



Nanotechnology

in Turin and Piedmont



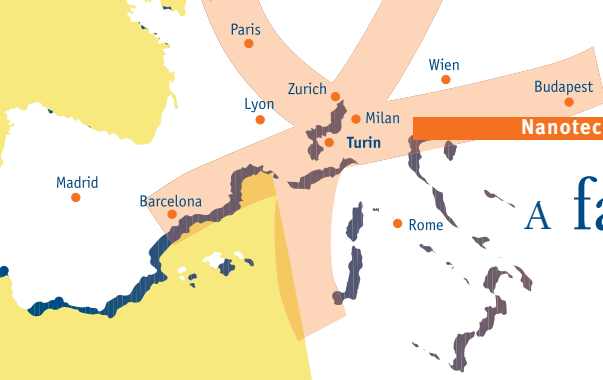
The choice of success

In the heart of North West Italy
At the centre of European development



Invest in Turin and Piedmont





Nanotechnology - Why Turin and Piedmont

A favourable environment for nanotech activities.

**PIEDMONT
FACTS & FIGURES**

- 4 million inhabitants (7.5% of the national population)
- €113bn GDP (8.4% of the national total)
- 460.000 companies
- €31bn exports
- €3.5bn FDI inflows and outflows 2003-2005 (8.2% of the national total)
- 1.6% of GDP invested in R&D
- 200 public and private R&D centres
- 18,000 R&D professionals (11% of national R&D employees)

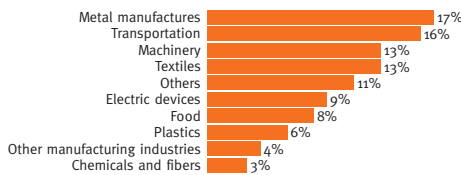
[Source: Unioncamere Piemonte, 2006]

STRENGTHS

- Access to the Central European and Mediterranean areas
- 1st Italian region for private investment in R&D [Source: Filas, 2006]
- 1st Italian region for expenditure on innovation in the manufacturing sector [Source: Filas, 2006]
- Training Institutions and R&D centres of international standing
- Europe's first Degree Course in Nanotechnology at the Politecnico di Torino
- Skilled and flexible workforce at competitive costs
- State-of-the-art telecommunications infrastructure with the first Italian Neutral Access Point (NAP)
- Second centre in Italy for venture capital operations [Source: AIFI 2006]
- Public and private financing resources to fund technological innovation projects
- The Olympic Winter Games in 2006

A unique industrial vocation

A deep industrial know-how and diversified manufacturing activities provide the ideal environment for finding commercial applications for several nanotechnology innovations. Turin and Piedmont are in the heart of Europe, a 450m people market.



[Source: Confindustria Piemonte 2003]

Tradition of innovation

Piedmont has been a hub for major technical innovations from the electric engine in the 19th century, to the MP3 file format in the software industry, and the common rail for diesel engines in the automotive industry.

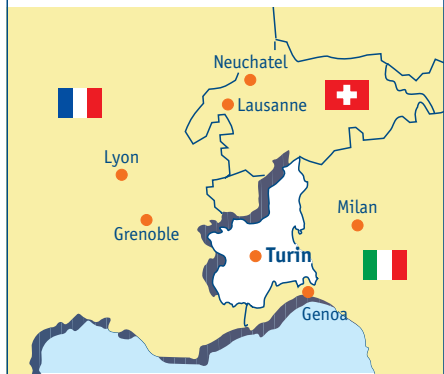
Availability of skilled personnel

Three major universities (Università di Torino, Università del Piemonte Orientale, Politecnico di Torino) and an extensive network of postgraduate schools provide a steady stream of highly motivated and skilled young people.

R&D intensity

- 1st Italian region for private investment in R&D
- Over 200 private and public R&D centres active in the region with 17,000 researchers
- Qualified professional services experienced in the full development of intellectual property potential, in terms of patents, trademarks and licensing.

At the centre of a thriving network of excellence in nanotechnology



Turin and Piedmont are located right in the centre of an area with international capabilities in micro and nanotechnology, linked to major education and research centres in Italy, France and Switzerland.

A "five star" region, between Europe and the sea

With its extensive vineyards, hundreds of kilometres of ski slopes, spa towns, lakes, nature parks and a vast artistic heritage, Piedmont has much to offer. Everything is at your fingertips,



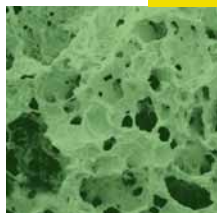
from the Alps to the Mediterranean Sea, with Liguria and the Côte d'Azur just an hour away. The region has successfully hosted the Winter Olympics of Torino 2006 and is now equipped with brand-new facilities and further specialized services.



Piedmont areas of specialization in nanotechnology.

THE CONVERGENCE OF NANOSCALE RESEARCH WITH OTHER SCIENCES SUCH AS BIOLOGY, CHEMISTRY AND PHYSICS THAT LINK UP WITH ENGINEERING, CREATES VAST OPPORTUNITIES TO ENHANCE PERFORMANCE. IN PIEDMONT, INDUSTRY CAN BENEFIT FROM A FAVOURABLE ENVIRONMENT, THAT COMBINES TECHNOLOGY, MATERIALS AND CHARACTERISATION KNOW-HOW WITH THE CAPACITY TO DEVELOP NEW APPLICATIONS.

Nanomaterials



Different synthesis methods allow the production of nano-structured materials with remarkably improved properties and applications in many fields such as textiles and automotive. The three Piedmont universities carry on research in this field in combination with local research centres dedicated to nano-structured interfaces and surfaces, semiconductors, ceramic and plastic materials.

Textiles



Thanks to nanotechnologies textiles and clothing are going to become "smart". They will be able to give us cold or heat according to our needs, as well as deliver drugs through the skin. Applications for 'smart' clothing will include healthcare and telemedicine, but more and more uses for these materials are being identified. Projects in this field are coordinated by the association Tessile e Salute (www.tessileesalute.it).

MEMS/NEMS



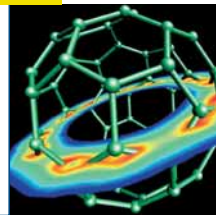
Micro and Nano Electro Mechanical Systems are micro/nano components and devices merging mechanical and electronic know-how. Public research centres (such as the Xlab), dedicated to materials, micro and nano systems, offer the technology and know-how for MEMS/NEMS business oriented research and prototyping. Research centres of both the Fiat Group and Telecom's Olivetti carry on applied research on MEMS/NEMS with relevance to their businesses. Avago Technologies has developed a related technology with applications to its semiconductors products and lasers.

Agriculture and food sensors



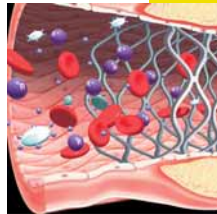
Important improvements have been identified in agriculture both directly on field applications and in food packaging. Thanks to chemical functionalization of surfaces a great number of sensors are developed in order to produce smart food packaging. The Cuneo district is strongly involved in these applications.

Chemicals



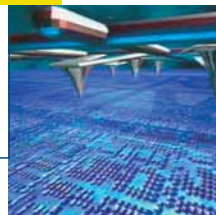
Chemistry is involved in numerous areas of nanotechnology. The use of nanoparticles as excellent catalysts is an example of nanotechnology applied to chemistry in the automotive industry. The universities and corporate research centres carry on joint research programs.

Bio- micro and nanotechnologies



Major areas of interest with local specific know-how are diagnostic and drug delivery systems, as well as coating surfaces for biocompatible materials. Key players are Sorin and the Politecnico di Torino with the Centre of Excellence Latemar. Another important application is the use of micro arrays in the field of oncogenomics at the Institute for Cancer Research (IRCC).

Nanometrology



Nano scale requires specific tools and know-how for measurements, testing and certification. The region hosts the National Institute of Metrological Research-INRIM (www.inrim.it).

Academic know-how in nanotechnology.



PIEDMONT UNIVERSITIES AND RESEARCH CENTRES HAVE A WORLDWIDE RECOGNITION FOR TOP QUALITY RESEARCH BY INTERNATIONAL JOURNALS AND PUBLICATIONS. TURIN AND PIEDMONT HAVE THE HIGHEST CONCENTRATION OF ENROLLED STUDENTS IN SCIENTIFIC COURSES IN THE WHOLE OF ITALY.

Politecnico di Torino (www.polito.it)



In the field of microsystems, biomedical applications of micro/nanotechnology, nanostructured materials and chemical applications of nanotechnology, the departments of mechanics, physics and electronics, and materials science offer interdisciplinary competencies ideal to foster research. A Master's Degree in Micro and Nano Technologies for Integrated Systems (www.master-nanotech.com) is active in collaboration with the Ecole Polytechnique Fédérale de Lausanne in

Switzerland and the French Institut National Polytechnique de Grenoble together with Minatoc.

In 2005 Politecnico was funded by the Ministry of Education University and Research for the creation of the Centre of Excellence LATEMAR-Micro Technology Laboratory for Bioelectrochemical Diagnostics and Research.



- 26,000 students
- 900 lecturers/researchers
- 4 schools of Engineering
- 2 schools of Architecture
- 35 Master of science courses
- 30 doctorates
- 18 departments for research activities
- 800 research contracts with public institutions and industries

[Source: Politecnico di Torino]

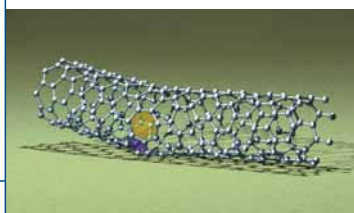
Università di Torino (www.unito.it)

The Department of Inorganic, Physical and Material Chemistry promotes and coordinates research in the field of chemical sciences, especially in those sectors covering the study of structures and properties of inorganic compounds and materials.



- 65,563 students
- 4,331 teachers
- 770 researchers
- 12 faculties
- 55 departments
- 6 university schools
- 7 bi-national degrees
- 3 centres of excellence

[Source: Università di Torino]



Università del Piemonte Orientale

"Amedeo Avogadro" (www.unipmn.it)

Materials Science and Solid State Chemistry are developed in the Department of Science and Advanced Technology-DISTA (<http://dista.unipmn.it>).

A permanent staff of professors and researchers along with PhD students and post-docs works on nanostructured materials suitable for light emission, sensors, catalysts, nanocomposite polymers, superconductors and magnetic solids.



- 9,858 students
- 12 departments
- 13 master's degrees
- 16 specialization schools in the medical field
- 39 research partnerships with foreign universities

[Source: www.miur.it]



Collaborative partnerships.

Research centres are the key to the development of the converging technologies that make up nanotechnology. They offer to companies their research facilities and their skilled personnel. They employ full time staff and also part-time/temporary staff, generally from both universities and companies.

Xlab-Materials and Microsystems Laboratory (www2.polito.it/ricerca/thin-film/Chivasso/Chivasso.html), managed by the **Politecnico di Torino** and the National Institute for Physics of Matter (INFN), works on the design and creation of micro and nano systems prototypes, with a specific focus on technological transfer. Xlab collects both technological and fundamental knowledge for materials analysis, processes and design of devices, circuits and systems suitable for MEMS, NEMS and microsensors. It offers facilities for the main lithographic techniques and all the equipment necessary for the production of micro and nano systems. Measurement instruments and facilities for the characterization of films and devices are also available. About 30 researchers work in the centre. In 2005 the Ministry of University, Education and Research funded Xlab to coordinate the Micro-Technology Laboratory for Bioelectrochemical Diagnostics and Research (LATEMAR), a national centre of excellence operating in the field of micro and nanotechnology applied to biology and medicine.

Nanotechnology research centres.

■ The **National Institute of Metrological**

Research-INRIM (www.inrim.it) is the national public body born from the merger of the Istituto Elettrotecnico Nazionale “Galileo Ferraris” (www.iien.it) and the Istituto di Metrologia “Gustavo Colonnetti” (www.imgc.cnr.it).

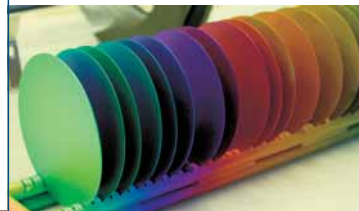
With 280 researchers, it has become the focus of most scientific metrology activities in Italy. Its research activities in measurement science, materials science and innovative technologies are recognised at world-wide level.

INRIM carries out studies and researches on the realization of primary standards for the basic and derived units of the International System of units (SI), assures the maintenance of such standards, their international comparison and in general provides measurements traceability to the SI. In addition to physical and engineering metrology, its main R&D areas are in fundamental physical constants, materials, metrology for chemistry, nanotechnology, innovation, quantum information, and artificial vision.



■ **ISTEC - Istituto di Scienza e Tecnologia dei Materiali Ceramici** (www.istec.cnr.it)

is the institute of the National Research Council (CNR) that conducts research to develop advanced ceramic materials with nanometric microstructure, both monophasic and composite. The team includes 100 researchers, 15 of whom work in Turin.



■ **Clean NT Lab** (www.cleanntlab.com),

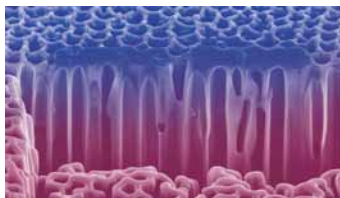
based at the Environment Park in Turin, is dedicated to experimentation on innovative coatings with high technology content and low environmental impact. The Lab, with a team of 5 people, provides a PVD (Physical Vapor Deposition) plant to carry out PVD coating tests, characterization tests on coated components, functional resistance and life prediction tests and samples.

NIS - Nanostructured Interfaces and Surfaces (www.nis.unito.it) is one of the eight Italian Centres of Excellence, together with Cebiovem (www.cebiovem.unito.it) also based in Turin, recognized by the Ministry of Education University and Research (MIUR). It originates from the joint effort of several research groups of the Università di Torino and of the Università del Piemonte Orientale in the fields of chemistry, physics and biology. The Centre offers a multidisciplinary laboratory equipped with the most advanced techniques in microscopy and spectroscopy. NIS, with its team of 80 researchers, focuses on nanostructured interfaces and surfaces that strongly influence the materials' final properties.

The Center for the Plastics Engineering (www.cdcmp.it) is promoted by the Politecnico di Torino and the Proplast Consortium (www.proplast.it) including 60 companies, many of which operate worldwide, and 8 universities, among which the Università del Piemonte Orientale “Amedeo Avogadro”. The Centre, based in Alessandria and employing 15 researchers, was founded as a point of reference in the field of plastics for professional education within the University, as well as for enterprises. The Centre for Engineering of Plastic Materials has significant experience in the investigation of nanocomposites.

Nanotechnology industrial expertise.

- **Avago Technologies** (www.avago.com), which was spun off from Agilent Technologies (formerly Hewlett-Packard) in December 2005, provides an extensive range of semiconductor components and subsystems for electronics, wireless, networking and imaging applications. Turin hosts the R&D Labs of the Fiber Optic Product Division and the Manufacturing Pilot Line for Semiconductor Laser fabrication, with more than 80 employees. Technology such as electron beam lithography and dry etching are used to work on challenge fields that include multi quantum well active layers and high operating temperature lasers.



- **Fiat Group Research Centre-CRF** (www.crf.it) was founded as an Engineering Centre providing R&D services to the different companies within the Fiat Group. Over the last ten years CRF has opened its doors to business with other companies in and outside the automotive sector. Currently it has a workforce of approximately 1,200 of which 800 have masters equivalent degrees or higher. CRF develops research in micro and nanotechnologies concerning lighting, sensing, information, energy and actuation applications.
- **International Rectifier** (www.irf.com), US company leader in power management, is holder of 450 technology patents and has operations in 20 countries. Its Borgaro facility in the province of Turin, with 270 employees, is certified to produce JANS Schottky diode and FRED wafers for use in hi-rel applications, such as commercial and military aircraft, space-launch vehicles, satellites and strategic weapon systems.

- **MEMC Electronic Materials** (www.memc.com), a leading global supplier of wafers to the semiconductor industry has a manufacturing plant in Novara, which is the site for wafer production and epitaxial deposition in Europe.
- **Olivetti Ink Jet** (www.olivettii-jet.it) is the Telecom Italia Group company dedicated to the research development and production of ink-jet technology, employing 400 people, 70 of whom in the research area. It is the only European company (and one of four worldwide) to run a full-cycle ink-jet production process and to develop all related components, from inks to printheads. Years ago, thanks to the know-how and investment in sophisticated equipments for the silicon foundry, Olivetti I-Jet started activities on MEMS.
- **Sorin Biomedica Cardio** (www.sorin-cid.com), with 1,000 employees, has developed some of the most clinically important cardiovascular and cardiopulmonary devices. Its activity in nanotechnology, in which 20 researchers are involved, concerns the treatments of heart valve surfaces. Research is also aimed at the development of an innovative drug delivery system in drug eluting cardiovascular stents.
- **Bracco** (www.bracco.it)
- **Cori** (www.corigroup.com)
- **Elettro Rava** (www.elettrorava.com)
- **Ferrania** (www.ferraniait.com)
- **Gpharma** (www.gipharma.it)
- **Nanovector** (www.nanovector.it)
- **Novara Technology** (www.novaratechnology.com)
- **Ozella** (www.ozella.it)

SCIENCE AND TECHNOLOGY PARKS

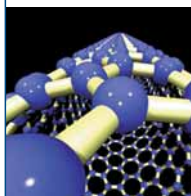
Two science and technology parks are involved in nanotechnology activities, the Bioindustry Park Canavese and the Environment Park. They are closely linked with the Universities and the Politecnico. They have been created with the aim of supporting research and development and encouraging technology transfer. The parks offer facilities, an extensive network of skills, contacts with potential partners and help with financing for the development of innovative projects with a high technological content.

ENVIRONMENT PARK (www.envipark.com) is devoted to environmental technologies and ICT. A cluster of private companies and public research centres (Università di Torino, Politecnico di Torino, National Research Council) work within the facilities of the Park, building up synergies and sharing experiences. Environment Park also acts as an incubator providing support and facilities for starting up activity. Besides the Clean NT Lab, the Park hosts the HySY_LAB (www.hysylab.com), a centre of excellence for hydrogen technologies.

BIOINDUSTRY PARK (www.bioindustrypark.it) offers researchers and companies facilities and R&D services to help locate pilot research centres and laboratories, with EU funding for SMEs. The labs co-ordinated by the Park can deliver a wide range of scientific, technology transfer and research services. Over 20 private and public organisations have already located in the Park, with 200 researchers, together with several university departments (mainly specialised in Chemistry and Biology and Medical Genetics) and a CNR (National Research Council) research group specialised in proteomics and food allergens. The Park works with a number of companies (Bracco, Creabilis Therapeutics, etc) and Italian and foreign university research groups. Discovery is the bioincubator of the Park, specialised in supporting the start-up of new companies. It acts coupled with the seed capital company Eporgen Venture.

Resources available for research.

IN PIEDMONT RESEARCH ACTIVITIES RELY ON THE SOLID ECONOMIC BASE OF THE REGION THAT PRODUCES ALMOST 10% OF THE OVERALL ITALIAN INCOME. FINANCING COMES FROM BOTH PUBLIC AND PRIVATE PLAYERS WITH THE AIM TO FOSTER INNOVATION.



Public Funding

The **European Union** considers Nanotechnology one of the most important fields of research and, in the Seventh Framework Programme 2007-2011, it will confirm the aid granted within the previous framework programme (2003-2006).

With the aim to increase the EU's annual spending, the overall budget for research will be doubled in the period 2007-2013, and it will be about €70 billion.

The **National Funds** aid companies both in basic research, and in product development, including large projects and large companies. Financial grants are assigned through few strategic lines that include Nanotechnology. For further information: www.miur.it

The new **Regional Law** for Research (2006) will finance companies for research activities (including Nanotechnology) with €293mln in the period 2006-2008.

Part of them, as well, will be solely dedicated to Nanotechnology, considered one of the most important targets of the Regional Plan.



Venture Capital for hi-tech companies

Piemontech (www.piemontech.it), the holding company of the Torino Wireless Cluster, and Eporgen Venture provide with venture capital the most promising Piedmont-based companies operating in information and communication technologies, biotechnologies, biomedics, advanced mechanics, energy, innovative and high value-added services. Turin ranks second in Italy for venture capital operations.

Non-Profit Foundations pursue aims of public interest and social use. Over the years, they have refocused their objectives from the wholly charitable to cover a wide range of topics. Within this framework, their actions foster both private and public scientific research.

Compagnia di San Paolo (www.compagnia.torino.it). Since 1563, when it was founded as a charitable brotherhood, it has been serving the local community. Today, it is one of the largest foundations in Europe with its work mainly in the region, but with a significant role in international projects too. The Compagnia di San Paolo had a 2005 budget of around €134m.

Fondazione CRT (www.fondazioneCRT.it). Since 1991 it has been investing considerable resources in culture, health, welfare, research and education. The Foundation, whose 2005 budget was around €75m, plans and implements a wide range of projects.

Stock exchange for SMEs

With the aim of supporting the growth of small and mid caps companies, Borsa Italiana (www.borsaitalia.it), the official Italian Stock Exchange, dedicates two special Markets with minimal costs and quick timing of listing: **Expandi™** and **STAR™**. The Expandi market is for those small companies (€1 million minimum capitalization) that wish to take the first steps towards listing in financial markets (offering a minimum floating of 10%). **STAR™** is the market dedicated to midsize companies with a capitalization of less than €1 billion, and that voluntarily comply with some strict segment requirements, aligned with international standards.

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ITP Invest in Turin and Piedmont,

created by the main public institutions and private business associations, is a non-profit organisation dedicated to securing new investment from overseas.

It responds to inward investment enquiries from all over the world and supports foreign companies expanding within the region.

From finding the most suitable location to sourcing advice on financial incentives for your investment in Piedmont, ITP support will continue as you expand and develop, once your operations are established.

ITP services

We support companies in developing their investment projects in Piedmont through macroeconomic factors and market research, pre- feasibility and feasibility studies, introduction to public and private agents in the region, selection of location opportunities in the target areas (objective 2) funded by the EU, and 360° support for the identification of incentives and fiscal advantages for investments.

Our services are free and confidential.

With the collaboration
of the Politecnico di Torino

With the contribution of:



MINISTERO DELL'ECONOMIA E DELLE FINANZE



REGIONE
PIEMONTE