

Technology Strategy Board

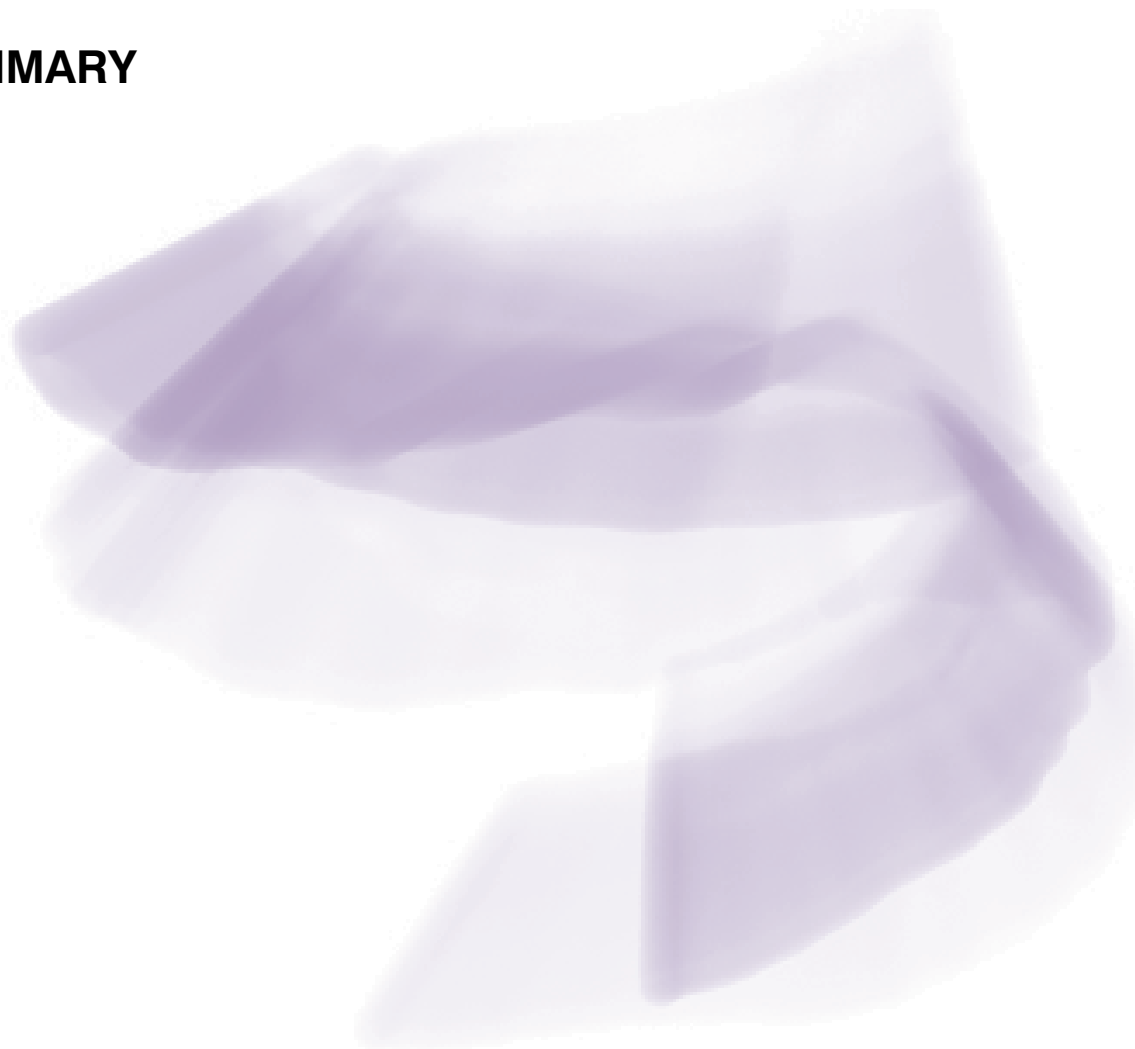
Driving Innovation



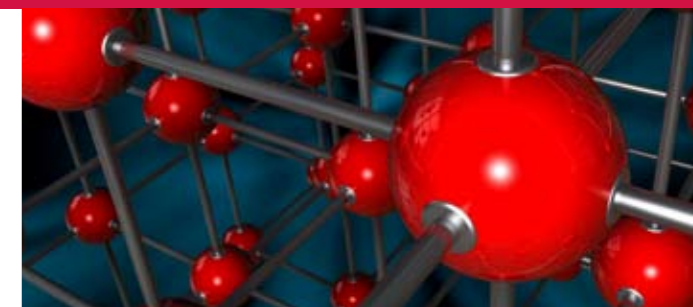
Nanoscale Technologies

Strategy 2009-12

EXECUTIVE SUMMARY



Executive summary



The purpose of this document is to set out the way the Technology Strategy Board will support UK businesses to responsibly deliver market-leading nanoscale technology solutions, channelled through high-value applications, that help to solve society's greatest challenges.

To realise this strategy the Technology Strategy Board will:

- invest in technologies that have strong potential to address market needs that are driven by society's greatest challenges
- focus investment in line with those of other parties (eg research councils, regional development agencies, devolved administrations and government)
- foster the creation of a climate for success (regulatory, public perception, responsible development)
- invest only in those activities that recognise the need for sustainable development.

Applying new technologies to meet challenges

This strategy for nanoscale technologies has been developed to set out the processes the Technology Strategy Board will use to determine how it will invest in this technology space in a way that helps UK businesses to succeed on a global scale. It is based on the fundamental premise that the technologies likely to see the most success will be those that result in developing materials and devices with new functionality that address markets driven by society's greatest challenges.

Accordingly, the Technology Strategy Board will channel its investment into nanoscale technologies that address the following three challenges:

- **Living with environmental change, including:**
 - environmental sustainability, which will cover secure global water supply and address the 'reduce, reuse, recycle' agenda in all industries
 - secure, clean and affordable energy supply, distribution and usage
 - monitoring structures and waste streams.
- **Living with an ageing and growing population, including:**
 - applying nanoscale technologies to healthcare such as drug delivery and discovery; diagnostics and imaging; disease prevention; diagnosis, treatment and management; implants; and surface cleanliness
 - food packaging and storage.
- **Living in an intelligent, connected, modern world, including:**
 - safety and security systems
 - intelligent transport systems
 - increased user interaction with products
 - next-generation computing and entertainment systems.

What are nanoscale technologies?

Nanotechnology is not a discrete technology in itself but covers technologies at the nanoscale. We have broken down what we call nanoscale technologies into four key sectors of primary importance: **materials, manufacture, measurement and integration.**

We refer to nanoscale technologies in this strategy since they are enabling technologies usually embedded into a larger scale component or system rather than products in their own right.

Nanoscale materials have one or more dimensions measuring between approximately 1nm and 100nm and have one or more specific properties that differ from those seen in bulk or larger-scale materials. They are usually **manufactured** using different techniques from those used for manufacturing bulk materials so new processes need to be developed to manufacture them, using a combination of both top-down and bottom-up techniques. To understand material properties and to achieve quality control in manufacture, **measurement** through standardised processes is key; new techniques and tools are constantly required. Usually, the added functionality offered by a nanoscale material or component will need to be designed and **integrated** into a final product to realise its value; this is where much of the added value will be created and where the UK business community should focus its efforts in order to maximise the chance of creating wealth in the UK.

What does the market look like?

Many nanoscale technologies are not new. What is new is that we are improving our understanding and our ability to control at the nanoscale by using novel measurement and fabrication techniques. This has resulted in a global race to engineer and commercially exploit the exciting and novel properties found at the nanoscale.

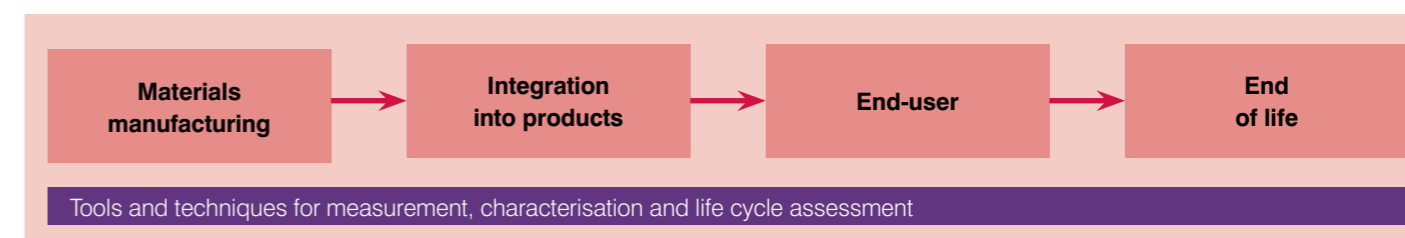
At present, the products on the market that incorporate nanoscale technology are generally evolutionary improvements of existing products rather than anything revolutionary. Indeed some companies have been exploiting nanoscale materials for over 100 years.

In the next 5-10 years we expect new materials to make more dramatic impacts over a wide range of market sectors, with an estimated growth from \$2.7bn in 2007 to \$81.4bn by 2015 according to the Nanoposts 2008 report, *Nanomaterials and Markets 2008-2015*.

Globally, public and private investment in nanoscale technologies has been growing year on year, reaching \$10bn worldwide in 2007. The majority of revenue generation comes from the sale of coatings, particles, nanoporous structures, and composites.

Global leaders are considered to be the US, Japan, Germany, the UK and South Korea, measured in terms of numbers of companies able to exploit nanoscale technologies in commercial markets.

Supply chain for nanoscale technologies



The principal market applications of nanoscale technologies are likely to be those relating to:

- coatings and surfaces
- particles
- porous structures
- composites
- treatments/medicines
- diagnostics.

All these areas are well represented by UK businesses. These can be applied across a wide range of market sectors, but with particular emphasis on:

- information and communications technology (hardware)
- automotive
- healthcare and medicines
- aerospace and defence
- food and drink.

The UK position

Within the UK, there has in recent years been significant investment into both infrastructure and R&D, through the Government's Micro and Nano Manufacturing initiative, with £150m joint investment split approximately 50:50 in micro (including microfluidics and micro electro mechanical systems) and nanoscale development. The UK has an excellent knowledge base through coordinated activity across the research councils using thematic investment to address challenges, and is taking a global lead in health, safety and the environment, standards and measurement issues. Finally,

the UK is leading in public engagement, through a variety of government channels, including a high-level ministerial group, to tackle the cross-cutting issues by setting up an information gathering website on nanotechnologies at www.bis.gov.uk. This highly pervasive technology area also has a fast-developing range of UK networks and bodies to promote knowledge exchange and responsible development.

UK businesses are well placed in the manufacture, measurement and integration of nanoscale materials, at various levels of maturity, and specifically in:

- coatings and surfaces
- structural and functional materials
- modelling, design and scale-up
- controlled release, diagnostics, therapeutics
- displays, memory, sensors
- instrumentation for measurement.

What are the barriers to commercialisation?

Current technological barriers include manufacturing and scale-up, measurement, life cycle assessment, and integration into new systems and products via design at an early stage. More general issues include the need to gain a better understanding of potential impacts on health, safety and the environment, appropriate balanced public debate on risks and benefits, and a real need for cross-disciplinary and cross-industry interaction.

Our action plan

Action and timing	Impact
1. Infrastructure review and recommendation (joint working with regional development agencies and devolved administrations) Review 2009	An independent review of the current state of UK funded infrastructure will lead to opportunities for coordination and will help to identify exciting opportunities relating to the three challenge areas
2. Collaborative R&D 2009-11	Opportunity for high value nano-specific solutions to societal, economic, and environmental challenges linking technology-inspired areas to application and challenge led areas
3. Leverage Framework 7 programme 2009-11	Increased industrial participation in areas where European partnership is beneficial. Participation in appropriate European networks will steer future direction beyond 2013 (Framework 8) to benefit UK businesses
4. Partner with EU and OECD initiatives for responsible development issues 2009-10	Stimulating the responsible development of nanoscale technology will help to improve understanding of the environmental, health and safety issues around nanoscale technologies across the globe. Working with European programmes will enable us to establish joint programmes and find areas where UK expertise would benefit from linking to EU expertise
5. Joint working with research councils and government departments 2009-11	Supporting the second stage of the three societally-led 'nano Grand Challenges' of energy, healthcare, and the environment will provide a structured approach across investors and will bring nanoscale technology ideas swiftly to the marketplace as new products Working with other UK organisations on nanoscale technologies to continue to develop a logical, well argued approach backed by strong science and life cycle analysis by application will help remove significant cross application barriers to commercialisation resolving issues of regulation and public perception
6. Knowledge transfer 2009-11	Successful transfer of knowledge from academia to business focused on commercial success
7. Clarity in roadmapping 2009-10	A review of the current nanoscale technology roadmaps to produce a 'super' roadmap for nanoscale technology will be valued by the business community
8. Promote UK excellence in nanoscale science and technology internationally 2009-10	Access to worldwide academic and industrial community to encourage trade, inward investment and collaboration will give rise to increased competitiveness of the UK nanoscale technologies industry

What should UK businesses do?

There are several ways that UK businesses could increase the chances of success in nanoscale technologies. These include:

- developing products enabled by nanoscale technologies, pulled through from the strong research base, which have improved functionality that address markets driven by societal needs
- identifying gaps in value chains, and developing/acquiring expertise across those value chains in growth nanoscale technology areas
- being in a position to understand and utilise existing infrastructure, including open access facilities and networking opportunities

- developing new products and processes responsibly, taking into account and addressing the potential risks of health, safety and the environment, life cycle analysis, and public perceptions.

Key success factors include collaboration across market sectors (for example, across healthcare, textiles and electronics), throughout the supply chain (for example, materials suppliers, integrators and end users), and finally, transferring knowledge across businesses and from the knowledge base to business.

Through all of these actions, businesses will create opportunities to succeed and gain market share in their chosen markets for nanoscale technologies.

This is a summary of the Technology Strategy Board's Nanoscale Technologies Strategy. For the full document, see www.innovateuk.org.

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