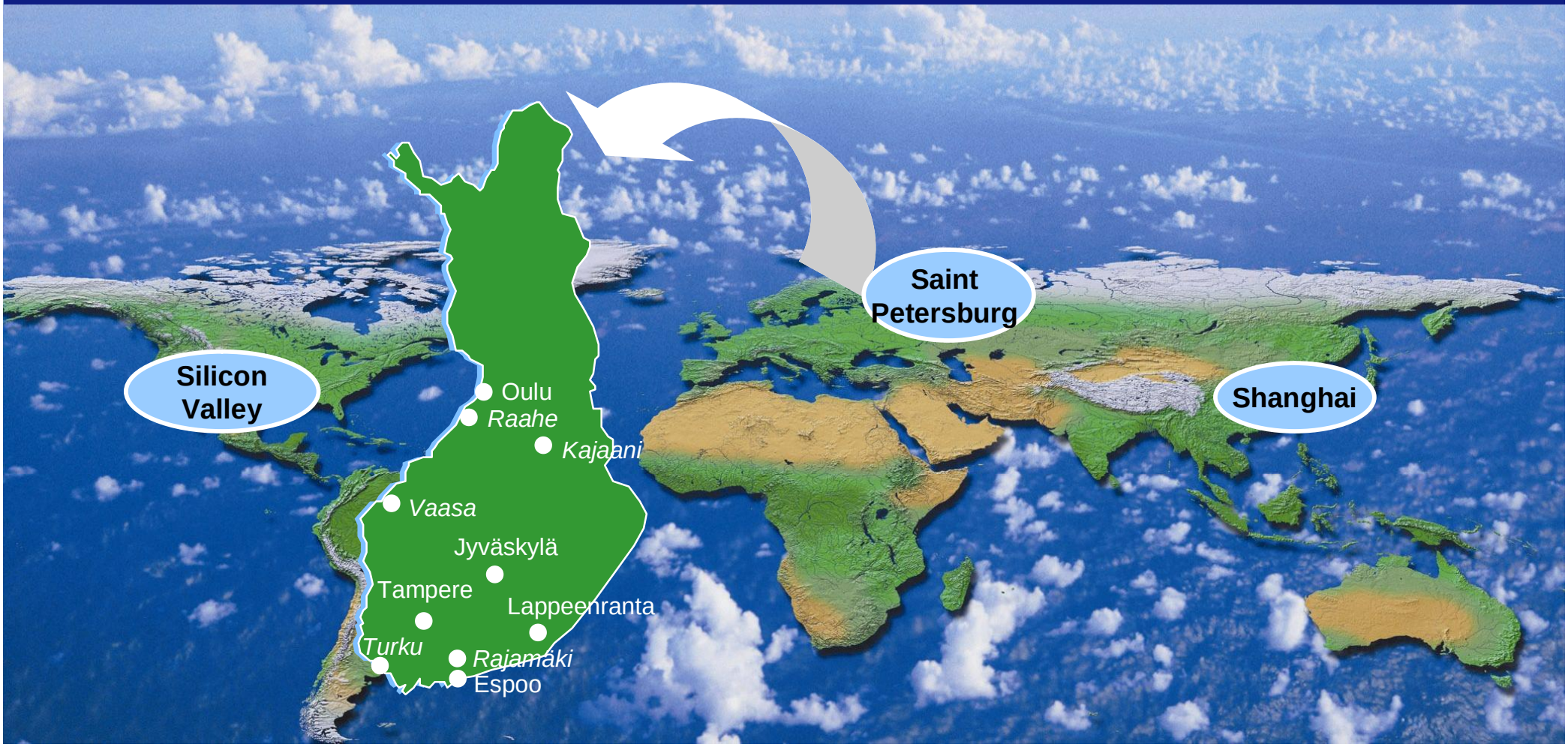
VTT TECHNICAL RESEARCH CENTRE OF FINLAND IN BRIEF

2007

Business from technology

VTT ON THE MAP



PUBLIC DECISION MAKERS, FINANCIERS AND R&D PERFORMERS

Parliament of Finland

Council of State

Ministry of Education

Ministry of Trade and Industry

Other ministries

Academy of Finland

The Finnish Funding Agency for Technology and Innovation

The Finnish Innovation Fund

Universities

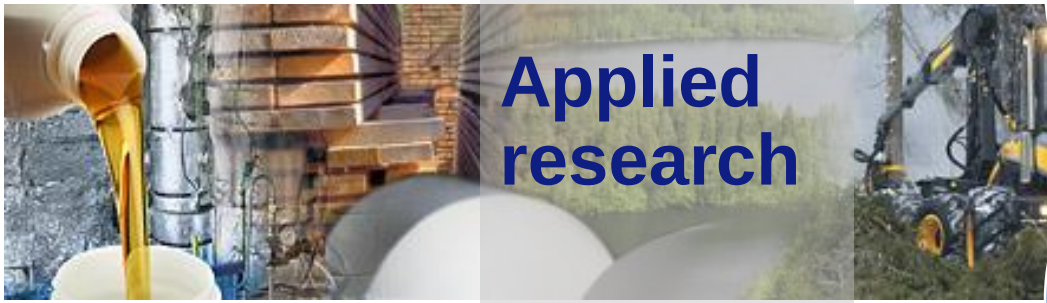
VTT

Other research institutes

TE-Centers

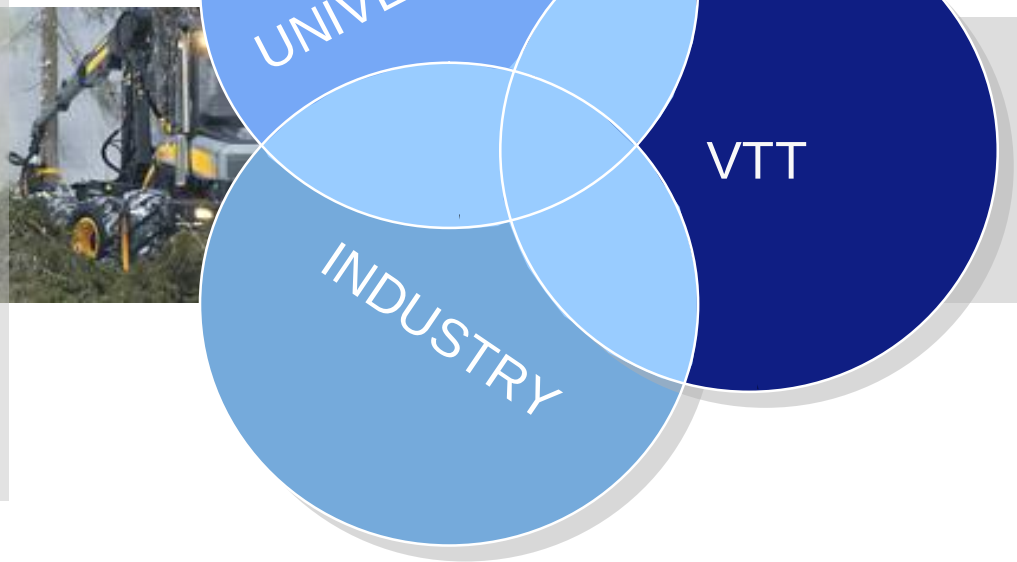
VTT'S STATUS AS PERFORMER OF R&D WORK

Basic research



Applied research

Development work



VTT - CREATING BUSINESS FROM TECHNOLOGY

VTT IS:

- The biggest multidisciplinary research organisation in Northern Europe
- An essential part of the Finnish innovation system

VTT HAS:

- Polytechnic R&D covering different fields of technology from electronics to building technology
- Clients and partners: industrial and business enterprises, organisations, universities and research institutes

VTT CREATES:

- New technology and science-based innovations in co-operation with domestic and foreign partners

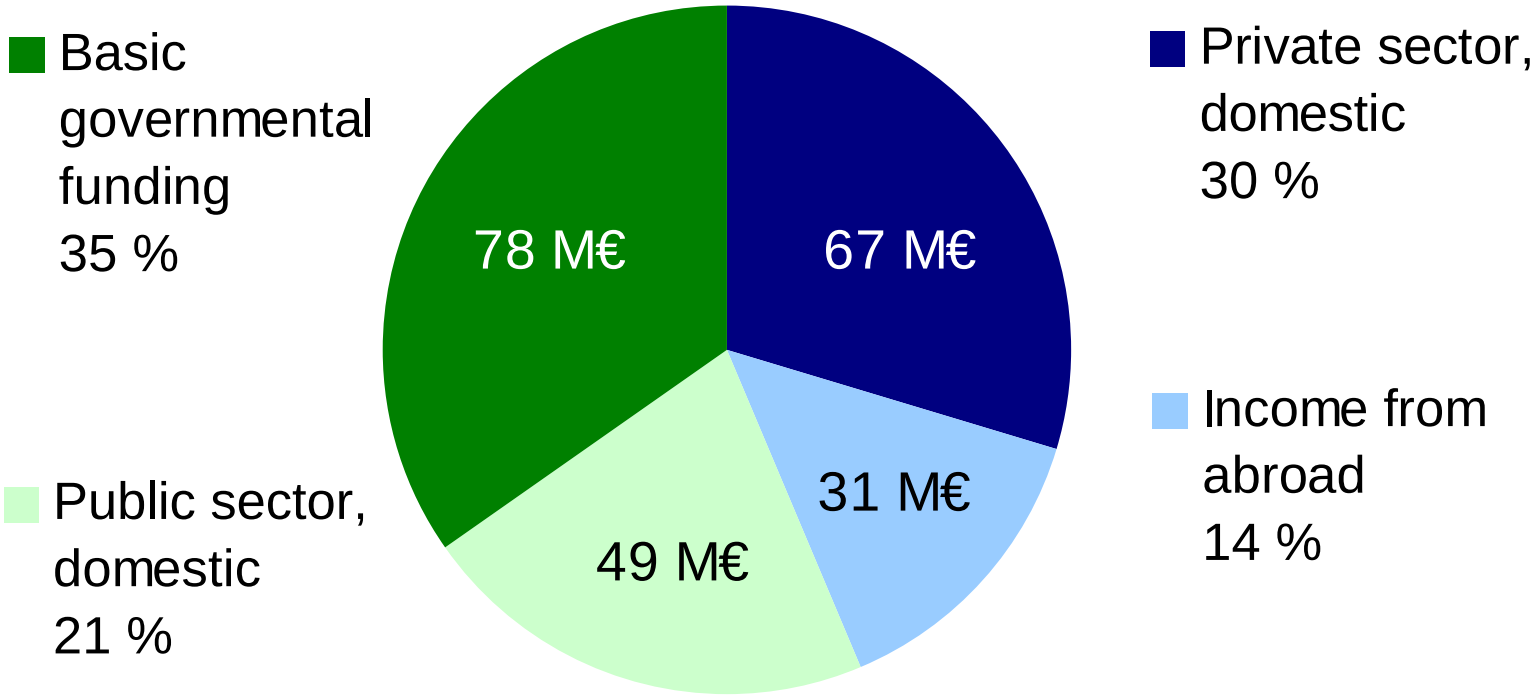
VTT IN BRIEF 2007

2 780 employees
217 M€ turnover 2006

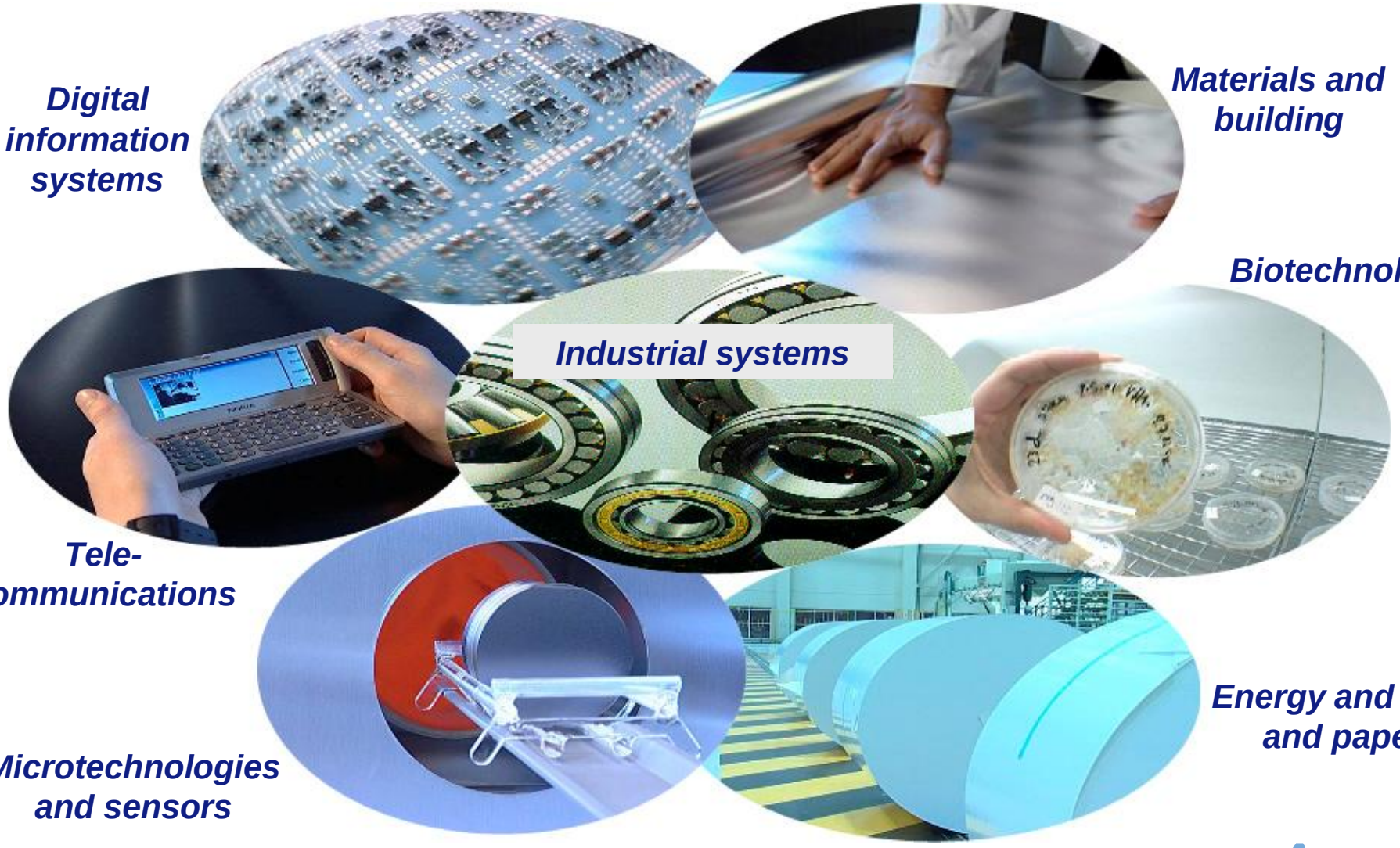
7 Knowledge Clusters:
§ Digital Information Systems
§ Telecommunications
§ Microtechnologies and Sensors
§ Materials and Building
§ Industrial Systems
§ Biotechnology
§ Energy and Pulp&Paper
46 Knowledge Centres

9 Key Customer Sectors:
§ Biotechnology, pharmaceutical and food industries
§ Electronics
§ Energy
§ ICT
§ Real estate and construction
§ Machines and vehicles
§ Transport and logistics
§ Forest industry
§ Process industry and environment

TURNOVER


Basic governmental funding 35 %
Private sector, domestic 30 %
Public sector, domestic 21 %
Income from abroad 14 %
78 M€
67 M€
49 M€
31 M€

VTT KNOWLEDGE CLUSTERS



VTT ’S CORE COMPETENCIES

ENVIRONMENTAL RESEARCH

Business from technology

ENVIRONMENTAL TECHNOLOGY INNOVATIONS

Our goal is to take environmental impacts into consideration in all aspects of our technological development work

Our research is focused on

- Emission control (vehicles, motors, processes)
- Environmental monitoring technologies
- Waste and waste water
- Sludges and sediments
- Environmental risk management
- Clean products and processes
- Prevention of climate change
- Sustainable energy systems

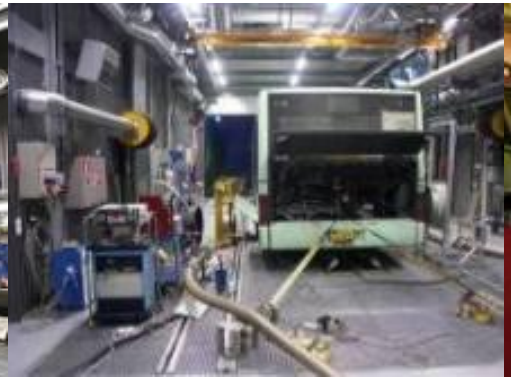
VEHICLE EMISSIONS AND ENERGY USE

Competence

- Our activity is focused to the efforts of reducing energy use in transport and traffic, along with the environmental impacts

- We have expertise to deal with the complex interactions between fuels, engines, vehicles, emissions and energy supply

- Our top-rate research facilities for light and heavy-duty vehicles allow very realistic simulation of real-world operations regarding duty-cycles and conditions aiding e.g. the development of emission control technologies or determining energy use and emissions of vehicles in any dedicated operating profiles


VEHICLE EMISSIONS AND ENERGY USE

Solutions

- Our facility for heavy-duty vehicles enables us to determine emissions and energy use from either engines or complete vehicles using real-life transient-type duty-cycles
- Development of emission control measures and assessment of means to reduce energy use is also more accurate

Benefits

- The possibility to work with complete vehicles and accurately simulate real-life duty-cycles opens up excellent possibilities to determine specific emissions and energy use simulating realistic, in-use conditions
- Running tests with complete vehicles is more cost-effective than testing stand-alone engines, especially if in-use vehicles are involved



VEHICLE EMISSIONS AND ENERGY USE

Facilities

Light-duty vehicle research

- chassis dynamometer for light-duty vehicles + a climatic test cell (+25…-30°C)

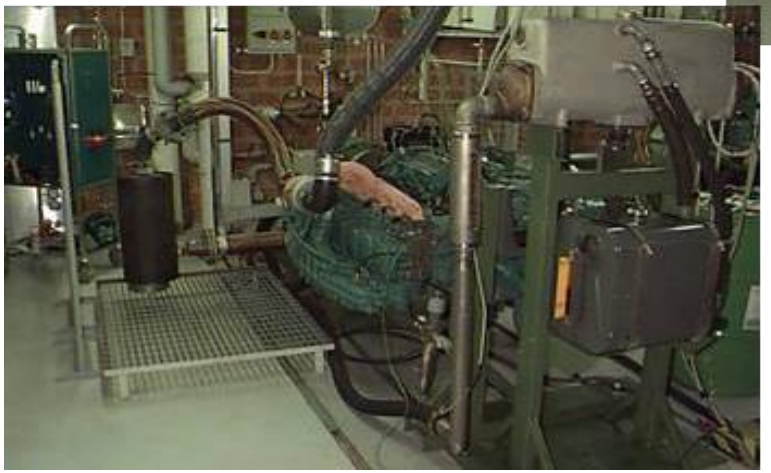
- measuring equipment for exhaust research, including non-regulated gaseous emissions and particle emissions

VEHICLE EMISSIONS AND ENERGY USE

Facilities

Engine research

- 5 steady-state engine dynamometers
- climatic test chamber for engine tests (dynamometer + hydraulic propulsion)
- 1,6 MW(e) research diesel power plant
- measuring equipment for engine research
- exhaust emission analysers



WASTE UTILIZATION

Competence

- Our expertise covers the whole waste management chain and the operational environment of the waste sector; waste utilization, processing and disposal
- We use lab-scale and pilot tests, chemical analyses, life cycle analysis, risk assessment tools, and modelling to find new sustainable solutions to our customers
- VTT has a long-term experience in the assessment of environmental impacts of all kinds of wastes and by-products, their utilization, processing and disposal

WASTE UTILIZATION

Solutions

- From waste to product
  - Development of alternative products and materials from industrial residues and wastes
  - New techniques for enhancing the technical and environmental characteristics of materials
- Assessment and minimization or environmental impacts and risks of waste utilization, treatment and disposal
- Development of sustainable re-use, treatment and disposal alternatives for different kinds of waste streams

Benefits

- Resource conservation
- Saving of landfill space
- Financial benefit, new valuable materials from waste
- Minimizing of environmental impacts and risks

NEW MATERIALS FOR MINERAL TOP LAYER OF LANDFILLS

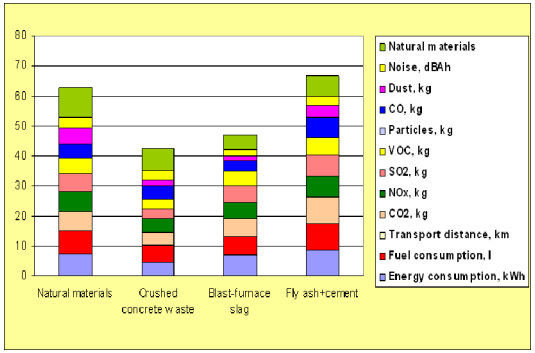
Achievements - Project examples

- A methodology for the assessment of acceptance of industrial by-products in the mineral top layer on landfills
- Recommendations for suitable test methods and environmental criteria
- Advances the use and acceptance of waste materials suitable for landfill liners / mineral top layers
- Creates the basis for the development work of competitive liner materials

LIFE-CYCLE IMPACTS OF BY-PRODUCTS IN ROAD CONSTRUCTION

Achievements - Project examples

- Methodology and tool (MELI) for calculating life-cycle environmental impacts of the use of by-products in road construction (1996 - 2000)
- Calculation and comparison of alternative constructions including fly ash, blast furnace slag and crushed concrete
- Pilot-testing in actual road construction projects in 2003 - 2004
- Further development of an Ecoindicator system (EIMI) for calculating environmental impacts of infra construction (2006)



RISK BASED MANAGEMENT OF ORGANO-TIN CONTAMINATED SEDIMENTS

Achievements - Project examples

- Instructions for dredging, depositing and remediation of organo-tin contaminated sediments include:
  - Assessment of the possibility to deposit contaminated sediments into sea
  - Selection of appropriate techniques
  - Recommendations for investigation and monitoring procedures
  - Risk assessment and risk management procedures
  - Environmental impact assessment using LCA

- The main focus is on capital and maintenance dredging operations in the Baltic Sea

- The overall aim of the instructions is to execute dredging, depositing and clean-up works of sediments according to the Best Environmental Practice including cost-benefit analysis into the planning



TREATMENT TECHNOLOGIES FOR ACID MINE DRAINAGE

Achievements - Project examples

- Utilization of sulphate reducing bacteria: method for treatment of metal and sulphate containing waters
  - The application uses flooded mine pits as a reactor
  - The idea is to stimulate bacterial activity directly in the contaminated water body and to use mine itself as a sedimentation basin for metal sulphide sludge
  - To promote bacterial growth e.g. liquid manure will be added into the open pit or mine shaft

- Permeable reactive barriers for contaminant degradation or removal
  - No aboveground structures or external energy needed → low operating costs
  - Granular cast iron (Fe0) and also scrap iron or other by-product materials can be used as a reactive material

MEASUREMENT TECHNIQUES FOR GAS COMPONENTS

R&D in measurement technologies

- sampling
- on-line techniques, coupling to process control
- development of instruments and methods

Characterization of emissions

- gases, particulate matter, fine particles, odours
- advanced measurement technologies
- quality control and quality assurance of measurements

Capacity building and technology transfer projects

R&D IN EMISSION MEASUREMENT TECHNOLOGIES

Competence

- VTT has diverse facilities for the development of new measurement techniques for gaseous components as well as for particulates
- We can combine our knowledge concerning the legislation, standards and industrial processes when defining the needs for new innovations

Challenges

- On line measurement techniques are needed widely in environmental monitoring; for example several European Union directives dealing with emissions require continuous measurement of polluting components (directives for large combustion plants and waste incineration)
- Process optimisation can be performed effectively only if the components are measured on a real-time basis
- Climate change brings new challenges to the world: also to the measurement techniques

R&D IN EMISSION MEASUREMENT TECHNOLOGIES

Solutions

- Development of novel techniques for the determination of gas components and flow
- Suitable sampling techniques for challenging applications

Benefits

- Real-time information about the process
  → process savings
  → suitable abatement techniques

R&D IN EMISSION MEASUREMENT TECHNOLOGIES

References

- Several innovations with patents
- Acoustic flowmeter
- Rotating pitot-type flowmeter
- Development of novel mercury analyser for emissions together with Gasmet Technologies Ltd.
- Sampling system based on porous tube dilution
- Flux hood for gaseous emission sampling from diffusive surface sources

R&D IN EMISSION MEASUREMENT TECHNOLOGIES

Projects examples

- Continuous mercury monitor, CMM
  - VTT and Gasmet Technologies Ltd. have developed together Gasmet™ Continuous Mercury Monitor (Gasmet CMM)
  - CMM utilizes Cold Vapour Atomic Fluorescence (CVAF) measurement technology which is specific to mercury, ensuring excellent sensitivity (5 nanograms / m^3)
  - CMM has been designed to exceed the requirements of US EPA Performance Specification 12A. It offers a cost-effective and reliable solution for total mercury monitoring

CHARACTERISATION OF EMISSIONS

Competence

- VTT has profound expertise on the characterisation of emissions from different sources, such as power plants, industrial processes and other sources emitting pollutants

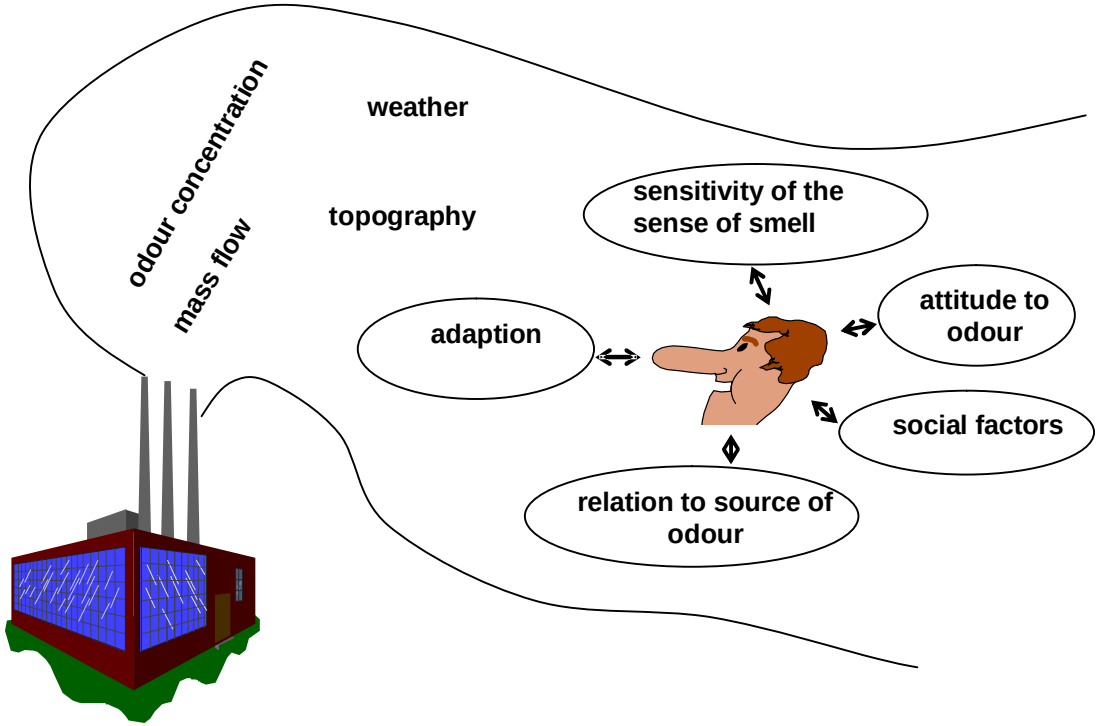
- VTT has versatile measurement techniques for the characterization of emissions, e.g.
  - Fourier Transform Infrared Spectroscopy, FTIR
  - Portable Gas Chromatographs
  - Electrical Low Pressure Impactor, ELPI
  - Tapered Element Oscillating Microbalance, TEOM
  - Scanning Mobility Particle Sizer, SMPS
  - Electron microscopy laboratory (SEM, TEM)

- Quality assurance in the field of emission measurements is one of our main interests

CHARACTERISATION OF EMISSIONS

Competence

- Odour assesment is one of our field of expertise and it can be studied using following methodologies:
  - Olfactometry, including different techniques for odour sampling
  - Field investigations
  - Population panels
  - Population surveys



CHARACTERISATION OF EMISSIONS

Benefits

- Reliable and internationally comparable information about emissions (for compliance assessment etc)
- Financial benefit through process optimisation
- Less environmental impacts

CHARACTERISATION OF EMISSIONS

Project examples

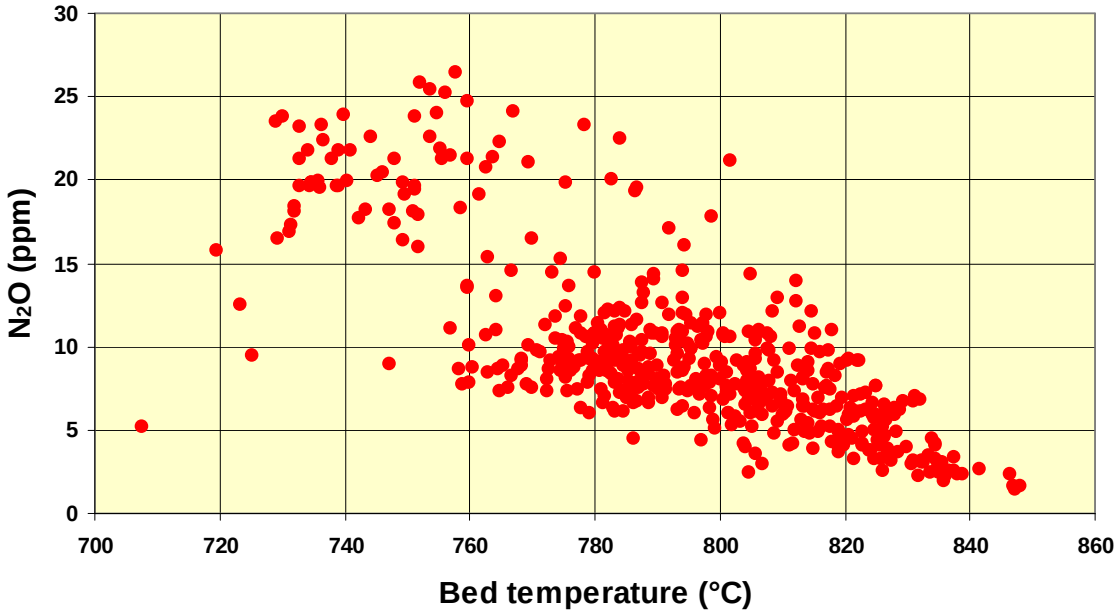
- Revision of emission factors for N_2O and CH_4 in Finland, results used in intergovernmental panel for climate change, IPCC
  - Aim of the project: to improve emission factors used by Statistics Finland in reporting to the UNFCCC
  - Measurements carried out in different combustion conditions
  - Results: http://virtual.vtt.fi/inf/pdf/workingpapers/2006/W43.pdf (in Finnish with English summary)
  - Funded by Statistics Finland, ministries, interest groups of industry and boiler manufacturers

CHARACTERISATION OF EMISSIONS

Projects examples

- Revision of emission factors for N_2O and CH_4 in Finland

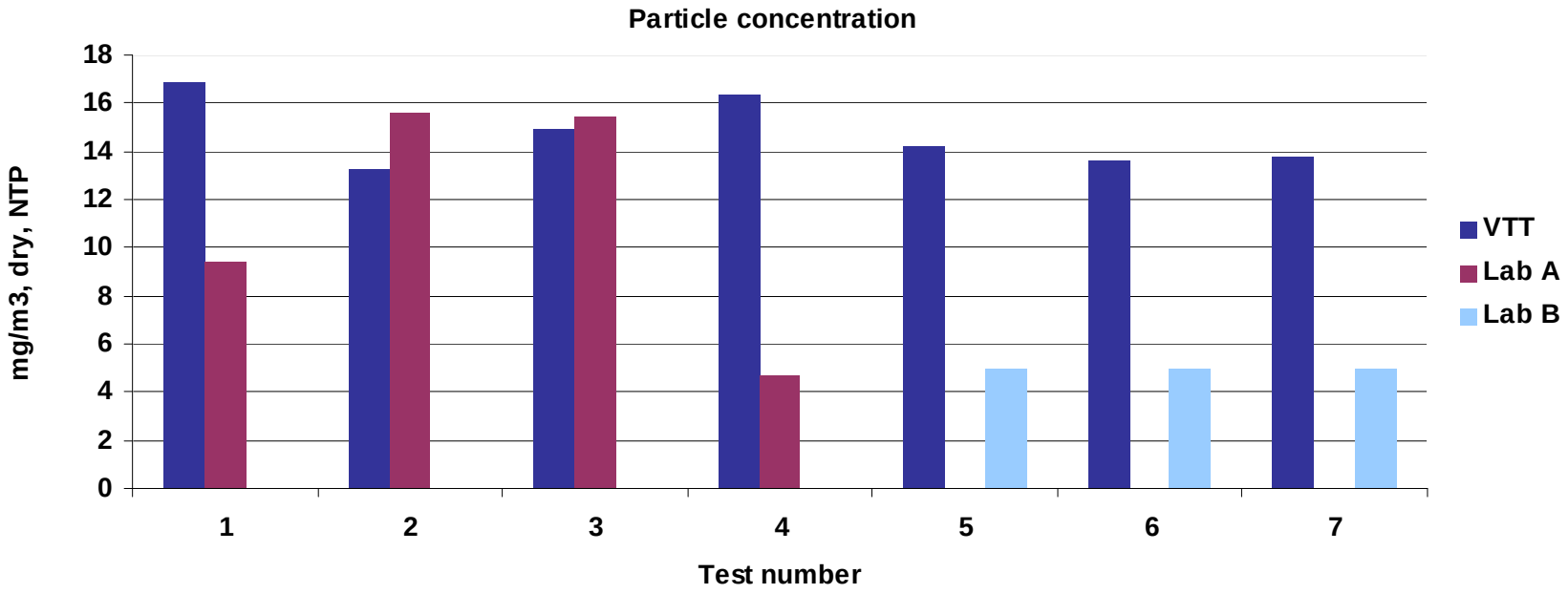
N_2O VS. BED TEMPERATURE OF THE CFB -BOILER; mixed fuel – mainly peat



CHARACTERISATION OF EMISSIONS

Projects examples

- Organisation of several national and international comparison measurement campaigns for emissions



CHARACTERISATION OF EMISSIONS

Projects examples

- Harmonisation of national emission measurement procedures in Finland, ”Handbook for emission measurements”

  Part 1: Emission measurement techniques and their quality assurance

  Part 2: Control and permitting of industrial enterprises in Finland

  Part 3: Presentations of analyser manufacturers

CAPACITY BUILDING PROJECTS

Competence

- VTT has more than 30 years of experience in the research related to emission measurements and the quality assurance. Based on this experience, VTT has carried out capacity building projects for Baltic countries (Estonia, Latvia and Lithuania) and Russia since 1992

- VTT has also organized several comparison measurement campaigns for both domestic and foreign emission measurement consultants

CAPACITY BUILDING PROJECTS

References

- Capacity building projects dealing with the emission measurements and odours in Russia, Baltic countries, India and Uruguay

- Clients:
  - Finnish Ministry of the Environment
  - Finnish Ministry of Foreign Affairs
  - Local authorities (e.g. Rostehnazor in Russia)
  - Local research institutes (e.g LATU in Uruguay)

CAPACITY BUILDING PROJECTS

Project examples

- Build-up of central emission measurement laboratories in the Baltic countries
  - Duration of the project:1992 - 2006
  - Funded by the Finnish Ministry of the Environment
  - The objectives in this co-operation were:
    - Ø to establish national emission measurement activity in each Baltic country, and
    - Ø to disseminate the information to other measurement institutes
  - The history of emission measurement activities started along this capacity building project in each Baltic country
  - From the start until this moment, national emission measurement activity in neighbouring areas of Finland has been established

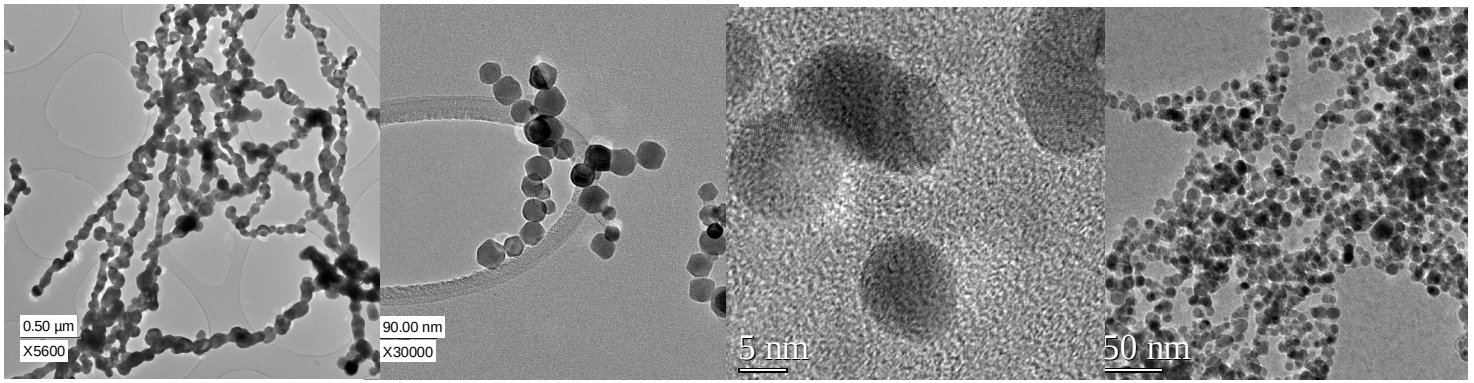
FINE PARTICLES

Competence

- VTT has key competence in fine particle technology for nanomaterial synthesis, combustion emissions and aerosols in nuclear safety

- Our combined knowledge on fine particle technology in main industrial applications makes it possible to create new breakthrough solutions for selected applications

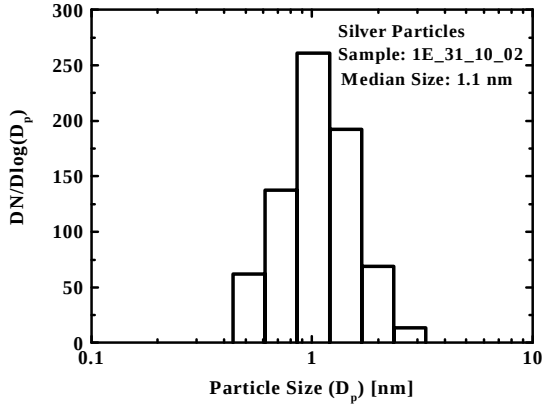
- High resolution electron microscopy, state-of-the-art fine particle characterization and modelling methods are the tools for top research



FINE PARTICLES

Challenges

- Fine particle technology is extensively needed in nanomaterial applications and health related issues on fine particles
- The applications of tailored nanoparticles are rapidly growing for example in electronics, sensors, catalysis and energy technology
- The demand of cleaner air will put new challenges on reduction of fine particle emissions
- Rapidly increasing demand for nanoparticles requires more refined production techniques for these materials



FINE PARTICLES

Solutions

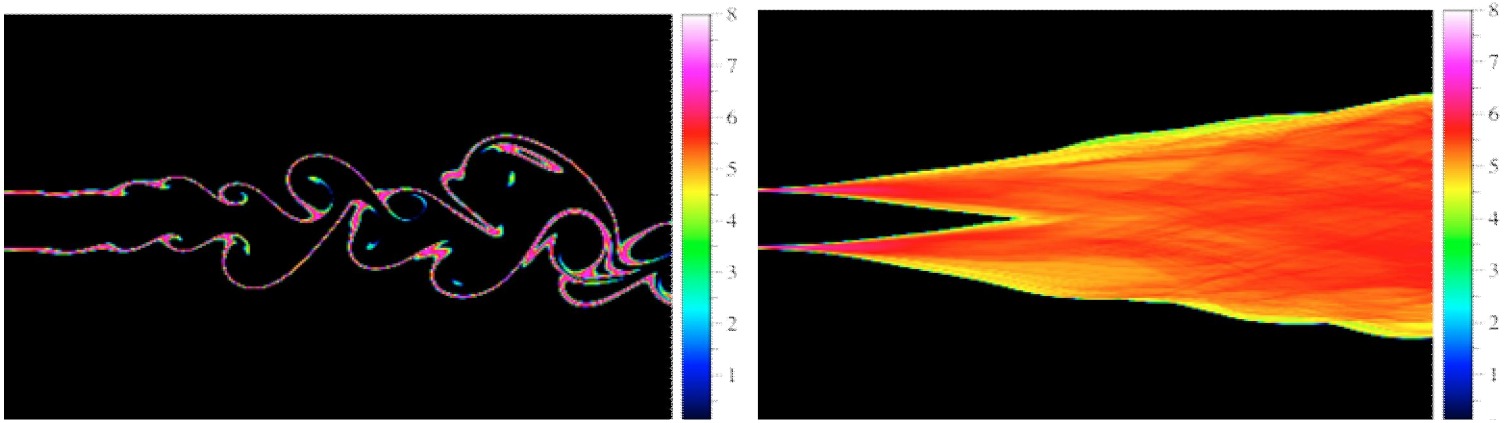
- New high yield method for nanosized metal particle synthesis with specified crystallinity and primary particle size

- Comprehensive data-base on fine particle sources in Finland for future reduction technology allocations.

Benefits

- Knowing what's what in fine particle business benefits the customer in fast and best solutions in every situation

- Professional experts in fine particle measurement technology, modelling particle dynamics and manufacturing technologies is a must for competitive solutions in air cleaning and nanoparticle synthesis



VTT CREATES BUSINESS FROM TECHNOLOGY