by the EU as critical and, in the case of cobalt, dangerous to health. The critical materials list contains substances of significance to the EU economy but whose availability is at great risk, and which are mostly non-renewable. The material developed by VTT and Exote is a more ecological alternative because the new manufacturing technology enables comparable properties to be acquired from other raw materials.

Exote's material endures high temperatures and has high-level strength and durability, making it ideal for the manufacture of crusher blades, shear cutters and other exacting product tools. The metal's properties recommend its use for ballistic protection of both humans and vehicles, having proved outstanding at even the highest protection level. The growing threat of roadside bombs, grenade splin-

ters and armour-piercing bullets can now be combated by solutions based on this new material.

VTT and Exote Ltd carried out further development on the material, in production at Exote, through the use of nano additives that enable robustness and hardness to be adjusted to the intended use.

The market potential for the metal is considerable, and great significance is being attached to a variety of uses especially within the EU area.

#### Further information

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## COMBINED PROPULSION POINTS TO LARGE SAVINGS

**The TRIPOD project, coordinated by VTT, has developed an innovative propulsion system promising annual fuel savings for a modern container ship of 0.5–1 million euros. The new system integrated three separate propulsion technologies – already known for their high efficiency over conventional propulsion – into a single system.**

The research produced a further increase in propulsion efficiency by combining RudderPod propulsion units developed by ABB Finland with Contracted and Loaded Tip propellers (CLT), developed by the Spanish company Sistemar, and contra-rotating propellers (CRP). Thanks to its lower fuel consumption and emissions, the new propulsion system appears a promising alternative to conventional propellers.

Based on the TRIPOD project results, the fuel consumption of a container ship retrofitted with the new propulsion system is about 5% lower, and that of a newly built ship 10% lower, than conventional solutions. The research showed that a single cargo ship could save up to €500,000 and a large container ship as much as €1 million in fuel consumption. The efficiency of newly-built systems could improve by 10 per cent and retrofitted engines by five per cent.

An additional economic cost benefit analysis further examined the viability of the new propulsion solutions for the reference ships, concluding that if – in close cooperation with the relevant specialist suppliers – the investment level

could be brought down, ship owners would be stimulated to explore further installation opportunities, especially in large container ship newbuilding projects.

The three-year programme TRIPOD – “Triple Energy Saving by use of CRP, CLT and Podded Propulsion” – was implemented within the EU's Seventh Framework Programme. Partners in the programme were VTT, ABB (Finland), Sistemar (Spain), Cehipar (Spain), CintranaVal-Defcar (Spain) and A. P. Möller Maersk (Denmark).

#### Further information

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## PROPELLING THE FRIENDLY ENVIRONMENT

**Wärtsilä, the marine industry's leading provider of innovative products, solutions and services, has inaugurated its new test facility for future propulsion products and technology. The Wärtsilä Propulsion Test Centre has been established in close cooperation with VTT.**

VTT and Wärtsilä are working together to develop propulsion products and technology in a test centre established and funded by Wärtsilä. The resources for operating the facility are provided by VTT.

The new facility enables Wärtsilä to speed the development of new, high-quality and environmentally sound propulsion products together with research institutes, universities and suppliers. The test centre will have a central role in propulsion-related research and development activities carried out by the company. In particular, the test centre will be used for functional and endurance testing, with emphasis on mechanical power transfer.

The test installation can accommodate thrusters up to slightly above 2 MW in power. The main components are a frequency converter with an electrical motor and generator, a specially designed gearbox, and a hydraulic loading system. The test centre covers an area of about 200 square metres, and is capable of running tests around the clock.

#### Further information

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# Real estate, construction, services, logistics

Building renovation accounts for 5.6% of GDP in Finland • Buildings take up 40% of the EU's overall energy consumption. According to an EU directive, all new construction after 31 December 2020 must be virtually zero energy buildings • Services account for 75% of GDP over the entire EU area, while the share of global trade stands at approximately 20% • Transport costs average 4.6% of Finnish company turnover, while 35% of the competitiveness of industrial firms derives from logistics.



# SUSTAINABLE BUILT ENVIRONMENT IN A KNOWLEDGE SOCIETY



A SINGLE GUY IN HIS EARLY THIRTIES, JÜRGEN, TRAVELS AROUND WITH HIS FRIENDS BY CAR. THEY ARE ON THEIR WAY TO A CONCERT WHERE THEY ARE TO MEET OTHER PEOPLE. THE CAR IS BRAND NEW BUT NEVERTHELESS BREAKS DOWN IN THE MIDDLE OF NOWHERE. ANYWAY, JÜRGEN AND HIS FRIENDS RECEIVE FULL SUPPORT FROM THEIR CAR.

THE CAR BOOKS THEM A PLACE ON THE NEXT INTERCITY TRAIN AND PROVIDES THEM WITH DETAILED INSTRUCTIONS ON HOW TO REACH THE NEAREST STATION, CONVENIENTLY LOCATED JUST A FEW KILOMETRES NORTH OF THEIR CURRENT LOCATION.

THE ROAD AUTHORITIES ALREADY KNOW THAT THE CAR IS ON THE ROADSIDE, PRESUMABLY BECAUSE OF AN ENGINE FAILURE. THEIR SYSTEM HAS GENERATED AN ALARM, INDICATING THAT A CAR HAS STOPPED ON A DUAL CARRIAGEWAY WHERE PARKING IS STRICTLY PROHIBITED. THERE HAS BEEN A LOT OF TALK ABOUT THE ROAD AUTHORITIES' ABILITY TO MONITOR TRAFFIC AUTOMATICALLY.

MANY PEOPLE ARE IRRITATED BECAUSE IT ALSO ENABLES AUTOMATED SPEED SURVEILLANCE AND ROUTE TRACKING.



## STREETWISE LED LIGHTING

**VTT has developed a dimmable LED street light that consumes significantly less energy than current lighting systems, while improving lighting characteristics.**

Traditional street lights work at full power when turned on, usually with no adjustment available for the amount of light. The new LED street lights developed by VTT adapt to the ambient conditions with the help of sensors and wireless control, allowing them to be dimmed on the basis of natural light and environmental conditions, such as light reflected from snow, and the number of road users. In order to maintain comfort, the street lights also take into consideration several characteristics important to road users, such as the amount and colour of light and the shape of the light beam. The design of light distribution paid particular attention to glare control, evenness of lighting and adequate illumination of road shoulders.

The intelligent street lighting system stores information on temperature, lighting level, the number of pedestrians and cyclists, and energy consumption, among others. Laboratory measurements show that without sensors the new LED street light is up to 50 per cent more energy-efficient than traditional lights on the market. An additional energy saving potential of 40 per cent has been observed with added intelligence adjusting lighting levels according to the number of users or to natural conditions.

The street lights were tested along a road in Malmin-kartano, Helsinki, where initially a total of 20 reference street lights were installed. These represented five differ-

ent luminaires on the market, comprising LED lighting and traditional high-pressure sodium and metal halide lamps. Aalto University carried out a survey among people using the area's roads, leading to VTT's development of the demo street light. Demo lights were installed at the end of 2012 as an extension of the first test installation, after which Aalto University carried out another survey on the experiences of the people using the area. VTT's demo street light received the best feedback in the survey.

The AthLEDics project, funded by Tekes – the Finnish Funding Agency for Technology and Innovation, research institutes and companies, is implemented by VTT and Aalto University, partnered by Alppilux, Helsingin Energia, the City of Helsinki, the City of Jyväskylä, Enerpoint, Ensto Finland, Hella Lighting Finland, Helvar, Herrmans, LumiChip, MTG-Meltron, Oplatek, Sabik, Senate Properties, Valopaa and YIT.

### Further information

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## NEW SOLUTIONS BRING A BREATH OF FRESH AIR

**VTT has developed more effective air filter solutions capable of removing 90% of ambient air particulates. The new filter solutions can be added to existing ventilation systems without resorting to changes in structure or size.**

Particulates are the cause of over one thousand premature deaths in Finland every year. Exposure generally occurs in indoor spaces. The most serious indoor air problems are caused by damp and mould. According to the Ministry of the Environment, 600,000–800,000 Finns are exposed to these impurities every day. The buildings in worst condition are day care centres, schools and hospitals. According to the Parliamentary Audit Committee report of January 2012, the level of health-related costs arising from damp and mould damage is in the order of EUR 23–953 million.

Development of traditional ventilation systems can bring considerable improvement in ambient air quality. Equipment solutions consist of a central ventilation unit and air filtration solutions for supply air terminal devices within the rooms. VTT's solutions entail no alteration to the basic structure



of ventilation systems, nor add significantly to their size, air flow or energy consumption. Annual usage costs are estimated to be no more than 10 euros per square metre.

The new filter solutions also reduce the amount of ambient particulates by 10% compared to the current level, together with efficient removal of harmful ozone, and help in relieving any damp and mould problems.

The filter solution for the ventilation unit passes supply air through a combined electret fibrous filter and active charcoal filter, where the filtering effect is enhanced by means of electrostatic charging. Air supply units are of the so-called 'active chilled beam' type to which an indoor air particle filtering solution has been added.

The solution for the air supply unit consists of a section for collecting particles entering the unit and an externally fitted, electrostatically charged unit for particles passing the underside of the supply unit's base plate. Poor quality air in the air supply unit is cleaned on the recycling principle, where the most important variable affecting air cleanliness is 'effective air flow' (the product of collecting efficiency and air flow or, in other words, the volume of air that is free of particles).

The operability of both solutions has also been tested by VTT in practical environments, including offices. According to the measurement results, a 90% reduction in the particulate content of indoor air is a realistic target. The result for the reduction in ozone content was approximately 75%.

The next step is testing in larger projects for the air quality that can be achieved using air supply unit solutions

in office and school environments, among others in the Helsinki metropolitan area. The principal funding agency for this project is The Finnish Work Environment Fund.

#### **Further information**

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## **INTELLIGENT TRANSPORT SERVICES MEAN SAFER MOBILITY**

**VTT has led a team of research scientists in a European collaborative project to assess the impacts on driver behaviour of support functions provided by smartphones, navigators and other in-vehicle after-market and nomadic devices. Intelligent transport systems allowed drivers to find quicker and less congested routes and to avoid accidental speeding. Fuel costs also dropped.**

With a budget of EUR 15 million, the four-year TeleFOT project is coordinated by VTT and numbers among the biggest traffic ICT projects in Europe. The operational field trials produced a unique set of data on which to base research into the impact of the services on driver opinion and behaviour, and consequently on mobility, traffic flow, safety and the environment.

Many intelligent transport services provided by nomadic devices are already part of the daily lives of road users, but information about their actual impact, for example on road safety, has been unavailable until now.

The study was based on extensive field trials, with almost 3,000 drivers covering a combined distance of more than 10 million kilometres in eight European countries. The test drivers were recruited from Finland (360), Sweden, Germany, the UK, France, Greece, Italy and Spain.

The services tested included Static and Dynamic Navigation Support, Green Driving Support, Speed Limit Information and Traffic Information. Efficiency increased most through the use of navigators and traffic information systems that allowed drivers to find quicker and less congested routes. Green driving systems encouraged a more economical driving style and suggested routes that resulted in lower emissions.

At the Finnish test site, the use of a green driving system in bus transport helped to lower fuel consumption and to reduce speeding – another factor improving road safety.



A further significant finding is that the systems reduced driving-related stress and anxiety right across the board, and in all the participating countries increased the drivers' sense of safety and driving comfort. From the mobility perspective, the results were positive for all systems.

The European Commission gave recognition to the VTT-coordinated project by presenting an iMobility Award to VTT Senior Scientist Petri Mononen for exceptional work in accelerating the deployment of intelligent transport services.

#### Further information

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### BOOSTING PORT FLOW AND SAFETY

**VTT has been chosen by PSA Singapore Terminals to develop an advanced wireless network for improving flow and efficiency in the world's largest transshipment hub. Meanwhile, a new kind of piloting system with a WiMAX-based network solution was demonstrated in the Port of Cork.**

Smart technologies and automation play a crucial role in port logistics. PSA aims to use intelligent mobility in networks and a wireless mesh network to enhance operations at the Port of Singapore. The aim is to increase automation and make processes more fluent, as well as to support greater mobility and safety of the workforce and machinery.

A wireless mesh network consists of a group of wireless devices, for example WLAN base stations, through which terminal devices can be connected to other networks, such as the Internet. Terminal devices themselves can operate as data distributors by routing the data traffic of other terminal

devices to base stations for onward distribution to other networks.

VTT had also been developing the precise and rapid piloting system under a European research programme called DockingAssist. The system can be used to improve port safety and reduce fuel costs by speeding up marine traffic.

The DockingAssist system includes a base station located in the port area and a lightweight portable pilot unit that provides pilots and the port system with timely information on the location, speed and heading of the vessel. There is no necessary need to deploy expensive additional control systems at the quay.

A WiMAX broadband network and RTK-enhanced GNSS positioning technology combine to enable positioning, navigation and speed measurement accurate to within the nearest few centimetres. The WiMAX network also allows pilots access to other harbour services, such as information on weather and ship movements, for example. VTT designed and deployed the WiMAX network used by the system.

The research institutions participating in the two-year EU DockingAssist project were Ateknea Solutions (project coordinator, Spain), VTT and ASCAMM-CTAE (Spain). Marimatech (Denmark), Net Technologies (Greece), Prodevelop (Spain), Runcom Technologies (Israel) and the Port of Cork (Ireland) represented the private sector.

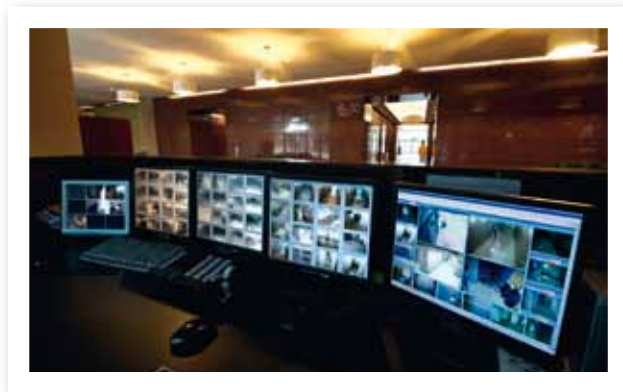
#### Further information

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# Business development, commercialization





### VTT SPIN-OFF COMMERCIALISES SECURITY SCREENING TECHNOLOGY

**Asqella Ltd, a spin-off of VTT, is in the process of commercialising revolutionary passive THz imaging technology capable of remote detection of concealed items. The company has received nearly one million euros in funding from business angels, VTT Ventures Ltd and Tekes – the Finnish Funding Agency for Technology and Innovation.**

The company sees substantial demand for the new high-throughput screening applications in areas such as loss prevention, event security, and security in public places. The absence of radiation means there are no health concerns in using the product. The financing will catalyse product development and help in building the routes to market.

The product provides the customer with an absolutely safe capability for detecting concealed items on moving subjects at a stand-off range of between 5 and 15 metres. The system is passive, neither irradiating the person subject to screening nor revealing anatomical details.

#### Further information

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### RISK ANALYSIS FOR OUTSOURCING WATER SUPPLY MAINTENANCE SERVICES

**The need to renovate ageing water mains and sewer networks will increase dramatically in the near future.**

**Water utilities will need to consider new operating models for network maintenance and for mitigating the growth in renovation debt. The SerVesi project developed risk analysis with regard to outsourcing.**

VTT, together with Tampere University of Technology and the University of Tampere, has studied the outsourcing of maintenance services for water supply networks under the SerVesi project. VTT Expert Services Ltd have evaluated the market volume for maintenance services in Finland at approximately EUR 250 million per annum. The market for network renovation and rebuilding is clearly more coherent than that for maintenance, with annual volume in excess of EUR 400 million.

Water utilities are facing increasing productivity pressures, while ever greater expertise in network maintenance is needed to support technological development. Collaboration is taking place with the private sector and with other water utilities in the search for new operating practices.

A survey under the SerVesi project established the extent to which water supply network maintenance has been outsourced and how future maintenance might be organised. The survey reveals that water utilities have procured services for practically all maintenance operations.

Most orders from service providers concern renovation of water mains and sewers with methods that require no excavation, TV inspection of sewers, and water meter repair. These are either outsourced completely or performed in close and continuing cooperation between water utility and service provider.

There is no desire, however, to outsource all maintenance tasks to a private contractor, or to another water utility. The response was least enthusiastic for outsourcing operations connected with drinking water supply, fault correction and customer services.

The partners in the SerVesi project developed methods for identifying the risks related to outsourcing. The principle of the risk analysis is to describe the service as completely as possible, split it up into sections, and identify the potential risks for different parts of the service from both supplier and customer perspective. Once the risks have been identified, the parties will be able to negotiate a method of risk management that is satisfactory to both. This enables transparency of operations and engenders reliable and open partnership.

#### Further information

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The goal: a successful Finland Ltd

**THE TOOL: TARGET-DRIVEN  
TECHNOLOGY DEVELOPMENT**





## **WE CREATE IMPACT THROUGH HOLISTIC SOLUTIONS:**

**DYNAMIC INDUSTRY • CLEAN LIVING ENVIRONMENT • EFFICIENT AND  
ECO-FRIENDLY USE OF MATERIALS • REDUCED OIL DEPENDENCY**



**"FINNISH INDUSTRY NOW FINDS ITSELF IN A SITUATION WHERE IT WILL TAKE COURAGE TO GRASP NEW OPPORTUNITIES.**

**VTT'S COMPREHENSIVE AND TARGET-DRIVEN RESEARCH AND INNOVATION PROGRAMMES SUPPORT THE STRUCTURAL CHANGE TAKING PLACE IN FINNISH BUSINESS LIFE. WE IDENTIFY THE CRITICAL CHALLENGES AND RESPOND TO THEM IN COOPERATION WITH OUR PARTNERS THROUGH TECHNOLOGY.**

**AS AN EXAMPLE, CONFIRMING THE COMPETITIVENESS OF THE FOREST INDUSTRY AND GENERATING A NEW BIOECONOMY SECTOR ARE THE KEY ISSUES FOR FINLAND'S FUTURE. A COMPREHENSIVE APPROACH WILL BE NECESSARY IF WE ARE TO OBTAIN THESE TARGETS. THE DEVELOPMENT OF INDIVIDUAL TECHNOLOGIES ISN'T ENOUGH. WE NEED TO BUILD THE ELEMENTS FOR THE ENTIRE ECOSYSTEM."**

**EXECUTIVE VICE PRESIDENT ANNE-CHRISTINE RITSCHKOFF**

## INDUSTRY'S OPERATING LOGIC IS IN TRANSITION

The structural change in global business life is pushing ahead at high speed, with direct impacts on industry here in Finland. Some we have already seen, and some we can anticipate. Others, though, we can only guess at. Faced with these challenges, the traditionally strong industries are looking into new openings that are expected to bring new growth and vitality. VTT, together with companies and other partners, creates and develops new innovative products and comprehensive solutions to respond to these challenges.

## FAST-TRACKING IDEAS INTO BUSINESS

The rapid transformation of new ideas into practical solutions produces significant competitive advantages for industry. According to VTT's customer survey, carried out

in summer 2013 by Taloustutkimus, in those VTT projects resulting in adoption of a whole new technology, 33% thought VTT's role was unique ("it would not have realised without VTT"), while the remaining 67% thought that VTT's participation had accelerated the realisation. Similarly, in projects resulting in generation of new or improved products, services or production processes, 23% of respondents said the result would not have been realised without VTT, while 71% said that VTT's participation had accelerated the realisation.

To technology development, VTT links an understanding of business logic and an ability to anticipate new business opportunities. The need for courage to step out of the comfort zone and take risks is also evident. VTT's programmes offer a versatile collaboration platform for building industry value chains and pilot environments for the needs of the various actors (SMEs, start-up companies, major corporations, the public sector, etc.).

*"THE BIOECONOMY TRANSFORMATION SPEARHEAD PROGRAMME IS THE TECHNOLOGY DEVELOPMENT PLATFORM FOR FINLAND'S BIOECONOMY. THE SOLUTIONS WE PRODUCE ARE THE SEEDS OF NEW GROWTH COMPANIES THAT ARE RENEWING THE BIOMASS PROCESSING INDUSTRY. OUR OBJECTIVE IS TO CREATE A STRONG AND DIVERSE BIOECONOMY SECTOR."*

*"AT THE START OF THE GREEN SOLUTIONS FOR WATER AND WASTE SPEARHEAD PROGRAMME IN 2011 WE HAD A STRONG VIEW OF THE GROWING DEMAND FOR WATER AND RECYCLING TECHNOLOGIES, AND WENT ON TO DEVELOP THEM WITH OUR PARTNERS. HERE, AT THE END OF THE PROGRAMME, DEMAND IS CLEARLY ON THE RISE AND OUR COMPETENCE NOW MEETS THIS NEED."*



PROGRAMME  
MANAGER

JUSSI MANNINEN

PROGRAMME  
MANAGER

MONA ARNOLD



## **TECHNOLOGY DEVELOPMENT IS DIRECTED BY THE NEEDS**

VTT is in tune with the times regarding the critical challenges both in public debate and in the operations and future planning of businesses. We at VTT play a key role in building a successful Finland Ltd, identifying the challenges where the required solution demands comprehensive technology development. This is how the objectives of VTT's spearhead and innovation programmes are formed. Programme implementation is also strongly directed by the essential needs for the competitiveness of business and society.

## **VTT'S HELP IN RESHAPING INDUSTRY IS TRIED AND TESTED!**

According to a study conducted in 2013 (Roles, effectiveness, and impact of VTT, VTT Technology 113, 2013) out of all public research organisations VTT is the most important R&D partner for Finnish companies. The same survey reveals that VTT has had a significant share in every fifth Finnish innovation, with VTT's expertise present in every third. VTT's role is in particular highlighted in innovations based on the customer companies' core technologies, of which no fewer than 43% contain VTT know-how. On the basis of the survey, cooperation with VTT also appears to ease the penetration of Finnish business enterprises and innovations into international markets. This trend has strengthened, particularly in recent years. The scientific quality of VTT's research services is demonstrably high. In particular, the citation indexes for scientific publications written by VTT research scientists were at a very good level.

**"TRANSPORT SYSTEM SERVICES HAVE BEEN SET CHALLENGING DOMESTIC AND INTERNATIONAL OBJECTIVES FOR QUALITY, EFFICIENCY AND ENVIRONMENTAL IMPACT. TO ACHIEVE THESE WE'LL NEED A SYSTEMIC APPROACH AND CLOSE COOPERATION WITH ACTORS. VTT'S TRANSMART SPEARHEAD PROGRAMME WEAVES TOGETHER THE NEEDS OF DIFFERENT ACTORS AND DEVELOPS SOLUTIONS TO MATCH."**



**PROGRAMME  
MANAGER**

**NILS-OLOF NYLUND**

**"THE PRODUCTIVITY LEAP WITH INTERNET OF THINGS SPEARHEAD PROGRAMME BRINGS INDUSTRIAL INTERNET WITHIN REACH OF FINNISH COMPANIES. AND OPPORTUNITIES THERE CERTAINLY ARE! WE COMPILED THESE IN AN ISSUE IN OUR VTT VISIONS SERIES ENTITLED 'PRODUCTIVITY LEAP WITH INTERNET OF THINGS', WHICH OUR CUSTOMERS WERE VERY ENTHUSIASTIC ABOUT."**

**PROGRAMME  
MANAGER**

**HEIKKI AILISTO**



## VTT'S STRATEGIC RESEARCH PORTFOLIO

### Bioeconomy transformation

- Sustainable use and refining of bio-based raw materials
- Industrial biotechnology and green chemistry
- Process and manufacturing technologies
- Bioeconomy business ecosystems

### Low-carbon economy

- Energy efficient solutions for industry, built environment, and transport
- Renewable energy sources
- Nuclear energy: safety and waste management
- Energy systems and modelling

### Clean environment

- Clean environment
- Clean water cycles on demand
- Industrial ecology and life cycle design
- Waste refineries, material recovery, and recycling
- Substitute material solutions

### Digital world

- High-performance microsystems and sensing solutions
- Printed intelligence
- Scalable digital service economy
- Internet of Things (IoT)

### Resource efficient production systems

- Eco-efficient machines
- Resource efficient processes
- Simulation based design
- Global production and services

### Health and wellbeing solutions

- Diagnostics
- Food products and health
- ICT for health
- User-driven spaces and environments

### Horizontal research:

Business and Services – Innovation methods and policies –  
Safety and security – User and customer understanding



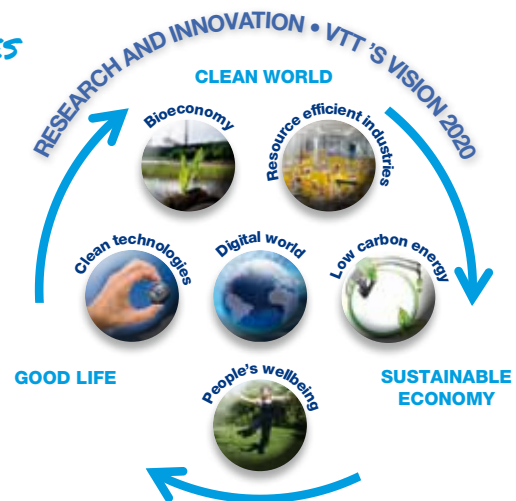
## VTT'S SPEARHEAD AND INNOVATION PROGRAMMES

### Spearhead programmes

- Bioeconomy Transformation
- Productivity with Internet of Things
- Smart Mobility Integrated with Low Carbon Energy
- Green Solutions for Water and Waste (ended 2013)

### Innovation programmes

- Intelligent Energy Grids
- High Performance Microsystems (ended 2013)
- Multidisciplinary and Multiscale Modelling in Engineering
- Arctic and Cold Climate Solutions
- Critical Technologies Towards 5G
- Personalised Health & Wellbeing
- Human Driven Design – “Design for Life”
- Safe and Sustainable Nuclear Energy
- Sensing Solutions (ended 2013)
- Mineral Economy (begins 2014)



### Further information

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# International and domestic cooperation

## STRATEGY SPEARHEADED BY INTERNATIONALISATION

RESEARCH UNITS IN BRAZIL AND SOUTH KOREA • ACTIVELY INVOLVED IN BUILDING THE EUROPEAN INNOVATION ECOSYSTEM • OPERATING ON ALL CONTINENTS, 19% OF TURNOVER GENERATED ABROAD • 9% OF COMPANIES ON THE GLOBAL FORTUNE 500 LIST ARE VTT CUSTOMERS • EXPERTS WORKING AT VTT COME FROM 50 DIFFERENT COUNTRIES • VTT'S EU/ERA FUNDING FOR 2013 WAS APPROXIMATELY EUR 59 MILLION.

THE MOST FREQUENT TARGET COUNTRIES FOR VTT EMPLOYEES WORKING ABROAD IN 2013 WERE USA, SOUTH KOREA, JAPAN, FRANCE AND GERMANY.

IN 2013:  
• FOREIGNERS ACCOUNTED FOR APPROXIMATELY 6% OF VTT EMPLOYEES AND 31% OF VISITORS WORKING AS EXTERNALS  
• THERE WERE 165 FOREIGNERS WORKING AT VTT WITH AN EMPLOYMENT CONTRACT



**VTT is present in the international arena through many research and innovation networks, alliances and partnerships. While the majority of VTT's research and innovation activities are European-driven, VTT's goal is to extend its reach to global innovation environments. The overall goal is contribution to the solutions that are needed when addressing the Grand Societal Challenges. This can only be done in cooperation, within larger initiatives and together with responsible partners, from both the private and public sector.**

## **EUROPEAN COOPERATION IS WHEELED TOWARDS NEW PRIORITIES**

VTT had 699 (2012: 541) publicly funded international research projects ongoing in 2013, of which 471 (2012: 361) were EU projects. Projects in the Seventh Framework Programme numbered 386. VTT was particularly active in ICT, Nanotechnology, Materials and New Production Technology, Energy, Biotechnology, Transport and Security programmes. On average, the share of industry partners is 42% in those consortia where VTT is engaged in FP7. Altogether 83 Finnish SMEs were involved, 27 of them in the specific Research for SMEs programme.

From the beginning of the 7th Framework Programme, VTT has received 22% (EUR 167 million) of all FP7 funding for Finland (EUR 758 million). Finland has also been active in developing the European Research Area (ERA), and 16% of all national funding from Tekes to VTT in 2013 was directly linked with European initiatives (Eureka and ERANet, as well as Article 185 Eurostars and AAL).

VTT is a key member and actively engaged in several networks and initiatives that have contributed to definitions, priorities and mechanisms for Horizon 2020. For VTT, central platforms are numerous ETPs (European Technology Platforms), PPPs (Public Private Partnerships), KET (Key Enabling Technologies) High Level Group, and European Innovation Partnerships between European Member States (especially EIPs in Raw Materials, Water, and Smart Cities and Communities). VTT has also been active in fostering information exchange with various stakeholders in Finland. The experience built up by working through new cooperation models is important in developing innovation systems in Finland and across the EU.

Horizon 2020 (2014–2020), the new European Framework Programme for Research and Innovation, will emphasise scientific research as well as closer-to-market research and innovation activities, in order to boost the European economy and jobs, and to address the Grand Societal Challenges. In Horizon 2020, VTT hopes to be able to engage in renewal of European industrial value chains and networking of regional ecosystems.

## **INTERNATIONAL OFFICE NETWORK FOR MORE IMPACT**

VTT's chosen strategic focus areas in international research cooperation are industrial biotechnology, forest industry restructuring and energy, and ICT and electronics. Significant emphasis on internationalisation continues the effort to boost business and improve the welfare of society. VTT has a total of 8 offices abroad. Three are managed by VTT International Ltd and have legal status in the countries concerned. The offices operate as research units where VTT engages in active research and innovation with local research organisations. The remaining five are so-called 'contact' offices intended to support and assist VTT's networking and marketing operations in the relevant country. Apart from its permanent offices, VTT examined the possibility of establishing a foothold in Singapore and a more active presence in US markets. The investigations failed to result in any additional offices, at least for the time being.

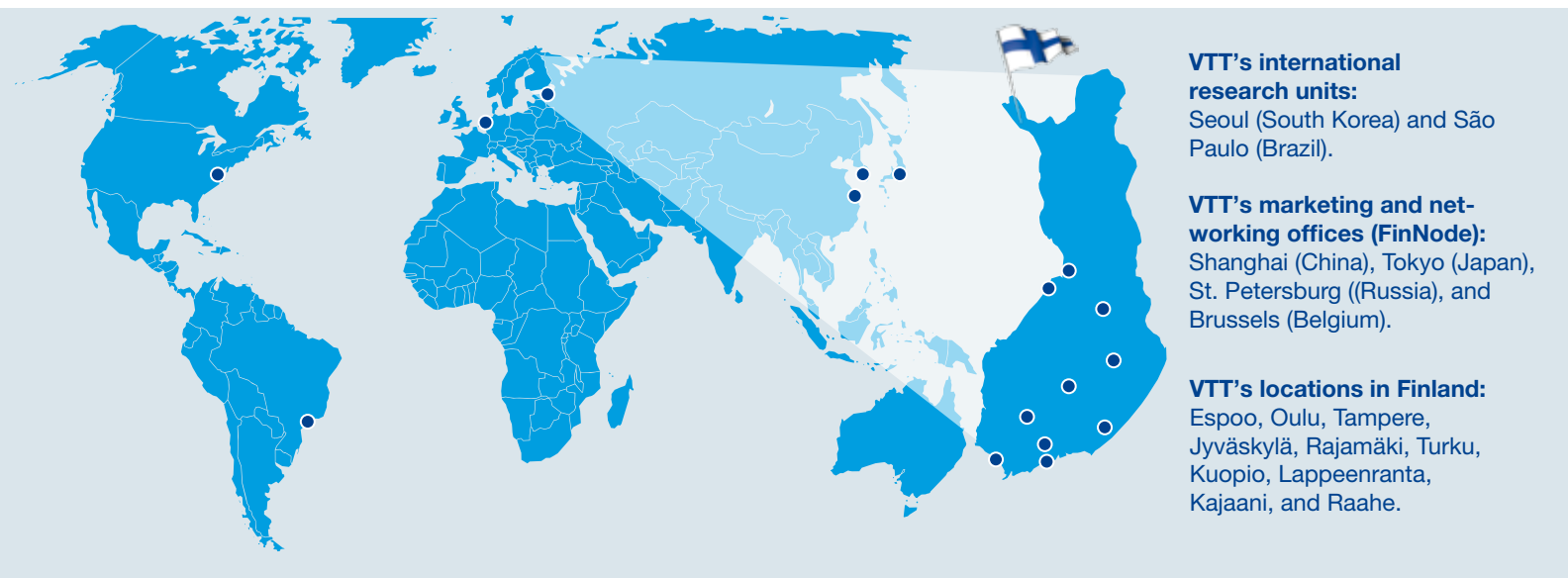
VTT's research units in 2013 were located in Brazil and Korea, and at Berkeley in the USA. Research at the Brazil unit concentrates on biomass use, water technology and the forest industry. Focus in 2013 continued on the Kemira Centre of Water Efficiency Excellence (SWEET) and on projects with companies in the forest industry, as well as on the major PAISS project, involving cooperation with businesses and universities in the development of bioethanol production technology. At the Korean unit, the main focus of research was on ICT and electronics in cooperation with local universities and research institutes. At the VTT/MSI Molecular Sciences Institute research unit at Berkeley in the USA, emphasis was on basic and applied research in industrial biology. VTT and MSI parted ways at the end of 2013. Reasons for VTT's withdrawal included the institute's strong focus on a narrow area of basic research – no longer

in step with VTT's renewed strategy aimed at creating new business – and the heavy competition for US public funding in the institute's focus area.

Of VTT's five contact offices, four belong to the joint Team Finland/Tekes network of Finnish innovation actors, and are located in Japan, China, Washington on the US East Coast, and St. Petersburg in Russia. VTT was invited to become a member of the Team Finland network in December 2013. As part of Team Finland, VTT participates in influencing the choices made in overseas markets to ensure that these are to Finland's advantage. Membership of the network also supports VTT's business and internationalisation objectives. The Ministry for Employment and the Economy, Ministry for Foreign Affairs and Ministry of Education and Culture form the core of the Team Finland network, together with the public funding organisations and overseas offices under their direction.

VTT's Washington office markets environmental and electronics expertise to major corporations and brand owners operating in the area. The office has also helped reinforce cooperation with local universities and research institutes. In Japan, special emphasis was on cooperation in

the ICT sector with local research institutes and universities. The main focus at Shanghai in China was on manufacturing industry and the energy sector, and supporting Finnish businesses. The St. Petersburg office in Russia concentrated on the transport and logistics sector and on nanoelectronics. This office was nonetheless relinquished during the year, and contact continues directly from Finland through the Team Finland/Tekes offices. The eighth office, VTT's office in Brussels, operates in connection with EARTO, the interest organisation for European research and technology organisations (RTOs) in Brussels. The main focus of the Brussels office is to contribute to the development of the Horizon 2020 programme. VTT also wants to increase the number of direct contacts with EU institutions and other key stakeholders in Brussels. According to a Taloustutkimus customer survey held in summer 2013, the internationalisation measures carried out by VTT that were of most benefit to VTT customers were international research and expert networks (52% thought these highly significant or fairly significant) and the networking of Finnish businesses with EU programmes (highly significant or fairly significant for 46%).





### VTT in European alliances and expert groups

- AERTOs – Horizontal partnerships between research institutes
- EERA – The European Energy Research Association
- EIT ICT Labs
- ETSO – European Technical Safety Organizations Network
- HTA – Heterogenous Technology Alliance
- JIIP – Joint Institute for Innovation Policy
- KET – Key Enabling Technologies High Level Group (EU Commission)
- NULIFE/NUGENIA – Nuclear Generation II and III Association



### VTT in Finnish research alliances

- BETA – Bioenergy Technology Alliance
- Industrial Biotechnology Cluster Finland
- FIMM – Institute for Molecular Medicine Finland
- FSA – The Finnish Service Alliance
- PrintoCent – Innovation Centre of Printed Electronics and Optical Measurement Technology
- Finnish Centre for Nanocellulosic Technologies



### VTT's participation in Academy of Finland Centers of Excellence (CoE)

- Finnish CoE in Atomic Layer Deposition (ALD) (2012–2017)
- Finnish CoE in Low Temperature Quantum Phenomena and Devices (2012–2017)
- Finnish CoE in Molecular Systems Immunology and Physiology Research (2012–2017)
- White Biotechnology - Green Chemistry Research (2008–2013)

## VTT A KEY PLAYER IN NATIONAL INNOVATION COOPERATION

VTT continued with structuring and implementing the FIT (Finnish Institute of Technology and Innovation) network. The objective of the network is to boost the use and impact of resources in Finnish research and development work by enhancing cooperation and the division of tasks, especially between universities and research institutes. VTT has fostered goal-oriented discussions with the key universities regarding the development of research cooperation strategies and partnerships. Partnerships are also being strengthened by developing new forms of cooperation for commercialising research results and encouraging entrepreneurship.

VTT continues its active and fruitful involvement in the Strategic Centres for Science, Technology and Innovation (SHOK). VTT contributes extensively to national research and technology programmes, most significantly those run by Tekes and the Academy of Finland. Of the new Tekes Strategic Openings, VTT is participating in the project Design Driven Value Chains in The World of Cellulose, which exploits wood-based cellulose in novel ways with the goal of turning Finland into a design brand as the country for refined cellulose-based products.

**"THE KEY OBJECTIVES THROUGHOUT THE EU ARE RENEWAL OF INDUSTRY VALUE CHAINS AND STRENGTHENING OF REGIONAL ECOSYSTEMS.**

**TO MAKE THIS HAPPEN, WE MUST BE ABLE TO TAKE FULL ADVANTAGE OF THE OPPORTUNITIES OFFERED TO BUSINESS LIFE BY THE EU MEASURES THAT HAVE BEEN LAUNCHED."**

**LEENA SARVARANTA,  
VICE PRESIDENT,  
EU AFFAIRS**





VTT leads the national nuclear safety research programme SAFIR2014 and coordinates the national nuclear waste research programme KYT2014, in addition to participating in four of the Academy of Finland's Centres of Excellence.

VTT continues its active role in the research alliances founded together with partners from industry and academia. Strategic customer partnership programmes have advanced and accelerated the renewal and competitiveness of businesses, among others at the Finnish Centre for Nanocellulosic Technologies at Espoo and the Printo-Cent innovation centre for printed intelligence and optical measurement technology at Oulu.

The Otaniemi Research Infrastructure for Micro- and Nanotechnologies has again been selected for the national roadmap for research infrastructures, and is now joined by BIOFACTORY, an alliance for excellence in sustainable biomass refining (both VTT and Aalto University).

## **NEW CONCEPTS FOR REGIONAL INNOVATION AND SMES**

VTT is present in 10 Finnish cities, actively nurturing collaboration with local universities, research institutes and companies. In its regional functions VTT is focusing on local research and innovation partnerships and project based collaboration. Together with its local representatives in 14 municipalities, VTT is organising events on a regular basis for local companies. These events stand as an important platform for screening cooperation opportunities.

VTT has an important role when networking Finnish companies and other Finnish actors in European value chains within EU projects. In particular, SMEs can find excellent opportunities for internationalisation and business development in these networks. In 2013, two important national development programmes for cities were under preparation: Innovative Cities (INKA programme) and Witty City (Tekes programme). The purpose of these programmes is to reinforce the development of internationally attractive innovation hubs in Finland. City regions are challenged to create new types of ecosystems based on smart specialisation, leading to knowledge-based development of business environments and lead markets. Moreover, cities and SMEs will find interesting new opportunities opened up in the Horizon 2020 programme, and the European Innovation

Partnership on Smart Cities and Communities will lay basis for integrated policy coordination between European Union and the Member States in the coming years.

In 2013, VTT participated in the discussion on new regional strategies in Finland. VTT highlighted the importance of smart specialisation, connectivity between regions, links with the KET strategy and new investment opportunities along the priorities of the new European industrial policy.

Ground-breaking development took place in a jointly funded TESTAA project concerning novel fibre-based products and new innovations related to fibre foam technology. Together with large companies and 15 forest industry SMEs, VTT began development work on a new pilot environment with the active goal of achieving the participation of 20–30 SMEs. The pilot environment enables the acceleration of SME business development and rapid entry into the market of the most promising research results.

The General Finland cooperative was established by VTT and six manufacturing SMEs in 2013 in order to promote access to growing Russian markets. Cooperative membership will be expanded during the course of 2014. From the Finnish point of view this is a new kind of business model for growth and internationalisation.

### **Further information**

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# Sustainability and responsibility



At VTT we take account of the principles of sustainable development, both in research and development and in our internal operations. Our reporting on corporate responsibility follows GRI-3 guidelines. We describe examples of corporate responsibility in the VTT Review and publish the selected GRI metrics on the VTT website. Reporting includes the VTT Review, VTT Group Corporate Governance (CG) and the HR Report ([www.vtt.fi](http://www.vtt.fi)).

All six themes in VTT's strategic research portfolio – bio-economy, low-carbon economy, clean environment, digital world, resource-efficient production, and health and well-being solutions – target a better living environment and sustainable economy. VTT's research activities produce a stream of totally new sustainable solutions for the major challenges facing society. According to studies, the utilisation rate for VTT's research results is extremely high, attaching great significance to VTT's impact in promoting

sustainable development. VTT's research results and experts are also extensively relied upon as a basis for public decision-making on the journey to a society founded on sustainable development.

## RESPONSIBILITY FOR OUR OWN PERSONNEL

VTT renewed its organisation at the beginning of 2014, which led to the decision to postpone the personnel survey until 2014. The outcome of the cooperation negotiations that took place in 2013 included VTT giving up some areas of expertise entirely. When finalising the tasks of team leaders within the new organisation it was stressed that among the most significant would be taking on responsibility for the team's occupational well-being and work safety. This objective would be supported by training for new managers. Calculated using the method of the Zero Accidents forum, the frequency of accidents was almost as low as the previous year: 1.56 occupational accidents per million work hours.

The gravity of the accidents had never been less, causing only 29 days of sick leave in total (4.14 days of sick leave per single accident). Not one serious accident occurred at a VTT workplace. Journeying to and from work revealed a different picture, however, with an unusually high number of serious accidents (8) while commuting. These caused just short of 430 days of sick leave. The occupational safety authorities had issued VTT with operating instructions in 2011 concerning the cutting of credit balance on the working time account of personnel, and in 2013 continued to monitor this and the effectiveness of corrective measures taken by VTT. VTT gave their response on the issue at the end of October, covering the period 1 October 2012 to 30 September 2013. Training for managers concerning the occupational safety card continued. Hazard assessments for machinery and equipment were also extended and a process description begun for managing equipment containing sources of radiation. Principles were also agreed for working alone, minimum protective equipment at certain research facilities, and the procedure for guests at experimental facilities. Chemical audits began in the major population centres and will continue in 2014.

## ENVIRONMENTAL ISSUES

VTT was recognised as a Green Office from 2009 to 2013. We ended cooperation with the WWF at the end of last year on receiving certification in accordance with ISO14001 criteria for environmental management systems. Precompliance of VTT's operational system with the ISO14001 standard was assessed in August 2013 and showed VTT to be ready to apply for certification. The actual audit took place in October, when two minor deviations were revealed regarding environmental issues. Corrective measures have since been agreed and begun by VTT.

By the end of the year, overall travel at VTT had turned out to be less than for the previous year. The reduction in domestic travel, thanks to use of the Lync instant messaging service and more effective videoconferencing, is significant in terms of CO<sub>2</sub> emissions. The total of 35.4 million flight kilometres accumulated was less than the previous year, even though flights are often long-distance because of VTT's internationalisation objectives. There was also a drop in personal car use.

The amount of paper purchased was again reduced (6.9%). Printouts fell by almost a million copies (11.7%), with colour accounting for nearly half of this reduction. The 2013 Environmental Deed of the Year went to Oulu for smart time- and temperature-controlled heating posts capable of reducing energy consumption by a half or even two thirds compared to conventional types. The posts were adopted as long ago as 2003 on an amateur basis, the project kickstarting when certain people fed up with heating posts not working properly set up a 'coffee table' project to fix the problem. Alterations being carried out on the Oulu office parking area at the time meant an ideal opportunity to observe how the idea worked in practice. The technology will nevertheless need to be updated for the 21 heating posts in the system to continue in use. Decontamination of the soil following the Otaniemi oil spill has been put back because of the delay in work on the metro.

### Further information

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# Awards and prizes

- VTT's Vice President, Research, Tatu Koljonen has been appointed a member of the EU Commission's CONNECT Advisory Forum for ICT Research and Innovation (CAF). DG CONNECT, the European Commission Directorate General for Communications, Networks, Content and Technology, channels funding for the Horizon 2020 programme to ICT research and innovation, while CAF shapes the EU's priorities in this area. Koljonen has also been appointed to a joint body established by the EU and China tasked with strengthening and coordinating innovation between the two countries.
- The European Association of Research and Technology Organisations EARTO has awarded VTT an innovation prize for technology work behind an allergy vaccine. VTT patented technology helps the human body to develop resistance to allergens.
- The Finnish Foundation for Technology Promotion has chosen DSc Marja Matinmikko, Senior Scientist at VTT, as the winner of the 2013 Young Researcher of the Year award. Matinmikko conducts research on the radio spectrum of mobile communication systems and on spectrum sharing.
- Petri Mononen has gained recognition from the European Commission through the iMobility Award for his outstanding contribution to the adoption of intelligent transport.
- The Building Information Foundation RTS has recognised the lifetime achievements of VTT architect Pekka Lahti through its RAKEVA award.
- The 2012 VTT Award was presented to John Kettle for the development and promotion of internationalisation in support of VTT's strategy.
- Satu Helynen was appointed as Finland's ambassador for clean energy in the CEM network for promoting the adoption of cleantech.
- The Finnish Society for Innovation Journalism Finjo has awarded VTT's Manager, External Communications, Sakari Sohlberg an Innovation Stone in recognition of his work on communicating technology to the media.
- The Smart Urban Spaces project coordinated by VTT received an Award of Excellence in the category 'Exploitation' at the ITEA and ARTEMIS Co-Summit event.
- VTT's ESiP project received the annual ENIAC JU Innovation Award for the high quality and reliability of its project applications.
- According to the Finnish Science Barometer 2013, published by the Finnish Society for Scientific Information, VTT is the most trusted research organisation in Finland.

NEWS: [WWW.VTT.FI/NEWS](http://WWW.VTT.FI/NEWS)  
REFERENCES: [WWW.VTT.FI/REFERENCES](http://WWW.VTT.FI/REFERENCES)

## VTT Impulse and VTT Newsletter



### VTT IMPULSE

*A magazine on science, technology and business*

The VTT Impulse technology magazine is aimed at VTT's partners and customers and anyone with an interest in top-level technology and its applications.

You can order a free copy at:  
[www.vtt.fi/publications/impulse.jsp](http://www.vtt.fi/publications/impulse.jsp)



### VTT Newsletter

Would you like to know how research is changing the world? VTT Newsletter will give you information on the latest research results, the possibilities offered by technology, and details of future events. The newsletter appears once a month.

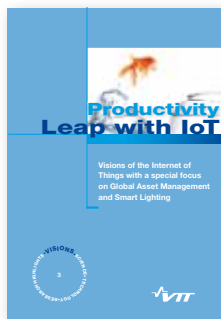
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WWW.VTT.FI/PUBLICATIONS**

VTT publications

**VTT EMPLOYEES PUBLISH RESEARCH RESULTS IN FOREIGN AND DOMESTIC SCIENCE JOURNALS, IN PROFESSIONAL PERIODICALS AND PUBLICATION SERIES, AS BOOKS, CONFERENCE PRESENTATIONS OR PATENTS, AND IN THE VTT PUBLICATION SERIES.**



**Productivity leap with IoT**  
Visions of the Internet of Things with a special focus on Global Asset Management and Smart Lighting

VTT Visions 3



**Value-driven business in the Cloud**

VTT Research Highlights 9



**Highlights in service research**

VTT Research Highlights 6



**Eco-efficient solutions for China's urbanization**  
Guidebook

*Satu Paiho et al.*

VTT Technology 105



**Novel AR solutions in media**

Customer perception of augmented reality in media applications – possibilities for new service innovations

*Aino Mensonen, Christian Persson, Terje Stafseng, Ravi Vatrapu & Örn Kaldalons*

VTT Technology 126



**Web-based co-design**

Social media tools to enhance user-centred design and innovation processes

*Pirjo Friedrich*

VTT Science 34  
Doctoral dissertation

## Impacts and results

### IN 2013:

- **291** INVENTION DISCLOSURES AND **20** SOFTWARE NOTIFICATIONS
- TOTAL PATENTS AND PATENT APPLICATIONS NEARLY **1,300**
- AT 31 DECEMBER 2013 VTT VENTURES LTD WAS A SHAREHOLDER IN **20** COMPANIES FOUNDED ON THE BASIS OF VTT TECHNOLOGY

### IN 2013:

- PUBLICATIONS TOTALLED **1,750**, OF WHICH SCIENTIFIC ARTICLES ACCOUNTED FOR **620 (36%)** AND CONFERENCE PRESENTATIONS **500 (28%)**, **100** PUBLICATIONS APPEARED IN VTT'S SERIES
- APPROXIMATELY **1,800** PUBLICATIONS YEARLY, **60%** OF THEM SCIENTIFIC ARTICLES AND CONFERENCE PRESENTATIONS
- SINCE 1943 MORE THAN **7,000** PUBLICATIONS HAVE APPEARED IN VTT'S OWN SERIES, OF WHICH **1,700** ARE AVAILABLE AS A WEB VERSION

## IMPACT OF VTT'S PROJECTS

Share of survey respondents who had this benefit as their goal in their VTT project and felt that the benefit was generated in the project:

- 95%** reported that their knowledge base and expertise had improved.
- 95%** thought that a VTT project had promoted networking.
- 89%** believed that a VTT project had speeded up or otherwise improved research and development work.
- 78%** confirmed that new products, services or processes were created.
- 76%** believed that a VTT project had contributed positively towards the opening up of new business opportunities.
- 75%** said that a VTT project had promoted their marketing.
- 73%** reported that their competitiveness had improved.
- 68%** said that a new business concept or a new earnings model was created.
- 57%** reported that a whole new technology was adopted.

Taloustutkimus Oy, VTT customer survey, 2013

# VTT's technology expertise is Finland's competitive edge



**VTT HAS THE VITAL TASK OF SUPPORTING FINLAND'S RENEWAL AND THE SEARCH FOR NEW GROWTH.**

## **VTT's Board**

Chairman: Aaro Cantell, CEO, Normet Group  
Vice chairman: Pekka Lindroos, Commercial Counsellor, The Ministry of Employment and the Economy

### *Members:*

Kirsimarja Blomqvist, Professor, Vice-Rector Lappeenranta University of Technology  
Kjell Forsén, President & CEO, Vaisala Oyj  
Petra Lundström, Vice President, Solar Business Development, Fortum Oyj  
Kaija Pehu-Lehtonen, Senior Vice President, Business development, Metsä Fibre Oy  
Riitta Varpe, Director General, Service Sector Employers PALTA

Erkki KM Leppävuori, President & CEO, VTT  
Iiro Auterinen, Principal Scientist, VTT (Staff representative)

VTT maintains top-level technology expertise in several key areas, and strives to use this know-how to enhance the competitiveness and growth of companies and organisations operating in Finland. Finland's industrial structure is in transition, with companies or even entire sectors either renewing and developing further or vanishing from the Finnish business scene. At this critical juncture, VTT finds itself charged with the vital task of helping to support Finland's renewal and the search for new growth.

Putting it a little more simply, competitiveness can be developed in two ways. One is to create value for the customer by producing the same products and services at lower cost. The other is to create greater value for the customer by developing new or better products and services. Debate concerning Finland's competitiveness has almost invariably revolved around the first of these, namely costs. This is despite the fact that Finland's rise over the past few decades – and indeed the global growth in productivity – derives from technological development and its successful exploitation. This will continue to be the case in future. VTT's technological expertise gives Finland a cutting edge, and this is something we must take full advantage of.

As always, the companies that will succeed in Finland are those that seek growth and renewal through technology – in other words, that take on the mantle of forerunners in their field. Fortunately, Finland still has many of these potential growth companies, in all shapes and sizes. VTT must identify these companies and encourage them and others to seek out and benefit from the opportunities that technology generates.

The goal that needs to be grasped at the national level is that companies would see Finland as one of the most desirable countries in Europe for building new business in the chosen areas where Finland has world-class expertise and actors. At VTT level we must try to become one of Northern Europe's most sought-after partners in those areas in which companies turn to technology to develop and grow their business.

Aaro Cantell,  
Chairman of the Board

# VTT in figures

## Internal income statement

	1.1. - 31.12.		Change
	2013	2012	
	(M€)	(M€)	(%)
<b>REVENUE</b>	<b>284.3</b>	<b>292.3</b>	<b>-3</b>
<b>Turnover</b>	<b>278.5</b>	<b>286.4</b>	<b>-3</b>
External revenue	189.6	192.5	-1
Revenue, domestic private sector	52.6	58.2	-10
Revenue, domestic public sector	84.5	83.1	2
Revenue from Tekes	58.2	57.5	1
Other revenues, domestic public sector	26.3	25.7	2
Revenue, foreign private sector	15.5	16.9	-8
Revenue, foreign public sector	37.0	34.3	8
Revenue from EU	30.7	29.8	3
Other revenues, foreign public sector	6.3	4.4	42
Basic government funding	89.2	94.0	-5
Turnover adjustment items	-0.3	-0.2	63
<b>Other operating income</b>	<b>5.8</b>	<b>5.9</b>	<b>-2</b>
<b>EXPENSES</b>	<b>290.3</b>	<b>291.6</b>	<b>0</b>
Personnel expenses	164.5	162.5	1
Materials and consumables	15.5	16.7	-8
Rents	29.4	29.5	-1
Purchases of services	45.8	48.6	-6
Other expenses	15.3	15.3	0
Depreciation	16.0	15.6	3
Financial expenses and revenues	3.9	3.1	24
Extraordinary expenses and revenues	-0.1	0.2	-131
<b>RESULTS</b>	<b>-5.9</b>	<b>0.6</b>	

## VTT Group

- Turnover 308 M€

## VTT

### Financial information

- Turnover 279 M€
- External revenue 190 M€ (68% of turnover)
- Basic government funding 89 M€ (32% of turnover)
- Revenue from abroad 53 M€ (19% of turnover)

### Personnel

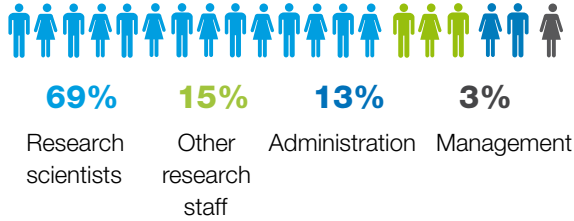
- Personnel 2,644
- University degree: 83%
- Doctors and licentiates: 28%
- 77 persons on assignment abroad
- 165 foreign visiting persons at VTT

### Customers

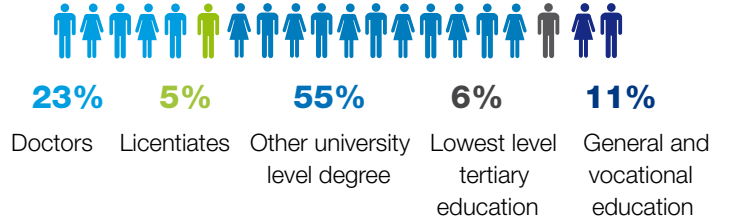
- 1,505 customers
- 815 domestic companies
- 415 foreign companies
- 275 public organizations in Finland and abroad



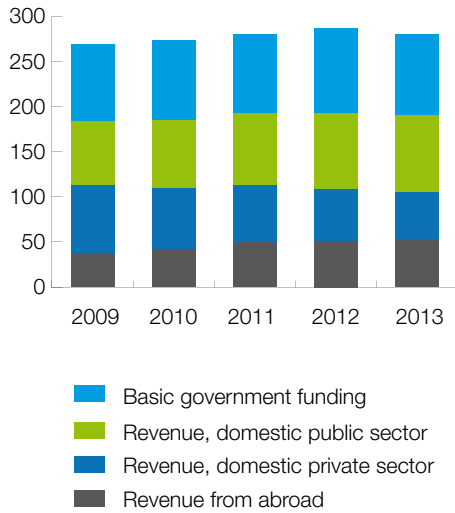
### Personnel strength and structure



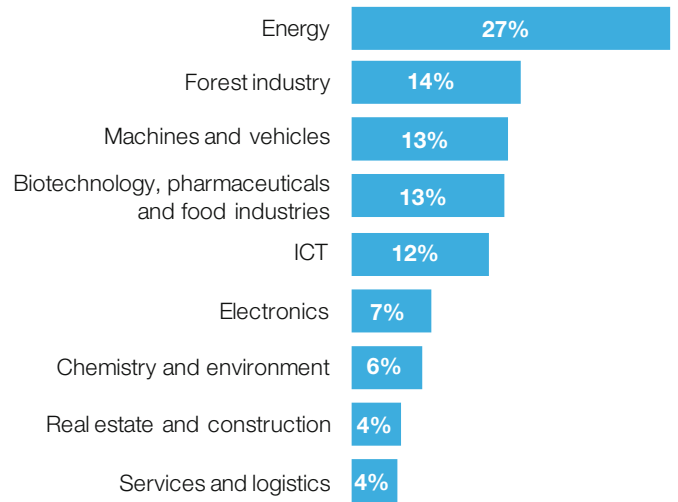
### Education of personnel



### Turnover, M€

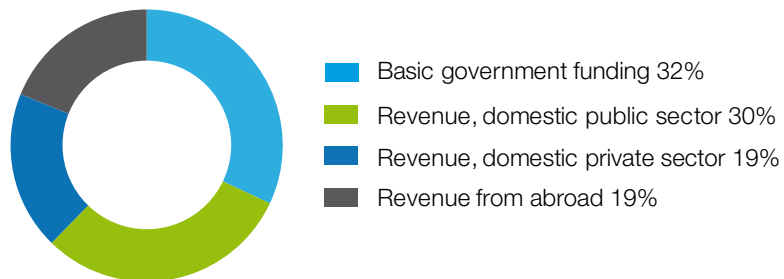


### Revenue from commercial activities in the domestic private sector (\*)



\*) Classification according to VTT's customer segments.

### Turnover by type of revenue



# Organisation

VTT has sharpened its strategy, focused its operations and renewed its organisation, effective from 1 January 2014. This is to respond to competition in the domestic markets and to strengthen competitiveness in the changing operational environment both at home and abroad.

The new strategy places emphasis on a multitechnological approach and the benefits and impact of research. Such benefits and impact are generated by combining multiple technologies and competencies – something that the new organisation supports – and serve to promote the business operations of VTT's customers and the well-being of society as a whole.

VTT's new organisation focuses research on three business areas: Knowledge-intensive products and services, Smart industry and energy systems, and Solutions for natural resources and the environment.

## Organisation 1.1.2014

Erkki KM Leppävuori, President & CEO

### Business areas

#### Knowledge intensive products and services

*Petri Kalliokoski, Executive Vice President*

#### Smart industry and energy systems

*Jouko Suokas, Executive Vice President*

#### Solutions for natural resources and environment

*Kari Larjava, Executive Vice President*

### CTO's office

*Anne-Christine Ritschkoff, Executive Vice President*

### Business support

*Seppo Viinikainen, Executive Vice President, Administration*

*Riitta Tolvanen, Senior Vice President, HR*

*Matti Karhunen, Senior Vice President, Legal, IPR and security*

*Timo Nurminiemi, Senior Vice President, Finance*

*Markus Ekman, Senior Vice President, Information management*

*Olli Ernvall, Senior Vice President, Communications*

### VTT companies

**VTT Expert Services Ltd**, *Laura Apilo, CEO*

**VTT Ventures Ltd**, *Antti Sinisalo, CEO*

**VTT International Ltd**, *Petri Kalliokoski, CEO*

**VTT Memsfab Ltd**, *Hannu Kattelus, CEO*

More information on VTT activities and research: [www.vtt.fi](http://www.vtt.fi)

Web version of VTT Review:  
[www.vtt.fi/vtt2013](http://www.vtt.fi/vtt2013)

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VTT impacts the the future by creating intelligent technologies, productive solutions and innovative services.

Together with you we create results from technology and well-being for people.



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