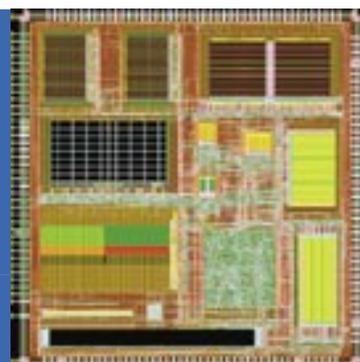
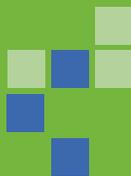


European Leadership in Nanoelectronics

A Joint Commitment





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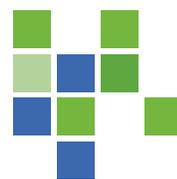
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1: Introduction

The purpose of this report is to stimulate debate on the technologies vital to Europe's industrial future, resulting in an action-oriented outcome.

The 'Information Society' is growing very rapidly and Europe's industrial base is now highly dependent upon information technology. As representatives of leadership companies in the technology sector, we need to be certain that legislators and the makers of public policy have a clear grasp of this new reality:

- Now more than ever, advanced microelectronics occupies a central position as the enabling engine of our economy, and policy decisions need to properly reflect this.
- Our industry has achieved critical mass thanks to a decade of public-private partnership to fund investment in research and development: this successful policy needs to be continued and expanded.
- Europe's position in advanced microelectronics is now threatened by competitor regions seeking to attract international businesses with better operating conditions. The public sector must affirm Europe's attractiveness with a clear policy roadmap and by meeting its funding commitments to support R&D. Otherwise jobs, investment and crucial know-how will abandon Europe.

This document reviews past successes and the scope of the future commitments necessary for continued European leadership. It outlines forms of co-operation, such as public-private partnerships, that are necessary to achieve stated goals. The initiatives to develop long term visions and strategic agendas in the form of 'European Technology Platforms' are supported and welcomed. ■

2: "Roots of Prosperity"

The European Councils of Lisbon, Göteborg, and Barcelona set out clear economic goals for the Community: "Within 10 years the European Union will become the most dynamic and competitive knowledge-based economy."

For consumers, this means new products and services that combine high added value with competitive pricing. At home, we want solutions that genuinely improve our quality of life. On the move, we want to stay in touch anytime, anywhere for business or private reasons.

In addition to driving industrial and consumer markets, advanced electronics is crucial to the public sector because of its power to deliver key social benefits such as security, health and welfare, education, as well as an efficient and respected public administration.

For the wider community to receive such benefits, industry needs to maintain a high rate of innovation for products and services,

"If our economy is compared to a tree, then nanoelectronics represents the hidden root system supporting huge diversity and richness above ground."

supported by advanced manufacturing techniques, all backed by fast and reliable data management.

This dynamic and competitive future requires one thing more: user-friendly solutions that conceal huge amounts of processing power. Providing users with intuitive, 'simplicity outside' devices that don't require any manuals or training to use, demands 'complexity inside' from advanced microchip engineering.

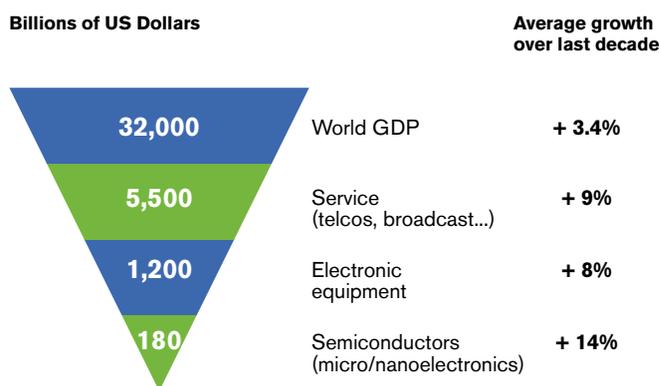
There has been a fast and strong evolution in semiconductors that comprise the building blocks of innovation: both the processing power and available features on new microchips have increased dramatically, while their size and price have decreased in proportion. Today the 'micro' of microelectronics is being shrunk into silicon chips measured in billionths of a metre (nanometres).

This is the world of nanoelectronics. It makes possible a new generation of advanced devices with easy to use features that conceal great complexity – thanks to a new ability to reconcile the demands of space, power and cost. These tiny nano-chips will power pervasive networks of miniaturised devices, providing consumers with solutions previously only affordable for large companies.

Nanoelectronics reaches well beyond the world of consumer gadgets: it will help Europe deliver lasting wellbeing, stability and the good things in life its citizens expect and deserve. It is an efficient, cost-effective route to achieving the European goal of prosperity within a strong social fabric.

If our economy is compared to a tree, then nanoelectronics represents the hidden root system supporting huge diversity and richness above ground. Tomorrow's consumer goods, industrial processes and improved systems for collective health, education and welfare will all sprout from a solid base in nanoelectronics.

In fact, without nanoelectronics there would be no electronics industry and the global economy would be badly affected. The chart shows how nanoelectronics forms the base of this 'pyramid of value.' ■



Source: Future Horizons IFS2004, Jan 2004

3: Harvesting Opportunities

Fifteen years ago, there was little indication of how advanced technology would change our lives. A few experts made what seemed wildly ambitious statements that mobile telephony might one day reach more than 10% or even 20% of the population. Today we know reality outperformed even the wildest dreams, which failed to foresee near-universal wireless connectivity and many other consumer applications.

Likewise, few could have guessed that Europe's troubled microelectronics industry – then clearly trailing its US and Japanese competitors – would even survive. Today Europe is on a par with competitors and we set global standards in key areas.

We succeeded because we took the right road. Companies made sound business decisions supported by their shareholders. And governments made sound investments both in infrastructure and in research and development. Concerted action by private and public sectors helped propel Europe to the forefront. Europe now has three of the world's top 10 semiconductor companies and represents one quarter of the worldwide market for chips. Systems companies are robust and in lithography, a European company has a global market share of more than 50%.

Years of successful policy coordination and heavy investment from private industry and national, regional and EU programmes have assured us a strong base. Europe leads in GSM services, smart cards for financial services and automotive security.

To ensure continued leadership, this strong base must now be shifted from micro to nanoelectronics. That requires a further huge effort and calls for major new investments if we are to deliver the full social promise of technology for people. Main technical challenges to be tackled are related to the increasing complexity of silicon process development making necessary a strong coupling of academic and industrial researchers.

Once again, we look into an exciting future scarcely easier to foresee than it was 15 years ago: today's dreams will again fall short of tomorrow's reality.

Yet we can be certain new nanotechnology developments will include:

- 'Everywhere visualizer'¹ personal communications allowing us to reach whoever we want, whenever we want.
- Affordable personal healthcare through remote monitoring, biochips and sensors giving people a 'doctor in your pocket.'
- Greater assurance or 'street democracy' thanks to enhanced collective and individual security at home or on the move.
- Secure 'intelligent retail' and banking networks for mixed reality shopping or services.
- Automotive safety by means of automatic cruise control and sensors ('car cocoon' functions) for safer driving.
- Educational tools bringing encyclopaedic resources and community learning benefits to individuals.

These devices will bring quality of life benefits to all age groups. There will be 'service robots' for the elderly, 'multilingual companions' for travellers, 'pervasive communication jackets' for the fashion-conscious, and sustained access to knowledge and education for all ages.

If Europe is to harvest these benefits, we must build on earlier investments and grow the nanoelectronics industry that enables

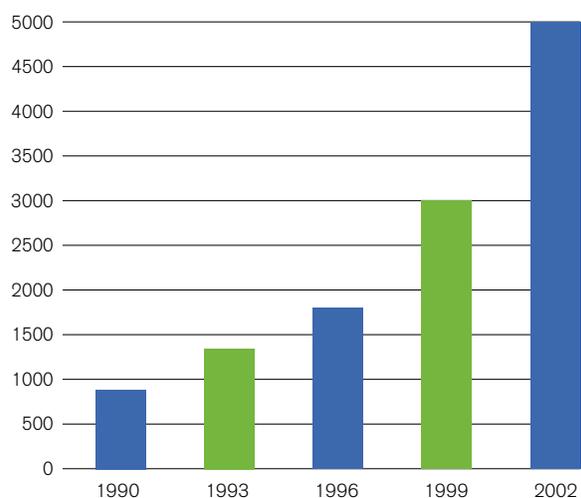
"This is about much more than enhanced consumer choice: it underpins Europe's capacity for economic and political self-determination."

leadership positions. This is about much more than enhanced consumer choice: it underpins Europe's capacity for economic and political self-determination. ■

4: Clear Economic Case

Europe has established a healthy position within the almost €200 billion a year global microelectronics industry. It is tempting to believe the sector no longer requires public sector investment. It is also tempting to believe that because microchips are now so ubiquitous, we can simply take them for granted.

This is not the case: the industry has unique dynamics that require very large investments. To maintain leadership in any category, some 20% of annual sales must be reinvested in R&D. And the new 'system on a chip' components need R&D spending of a much higher order.

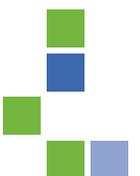


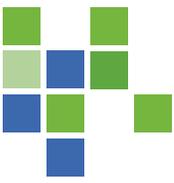
R&D spending by main European semiconductor companies (M€)

European companies are playing their part through intensive investment and over the last decade have put €35 billion into production and research facilities in Europe. As the chart shows, private sector investment in microelectronics R&D on a yearly basis increased by a factor of five in the period 1990-2002², allowing European companies to gain market share.

The gap between industry's spending and public investment in Europe is however widening at the very time when our major competitors in other regions are enjoying substantial increases in financial support.

Europe's recognition of this need to close the funding gap lay behind the Barcelona target which promised to commit 3% of the EU's GDP to research. But if Europe is to meet this target it is time to move from commitment to action. ►





Advanced microelectronics is a high-return, high-risk business. But thanks to the EC Framework programmes and Eureka Cluster projects such as JESSI, MEDEA and MEDEA+, this has proved a remarkably low-risk investment formula for public money. These investments have indeed delivered early payback and strong economic returns for all of society even in volatile periods.

They've helped create jobs and deliver taxes. Overall, the European ICT sector generates around €100 billion a year in tax revenues with strong contributions from the microelectronics segment.

Across Europe more than 50,000 jobs have been created by semiconductor manufacturers and the first circle of activity around them. Indirect job creation at local level has been three times greater. High technology clusters have proved their ability to attract and retain professionals of the highest calibre. ■

5: Winning 'Eco-systems'

A decade's investment strategy using 'clustering' in hi-tech hotspots has created healthy 'Eco-systems' comprised of semiconductor companies, semiconductor equipment suppliers, system companies, applications providers, service sectors and research institutes. Germany and France provide examples of successful private-public partnerships. These create jobs, economic growth and innovation leadership.

The Dresden cluster has created at least 15,000 permanent jobs at semi-conductor plants and their local suppliers, attracting more than 30 international equipment and service suppliers. An independent 2002 study³ on the economics of Dresden found this achieved break-even with tax revenues and social security contributions after just nine years (1994-2003). The study also found "the proportion of R&D activities has increased significantly" relative to other activity.

In the Crolles/Grenoble region of France, over 6,000 direct jobs have been created during a decade. The Crolles 2 facility is now creating a further 1,500 direct jobs and 3,500 indirect ones. This cluster is a significant driver of indirect job creation: the region now employs more than 20,000 people in microelectronics and related activities. "Intellectual capital is the new source of wealth from which a dynamic nation draws its vitality... research and innovation will rank among the key drivers of future growth" said French President Jacques Chirac⁴ when he inaugurated Crolles 2 in February 2003.

Other examples of successful Eco-systems are: Catania in Sicily, Leuven in Belgium or Eindhoven-Veldhoven-Nijmegen in the Netherlands. In the very depressed area of Catania new research and manufacturing semiconductor activities helped create 15,000 direct and indirect jobs. In the Netherlands, Nanoned, the nanotechnology network is intended to promote rapid advancement of knowledge in the country and to complement industrial activities. There is further coordinated activity in research and design around e.g. Munich, Stuttgart, and Aix-Nice.

High value production and R&D within Europe will remain a vital source of innovation. The region's high labour cost is an inescapable fact that makes commodity or low-end production non-viable. So the only sustainable solution is to foster active cooperation right along the 'microelectronics value chain,' and to focus on research and leading-edge production. ■

6: Competitive Landscape

Europe's advanced industrial base deserves a level playing field in response to challenges originating in other parts of the world. Competitor regions – notably Asia and the US – now openly vie with Europe for global supremacy by creating evermore favourable operating conditions for international companies relocating there.

It is vital that Europe remains an attractive base for industry and continues to be master of its own destiny. We must recognise that the new battlefield of international competitiveness is intellectual property. To win, Europe needs a research infrastructure and skilled people capable of delivering standard-setting innovations.

By contrast, a shallow service-based economy without leadership in intellectual property, design, or advanced manufacturing will turn the nations of Europe into customers rather than owners of the future. Policymakers in Europe understand that no leading economic bloc can afford to depend exclusively on discoveries made elsewhere.

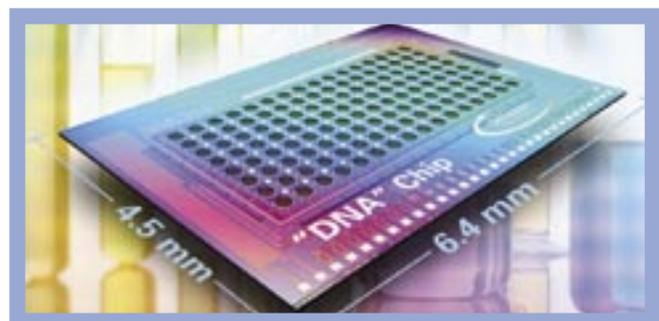
US industry has been reinvigorated in recent years, partly by federal spending resulting from post 9/11 security concerns. Meanwhile several US State governments are making available substantial funds for R&D. Japan's government has adopted a restructuring policy⁵ to revert its industry's decline.

And there are new competitors. Taiwan has become a global microelectronics power, thanks to a consistent investment strategy over 10 years. China is rapidly becoming the world's leading semiconductor market and is building a potent industry of its own, both from indigenous strengths and by attracting strong players from abroad.

If we are not to sacrifice all the industrial advantages, market leadership and innovation won at such effort since 1990, Europe must commit and act.

The alternative scenario is one of dependence, in which Europe renounces its technology ambitions to simply become a marketplace for products designed in the US and manufactured in Asia. Cutting off our nanoelectronics future at the roots would lead to steady decline and loss of competitiveness. Before long this would undermine Europe's entire research, educational and industrial infrastructure. ►

"The gap between industry's spending and public investment in Europe is widening."



Companies have a clear duty to create value for their shareholders. Our clear preference is to create such value through high-end R&D activity or value-added manufacturing based in Europe. Ultimately, though, nanoelectronics businesses will locate activities where it makes most sense, in terms of marketing, research and manufacturing. That means decision-makers cannot ignore the increasingly competitive scenario or the 'red-carpet' incentives offered by other regions. There is no reason why Europe could not be equally attractive. ■

7: The Next Step

A clear vision of the future for the nanoelectronics industry demands a horizon of at least a decade.

We know this next decade should not mean a continuation of past policies, although these have proved highly successful. A much broader initiative is needed to match bigger challenges and bigger opportunities.

Industry has begun to participate in discussions within the European Commission, regional organisations and national governments in order to develop a broad-based initiative. It suggests that the methods used in Eureka programmes, plus the accumulated learning, might be integrated into any new initiative.

As a first step we need policies to create fair and balanced operating conditions, plus a strategic accord to share risks and benefits between industry and public authorities.

Fair and balanced operating conditions include financial incentives, but should also reduce the complexity of doing business. Conditions should include:

- Reduced complexity and greater agility in regulation
- Regional/local incentives and funding policies
- Flexible application of labour conditions
- Tax incentives and tax credits for R&D
- Availability of skilled personnel (greater stimulus for scientific studies and rewards for researchers)

With these in place, the private sector is prepared to enter a strategic accord to maintain a significant high-end R&D presence plus high value-added production in Europe.

Industry recognises the time is right for a bold new programme and will play its part by stepping up investment. In order to ensure European success, a boosting of public sector investment is also required.

Industry will take the initiative to outline an ambitious plan to be implemented by means of a true public-private partnership.

Detailed initiatives to be developed jointly by industry and public policymakers include:

- Macro projects at European level
- 'Strategic agenda' of well-defined R&D themes
- Public sector support for collaborative R&D in 'pre-competitive' platforms
- Clear reciprocal commitment between public and private sectors



“It is vital that Europe remains an attractive base for industry and continues to be master of its own destiny.”

Examples of relevant macro-projects enabled by nanoelectronics development are to be found in areas such as 'electronic cocoon for a safe car', 'user-centric devices for health and security', 'easier access to Internet to reduce the digital divide', 'user-friendly devices and terminals for multimedia applications', etc.

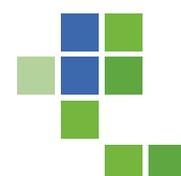
In the meantime we need to ensure an effective transition towards the broader nanoelectronics programme discussed here. So member states, regions and EU agencies should start discussing funding commitments to provide a bridge for the period up to 2007. ■

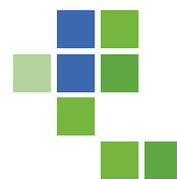
8: Conclusion

With the groundwork so promisingly laid, it is inconceivable that Europe could allow such great opportunities to be transformed into threats. Now is the time to make a positive choice if we hope to use advanced technology to help us realise our aspirations for the future.

So we stand at a cross-roads: experience gives us confidence we will once again choose the right road and repeat our past successes, but on a larger and even more ambitious scale. Yet this will only happen if Europe opts for a bold new programme of coordinated R&D investments to create more industrial clusters and 'eco-systems', creating and safeguarding tens of thousands of jobs in Europe.

Europe is engaged in a high-stakes industrial competition to guarantee its future as an innovative, prosperous and knowledge-based community. The private sector will play its part, but the public sector must join us in a full-scale public-private partnership aimed at safeguarding a common destiny in the global race between regions. ■





“We need a joint commitment on a private-public partnership **helping Europe achieve its long-term industrial and social goals.**”

endnotes



MEDEA+, as editor of this document, has made use of several documents circulating in draft stages.
'Industry Views' is in final review stage
'2020 Nanoelectronics at the centre of change' is a provisional paper not yet finalised by the EU

- ¹ Industry Views on Nanoelectronics, R&D and Innovation. MEDEA+ Report, April 2004.
- ² 2020 Nanoelectronics at the centre of change, an introduction to the Nanoelectronics technology platform, March 2004.
- ³ Deutsches Institut für Wirtschaftsforschung, Berlin 2002.
- ⁴ Speech at Crolles 2 official opening, 27 February 2003.
- ⁵ The Future of the European Microelectronics Industry, MEDEA+ Report, 2003.



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Artechnique, Infineon, Mijke van Dis, Philips, STMicroelectronics.

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