The European Semiconductor Industry:
2005 Competitiveness Report

EECA ESIA

European Semiconductor Industry Association

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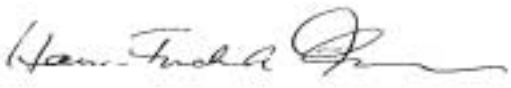
'Diamant' Building
Boulevard A. Reyers 80
1030 Brussels, Belgium
Tel: +32 2 706 86 00
Fax: +32 2 706 86 05
secretariat.gen@eeca.be ■ www.eeca.org

Foreword

On behalf of the European Semiconductor Industry Association (EECA-ESIA) and its Members we are very pleased to present a comprehensive report on the state of competitiveness of the semiconductor industry in Europe. By submitting our findings and recommendations we wish to raise awareness of the challenges ahead and share the purpose of our call for action to support the industry in Europe in its efforts to maintain and enhance its competitive position in the the global market .

As the President of ESIA, together with the Chairman of the task force of this report, we would like to express our recognition to all the Members of the task force as well as to the ESIA Secretariat for their dedicated and effective contributions. The work of creating this report was accomplished on a voluntary basis. We believe that this demonstrates an intense interest in the message we want to convey and is an example for the continuing support, through ESIA, for our industry in Europe.



Carlo Bozotti
President EECA-ESIA
President and CEO STMicroelectronics

Hans-Friedrich Bühner
Vice- President EECA-ESIA
Senior Director Governmental Relations
Infineon Technologies

EECA-ESIA

The European Semiconductor Industry Association (ESIA), part of the European Electronic Component manfacturer's Association (EECA), represents the European-based manufacturers of semiconductor devices. The semiconductor industry provides the key enabling technologies at the forefront of the development of the digital economy. The sector supports over 86 000 jobs in a market valued at around €31.7bn in 2004.

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Executive Summary

"The question at the heart of this report is, how can the semiconductor industry in Europe maintain and enhance its competitiveness?"

Why this report deserves special attention

The semiconductor industry is a key driver for the future of advanced technologies in Europe, and understanding it is therefore key to anticipating that future. The question at the heart of this report is, how can the semiconductor industry in Europe maintain and enhance its competitiveness? Because of its direct exposure to worldwide competition, understanding the opportunities and threats to this industry will enable stakeholders to address some of today's and tomorrow's challenges better, challenges reaching well beyond the industry itself and affecting the prosperity of Europe's economy at large and its citizens.

In Europe more than everywhere else, the semiconductor industry sector stands at a crossroads on the global playing field. The decisions taken in the immediate future will be decisive for determining which turning the industry will take. We, as the representatives of the industry in Europe, are determined to address the measures and actions that are required to enable the semiconductor industry to continue pursuing the formidable technological progress it has brought to end-user industries and to the economy at large. This is why the report outlines those aspects that make the semiconductor industry in Europe so uniquely important to the development of the European economy; indicates where Europe currently stands in comparison to other regions of the world; identifies which set of competitive factors Europe needs to focus on; and suggests actions that need to be taken. We see this report as a platform for further initiatives in specific areas of activity as well as a basis for discussing our recommendations with concerned decision makers.

What makes the semiconductor industry unique?

It is important to realize that this industry features a number of distinct characteristics that position it uniquely in the economy and in the global competitive arena. These include:

- *The very high intensity of R&D (up to 20% of annual revenues) and the required level of capital expenditures in semiconductor plants or 'fabs' (up to 25% of annual revenues)*. Both are the industry's main characteristics. They are the prerequisites that ensure constant innovation, be it in terms of increased performance, miniaturization, cost reduction or ever shortening design cycles. They also make the industry highly sensitive both to the global research infrastructure and the financial returns on investments.
- *The role of the industry as technology enabler*. The semiconductor industry is widely recognized as a key driver for economic growth in its role as a multiple lever and technology enabler for the whole electronics value chain.

  Semiconductor products form an increasingly vital part of a whole range of products ranging from electronic devices and systems (e.g. PCs, mobile phones, TV sets) to solutions and services (e.g. Internet

providers, telecom operators, broadcasting services). Revenues in the overall microelectronics industry have a multiplier effect on other major downstream sectors where electronic content is central. In other words, from a worldwide base semiconductor market of $213bn (€171bn) in 2004, the industry enables the generation of some $1200bn in electronic systems business and $5000bn in services, representing close to 10% of world GDP.

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The pervasiveness of semiconductors in other fields has become key to the industry's competitiveness: e.g., in the automotive industry for safety, energy consumption and driver assistance; in telecommunications for ubiquitous accessibility; in consumer applications for quality of products; etc. The global leadership of a number of European industrial sectors is a perfect illustration of how microelectronics represents a major if not predominant differentiating success factor and value added contribution in their respective markets.

- *Maximal exposure to international competition*. Dramatic changes in the conditions of global competitiveness have had an exceptionally strong impact on the semiconductor industry for over 20 years. For this reason, and as an advanced indicator of economic performance, it is mandatory for us to examine the present and future factors of success and failure with great care.
- *Continuous growth but in a cyclical pattern with high volatility.* While the current 20 year annual average growth of the semiconductor industry is on the order of 13%, this has been accompanied by equally above-average market volatility, which can lead to significant if not dramatic cyclical swings.
- *The need for high degrees of flexibility and innovation in order to constantly adjust to the rapid pace of change in the market*. Many products embedding semiconductor devices often have a very short life cycle. At the same time, the rate of constant price-performance improvement in the semiconductor industry is staggering. As a consequence, changes in the semiconductor market not only occur extremely rapidly but also anticipate changes in industries evolving at a slower pace. Yet another consequence of this rapid pace is that established market strongholds can be displaced all too quickly.

Where do we stand in Europe? – The challenges we face

"There are real concerns of the industry about its future in Europe..."

The original motivation of this report lies in the real concerns of the industry about its future in a Europe where strengths in one area are so rapidly undermined by weaknesses in others. Too often Europe appears to be its own worst enemy. The semiconductor industry in Europe has mobilized all its energy to face the challenges highlighted in this report.

- The European market represents approximately 20% of the world semiconductor market but *imports a much higher value from overseas that is not matched by equivalent exports*. Europe currently attracts less than 10% of investments in production capacity, which means that its future is in real danger. Can the semiconductor industry in Europe sustain growth and stay a source of innovation in such an environment?

"... the EU lacks a dedicated sectoral approach to supporting this key industry."

- Although Europe today enjoys a strong technological base, it also faces *structural weaknesses due to the information technology and computer industry's limited share in the economy*. In particular, we observe a comparatively smaller production of electronic goods for the mass consumer market (from PCs to videos) and attached services. These weaknesses slow down the productivity enhancing benefits of ITC diffusion in Europe, and reduce the semiconductor industry's capacity to reach the scale of production and market necessary to establish its products and applications as standards of competitiveness.
- There are many positive, world-class examples of European R&D programmes and co-operation. There are also encouraging initiatives regarding specific technology platforms in Europe. Nevertheless, *these fall short of a coherent and consistent concept for stimulating R&D investment* in the private and public sector, investment needed in order to reach the vital Lisbon target of 3% of GDP for R&D spending. The biggest R&D potential today lies with partnerships among semiconductor industries as well as with co-operation schemes along the supply chain.
- Whereas China, Japan, Korea, Malaysia, Singapore, Taiwan and the US have developed special incentive schemes to attract and retain foreign semiconductor investment, the EU lacks a dedicated sectoral approach to supporting this key industry. The revision of the Multisectoral Framework has actually reduced the financial support for the large investments that are necessary for leading edge semiconductor manufacturing facilities, leaving a void in large-scale future investment. As elsewhere, investment schemes have been crucial for supporting the build-up of a competitive and distinctly European semiconductor industry. From this perspective *the Multisectoral Framework should be replaced by a sectoral approach for semiconductors*.
- Leaving aside other strategic factors, our snapshot cost comparison study of the factor costs involved in setting up a leading-edge model fab in eight locations in the world concludes that *the net cumulative income over a given period of time in China, Korea and Malaysia is around 220% times higher than for the same fab in Germany*, with little difference between key regions in Europe. Apart from the known differences such as lower wages, lower social costs and higher number of working hours, the main single difference shown by this international comparison is that of the existence of favourable incentive schemes in the emerging markets.

  Considering the volatility of prices in the industry, these huge differences can be decisive for the survival of semiconductor companies in global competition. In light of such differences it also becomes more difficult to emphasize the perceived European strengths such as the existence of a highly skilled workforce and researchers along with the advantages of a sizeable internal market.

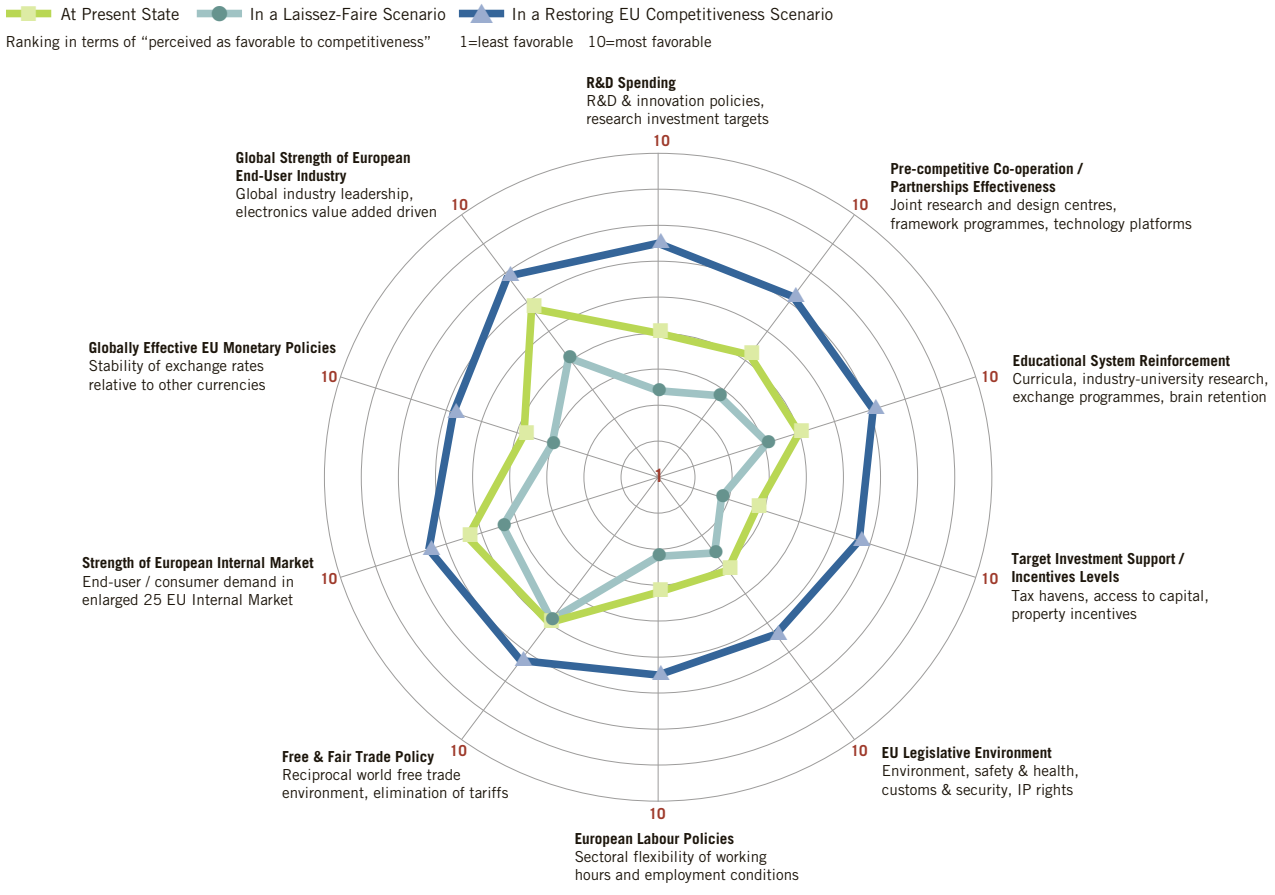
Where do we want to go – *laissez-faire* or restoring competitiveness?

The report lists ten competitiveness dimensions that are critical for the future of the semiconductor industry in Europe and which fall into three broad categories: *Investing for Europe*, *Level Playing Field*, and *Market Performance*.

- ***Investing for Europe*** looks at factors that have a sustained effect on the competitiveness of Europe's semiconductor industry. Focusing on stronger capabilities in R&D, technical education and industry partnerships will impact on the future orientation of the industry's economic environment and can be determinant for its sustainability and competitiveness over time.
- Establishing a ***Level Playing Field*** addresses the necessity of reaching comparable incentives and regulations for market entry, factor costs and legislative environment between regions and/or nations, thus avoiding disadvantages like the ones the European semiconductor industry is experiencing today.
- ***Market Performance*** refers to the European economic position and conditions in the overall environment of the world economy that have a more or less favourable impact on the industry, such as, e.g., the impact of the Euro.

The competitiveness dimensions indicate possible directions for targeted measures or policies that would help enhance the competitiveness of the European semiconductor industry in the future. Depending on the responses to these indications, two alternative scenarios may unfold.

Alternative scenarios based on an assessment of selected competitiveness factors conducted by the members of EECA-ESIA



- ***Laissez-faire:*** The situation is left to the industry players themselves and no additional efforts are undertaken at the EU or national governmental levels to create incentives for innovation or to restore a level playing field.
- ***Restoring EU competitiveness:*** Both the semiconductor industry and the EU and Member States embrace the competitive investment challenge and seek to initiate a virtuous circle throughout the semiconductor and the global end-user industry (see figure on page 10).

"... eliminating the obstacles to ensure that Europe fully reaps the benefits of a globally competitive industry at the cutting edge of technology."

The advisability of taking the option of constructively and decisively building on Europe's strengths and resources is clear: It is the option of eliminating the obstacles to ensure that Europe fully reaps the benefits of a globally competitive industry at the cutting edge of technology. Faced alternatively with the slow decline of its manufacturing base, gradually followed by that of its R&D, the semiconductor industry in Europe is convinced that concerted initiatives which aim at actively investing for Europe, creating a level global playing field and focusing on market performance issues constitute the only way forward towards enhancing competitiveness.

A call for action from the semiconductor industry in Europe

In order to maintain and enhance the competitiveness of the Europe's semiconductor industry, EECA-ESIA calls on all concerned stakeholders to act upon the following recommendations:

Investing for Europe

For Europe's semiconductor industry, three crucial priorities stand out. It is essential to:

- unleash Europe's R&D capabilities and achieve the 3% or more of European GDP spending level for R&D. A crucial requirement to accomplish this is the introduction of a *generalized tax credit on R&D spending* for all companies in the semiconductor industry in any European geographical area.
- open up *Europe's educational system,* from technical school education to research institutes, so it can also work for the industry. The range of initiatives to be developed needs to address all levels, increasing the attractiveness of technology and inverting the present trend toward brain drain.
- develop further successful models of *future-orientated R&D partnerships* such as setting up a limited number of mega-projects and promoting three-way cooperation between industry, university and government, e.g. under the European technology platforms for nanotechnologies (ENIAC) or embedded intelligent systems (ARTEMIS), or through research programmes such as Medea+. Building on horizontal, pre-competitive semiconductor partnerships and programmes, these may be expanded to encourage vertical cooperation along the supply-chain.

"Europe cannot afford to ignore what other regions in the world are striving to achieve."

Providing a level global playing field

For Europe to profit from an innovative semiconductor industry it is indispensable to provide a level global playing field that not only matches that of other regions but is Europe-specific. Hence we recommend:

- creating a *sectoral framework* that offers globally comparable incentive schemes for large investments.

- continuing to promote *free and fair trade*.
- ensuring a *European legislative environment* compatible with the imperatives of competitiveness, especially in the areas of environmental, safety & health (ESH) policies, customs & security and IP protection. Competitiveness has to be established as a criterion for legislation. Pooling the existing pockets of semiconductor expertise within European and national bureaucracies is an important pre-condition for creating the necessary awareness and coordination of targeted policies.
- establishing a *more balanced approach to ESH initiatives*, which promotes environmental practices and awareness without restricting innovative capacities.
- ensuring *consistant and efficient customs operations*, an area that warrants particular attention given the nature of Europe's diverse boundaries and traditions.
- allowing for *more flexible labour conditions,* in particular facilitating a better organisational alignment of working hours – in terms both of total amounts and distribution – to meet the competitiveness requirements of today's global market.
- rationalizing and simplifying procedures for *effective IP protection in Europe,* which is key to protecting competitiveness both within and outside Europe.

"If our call for creating the conditions that enable the European semiconductor industry to express its winning innovation capability and market approach is heard loud and clear, this plea for action will have served its purpose."

Answers for maintaining and enhancing the competitiveness of the European semiconductor industry are within close reach. Indeed, some of the measures mentioned are common to many industries in Europe and should reinforce a general industry perspective. Many are already on government action agendas.

However, as illustrated in the above Figure, *all* of these measures are especially relevant to the semiconductor industry inasmuch as they apply to the industry's characteristics and competitiveness factors. Two prerequisites have to be emphasized here, which will give these recommendations a better chance of enactment:

- It will be the *whole* rather than the sum of parts of the recommended actions that will determine the future of the semiconductor industry in Europe and help shape the European environment it needs to compete at the leading edge of the information society.
- It will require the concerted and explicit *will* of all concerned actors, i.e., EU authorities, national governments and industry representatives, to focus their joint attention on the unambiguously essential role semiconductors play in Europe as a catalyst and accelerator for economic performance and the quality of life of society as a whole.

Europe cannot afford to ignore what other regions in the world are striving to achieve. If our call for creating the conditions that enable the European semiconductor industry to express its winning innovation capability and market approach is heard loud and clear, this plea for action will have served its purpose.

The entire Report is available on the EECA-ESIA website under www.eeca.org/esia.htm

Introduction

Is Europe still sufficiently attractive, both as a market and as a base, for a leading-edge technology sector such as the semiconductor industry? What do we in Europe need to do to maintain and enhance our competitiveness? Who are our partners in this endeavour? Can we reap the benefits of a truly globalised semiconductor market both in and from Europe, or is Europe destined to lag behind the competition from other regions? What are the challenges ahead and what are the solutions?

It is with these questions in mind that the European semiconductor industry – comprising both European-based companies and companies with a strong manufacturing base in Europe, members of the European Semiconductor Industry Association (EECA-ESIA) – wants to report on the industry's competitiveness in Europe.

Europe has succeeded in developing a healthy and competitive semiconductor industry. Europe's own companies, along with those of most of the world, are currently producing and competing in the European and global markets. Today there are three European-based companies rated among the world's top ten. This has not always been the case.

Europe has achieved a lot in the past several decades thanks to a concerted effort by the whole industry to deliver a constant flow of cutting-edge innovative products at record growth rates that have ensured Europe sustained, business-critical access to strategic future generation technology.

Europe's semiconductor sector functions well in its role as an enabling industry, one that can pull along an equally competitive supply chain while continuing to provide other leading European industries such as the European information and communication technology or automotive sectors with the innovations they need to be globally competitive. Above all the industry has made modern daily life, in Europe as elsewhere, virtually unimaginable without semiconductors. Everyone reading these words has probably benefited from the service of a broad range of semiconductors within the last 60 minutes. If this is not true for you, you have used neither a computer nor a telephone nor any means of transportation during that time. Nor did you watch TV, use the brakes of your car, open your refrigerator, listen to the radio or play a video game.

As everywhere else in the world of semiconductor production, these achievements would not have been possible without support from governments and other authorities, whether by ensuring a level playing field for a free trading environment, by providing adequate incentives to attract investments or by focusing R&D funding on high-tech projects.

Yet as the world has become increasingly global, the industry is becoming deeply concerned that Europe is losing focus; it sees the realisation of the ambitious objectives of the Lisbon agenda to be in serious danger. We stand at a crossroads in Europe, with the risk of losing out on future key technology developments and innovations if we fail to understand the importance, the needs and the dynamics of the industry or if measures to enhance competition are taken in isolation from one another. With this report and its follow-up, the European semiconductor industry wants to contribute to the current competitiveness debate to ensure that Europe makes the right turning. Specifically, we want to:

- illustrate how the industry works and indicate what needs to be addressed in terms of its specific requirements;
- highlight the key role the industry plays as enabler and as a key innovator in Europe;
- show where Europe stands and what it can offer in the highly competitive global semiconductor market;
- outline how the industry's characteristics translate into competitiveness factors; and
- call for action to achieve conditions that are favourable for maintaining and enhancing the competitiveness of the European semiconductor industry – today and in the future.

Ironically, it is the Shanghai Museum of Urban Development that has adopted the saying that: "*Semiconductors are for the Information Society what grain was for the agrarian, and iron and steel were for the industrial society*."

Europe cannot afford to ignore what other regions in the world are striving to achieve. If our call for creating the conditions that enable the European semiconductor industry to express its winning innovation capabilities and market approach is heard loud and clear, this plea for action will have served its purpose.

Part I

This report focuses on the challenges that the European semiconductor industry encounters as a consequence of dramatic changes in the conditions of global competitiveness. It proposes actions that are needed to ensure that the semiconductor industry, and with it the entire European economy, continues to benefit in future from the formidable technological progress the semiconductor industry has brought. At the heart of the report is the question how the European semiconductor industry will be able to maintain and even improve its competitiveness. Its purpose, and the authors' motivation, is to explore and advocate the means for succeeding in this endeavour.

The content of this report is structured in three parts:

I. Exposing the economic and technical facts and background of the semiconductor industry

II. Reviewing key competitiveness factors and challenges along with possible future scenarios

III. Providing a set of recommendations aimed at improving the industry's competitiveness.

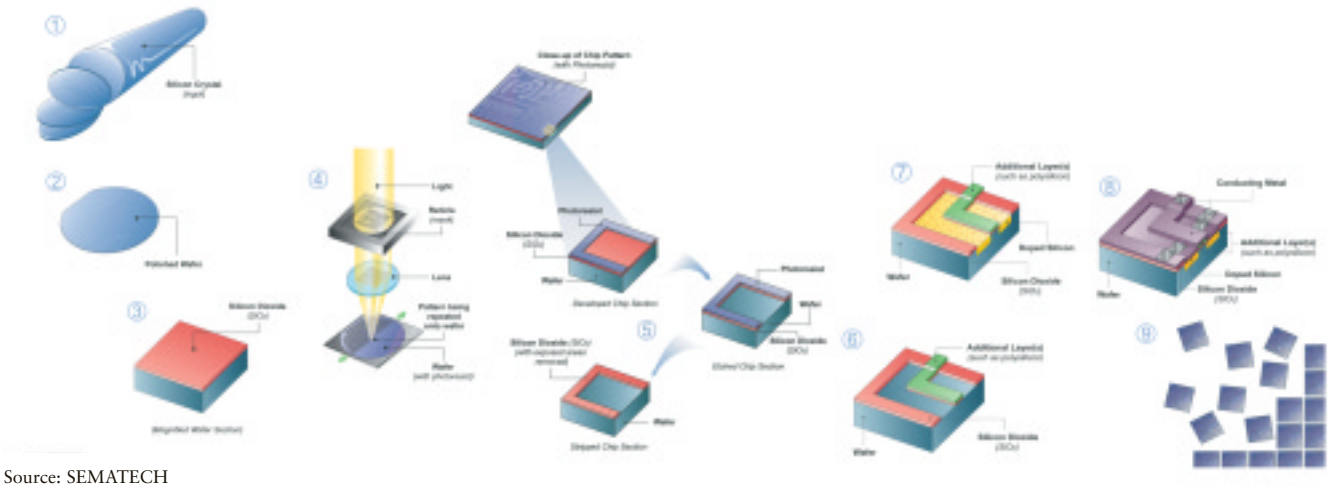
For the purpose of this report, and unless otherwise specified, the term *semiconductor industry* will be used to describe the activity of companies who have their business in the research, development, design, manufacturing and marketing of semiconductor products. Although not explicitly covered in this report, this description also concerns to a large extent companies operating in the same market, that supply manufacturing equipment, technology and materials for the development and production of semiconductors.

The Semiconductor Industry

1.1. Evolution of the semiconductor industry

Semiconductor products are the result of a complex manufacturing process (Figure 1). The basic production process is executed at two types of manufacturing facilities: front-end manufacturing takes place in so-called *wafer fabs*, and back-end processing in test and assembly plants. The process is composed of two main cycles, the diffusion/pre-test cycle with a cycle time that may take several months, and the

Figure 1: **The making of a chip**

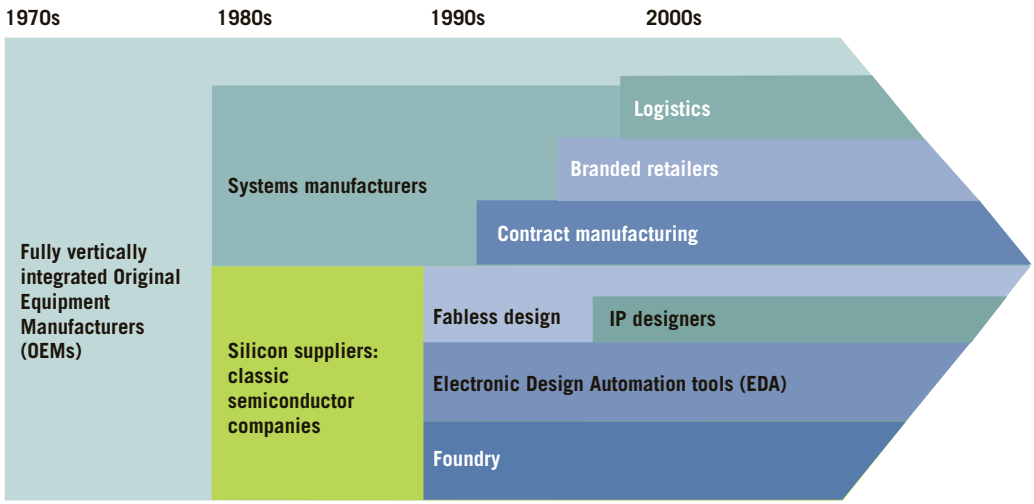


Source: SEMATECH

assembly/final test cycle with a typical cycle time of a few weeks. The diffusion process may take place in one or more wafer processing fabs in different localities around the world (e.g. Europe or the US). Assembly and test are typically done in the Far East, after which the product is 'shipped' to the final end customer. Consequently, during the production process a semiconductor product usually travels across the globe at least twice before being delivered to its final customer.

Over the past forty years the electronics industry value chain has changed dramatically (Figure 2). In a nutshell, it evolved from a number of large, vertically integrated companies into an industrial landscape with a multitude of distinct roles for increasingly specialized companies. As the semiconductor market grew and semiconductors found wider application in the 80's, the industry witnessed the emergence of specialized semiconductor manufacturers. These established themselves either as independent companies or as divisions of the formerly vertically integrated companies who now started marketing their products on the open market. At that time such companies, also called integrated device manufacturers, executed the entire manufacturing process in-house.

Figure 2 **Evolving differentiation and specialisation of the semiconductor value chain.**



Source: PwC Analysis, Dataquest, ICE, Semico

By the 90's, with semiconductor manufacturing technology having become more widespread, increasing process complexity resulted in a dramatic increase in the amount of investment required to set up semiconductor manufacturing facilities. This trend continues today and has opened market opportunities for two new types of business: semiconductor *foundry* services and *fabless* semiconductor companies. The first perform the semiconductor manufacturing process for other companies, providing manufacturing excellence and economies of scale to companies unable or unwilling to make sufficient investments in manufacturing facilities. The latter focus on the design and marketing of semiconductor products, while outsourcing production. Increasingly, the design and manfacturing of complete systems is outsourced to original design manufacturers (ODMs). At the same time, the growing complexity of integrated circuits has enabled the emergence of a separate industry providing design tools and automation to the design process. In brief, the current industry landscape represents a complex mix of different business models, with all kinds of intermediate variants.

The semiconductor industry in Europe has not escaped this evolution. To meet future market demands and stay at the forefront of innovation in a rapidly globalising

economy, the semiconductor industry has to face all the disadvantages of globalisation as well as benefiting from its advantages. This means it is exposed to increasingly fierce international competition for advantageous access to labour and capital, leading on the one hand to a steady concentration of its players and on the other to a further fragmentation of its value chain. The latter is allied with increased outsourcing, resulting in a growing mobility allowing new locations on the planet to be chosen.

Today there are real concerns in the industry about its future in Europe, where strengths in one area are always countered by weaknesses in others. Hence the decision of the authors of this report to address specific issues regarding the industry's competitive position in terms of levels of capital investment, R&D spending, availability of skills and intangible resources, legislative environment, accessible markets and government support. In order to address these issues it is important to understand some of the industry's unique characteristics.

1.2. Unique characteristics of the semiconductor industry

R&D and capital investment intensity

When pressed to characterise the semiconductor industry, economists often start by asking "how are computer chips different from potato chips?" Although rhetorical, the question implicitly admits that the generally assumed market mechanisms may work somewhat differently for the semiconductor industry than for other ones.

The reasons are to be found in two essential factors that have shaped the semiconductor industry since its beginning, factors that need to be appreciated to their fullest extent. These are

- the need to reach the highest possible intensity of R&D, coupled with
- the highest available intensity of capital.

Both requirements form not only an economic rationale for the existence and continuing prosperity of semiconductor industry; in reality, thanks to an unprecedented microelectronic technological innovation process that was initiated some 50 years ago, availability of R&D and capital are nothing less than *the* prerequisites for driving the never-ending progress of innovation upon which the entire economic activity of the industry depends.

This technological advancement is in turn fuelled by the ever-increasing demands of the electronic equipment markets for shorter product life cycles, rapid increase in features and functionalities, miniaturization, cost reduction, further integration of functions in the same or even smaller form factor and for shortening design cycles for increasingly more sophisticated products. All this is taking place in an extremely competitive and complex environment.

The intensive use of R&D and capital by the semiconductor industry becomes visible immediately when we consider the R&D efforts required in order to venture into previously unexplored technological universes such as nano- or biotechnologies. This intensity also appears when we recognise that without the unavoidably high capital expenditure for advanced semiconductor plants, allowing significant economies of scale, the demand for semiconductor products cannot be met.

The industry's increasing complexity was anticipated by '*Moore's law*' – a specific feature of the industry in itself – which states that the numbers of transistors on a chip doubles every 18 months. Proclaimed in the 1965, *Moore's law* continues to be valid today. Yet its validity is particularly puzzling since the price of computing power falls

exponentially as the power itself increases. Within the last ten years the price of 1MBit of memory has decreased by a factor of more than 300, falling from US$8.45 to below 3 cents. The conjuncture of this kind of pace for technological progress with such a price decline is unique when compared with other industries. To envisage the impact of this on daily life, just think of the differences in price, size and performance between a mobile phone today and one from 1995.

High growth, cyclicality and volatility

Historically the semiconductor industry has shown very high average growth rates, on the order of 15% per year. Despite this figure, however, the market has evolved according to a highly cyclical pattern, and is consequently exposed to much volatility, with significant upturns and downturns.

Structural drivers of this high average growth are the increased use of semiconductors in an expanding range of applications and the increasing functionality of semiconductor products. However, in the past decade this growth has slowed somewhat and is now becoming more in line with the growth rates realized by the electronics industry.

Truly global

A consequence of the global scope of the semiconductor market is its high international integration. This integration means that the semiconductor market behaves with full transparency of information from product creation to commerce. Regional price differences for example quickly fade out: even price differences of as little as a few cents last only a month. In other words, producers are price-takers rather than price-makers in the global market and competition is increasingly driven by the ability to reduce production costs.

Commitment to environment, safety and health (ESH)

The semiconductor industry has a clear commitment to ESH stewardship. The whole industry takes a proactive role towards its environmental responsibilities, with the EU and ESIA playing a significant role by pursuing, for example, voluntary initiatives to contribute to a comprehensive emission reduction programme for PFCs, which goes beyond the Kyoto requirements. This worldwide initiative was started in 1995 and aims to reduce absolute emissions by 10% by 2010, using 1995 as a baseline. It is currently well on track.

Intellectual capital creation

The impact of an R&D – and capital-intensive semiconductor industry has made a permanent contribution to new knowledge creation. The learning effects derived from semiconductors spill over seamlessly into the entire industrial production chain, their application in everyday consumer goods making a considerable contribution to people's quality of life.

Role of government

The nature of the industry has led governments to play a specific role in what is seen as a vital segment of their economies and to make an investment in their futures. This role has typically been to create the educational conditions for a highly trained workforce, encouraging scientific infrastructures with adequate public R&D spending and investment incentives as well as by taking measures that provide an environment in which an industry can prosper in a functioning world economy. As one of the leading semiconductor regions, Europe is no exception to this, given the efforts made by national governments and the EU.

Summary

R&D and capital intensity are the main elements shaping the semiconductor industry. They lead to further characteristics that will be referred to later in the report and which are summarized in the table below.

Distinct Characteristics of the Semiconductor Industry

- Very high, continuous R&D intensity
- Very high capital intensity
- Strong creation and diffusion of innovation
- Key enabling function for other industries
- Truly global from product creation to commerce
- Vital role of government support
- Cyclical market evolution with high volatility
- More than proportional need for highly skilled personnel
- Production with very high ESH sensitivity and diligence
- Significantly strong market presence for local applications development
- Significantly high value added for leading global end-user OEM manufacturers

1.3. Capital investment and semiconductor production

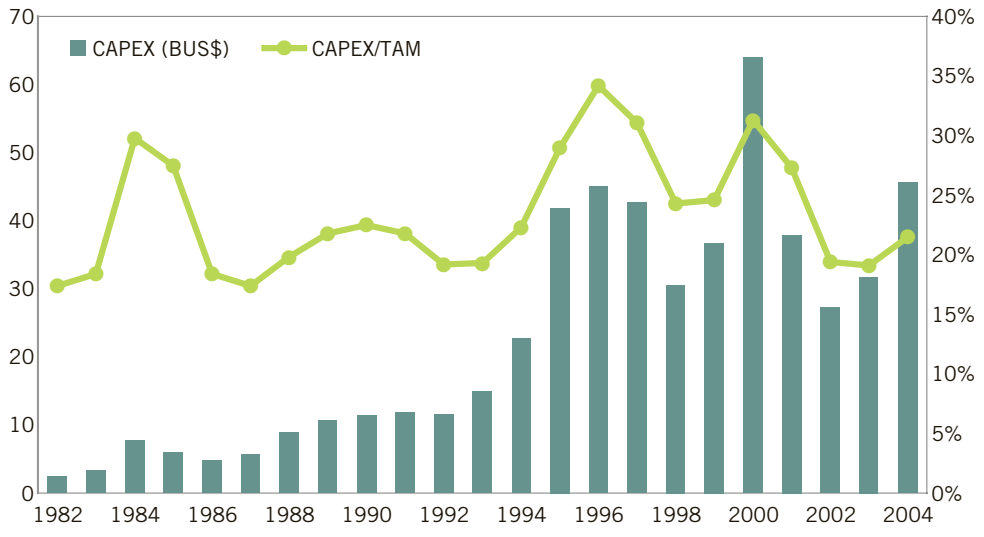
Economic implications

The semiconductor production process, given its high capital intensity, has a number of significant economic implications that distinguish the semiconductor industry from other industries in terms of competitiveness.

The set-up cost for a fab increases substantially over time. According to Moore's second law, costs for a leading edge fab double between two chip generations. Today the cost to set up a new 300mm fab amounts to €2-3 billion, and roughly 20% of the industry's annual revenues are spent on capital expenditures. If one adds an average of 15% of revenues for R&D investment to these 20% capital expenditures, one has a good indication of the tightness of expense budgets.

The pattern of industry investment relative to total market value has increased rapidly over a long period of time but recently has followed the market more closely despite some absolute peaks (Figure 3).

Figure 3 **Capital investment of the semiconductor industry – Capital expenditure (capex) and capex/total market**



Source: WSTS, MSDW

Even after a fab has been built, rapid technological advance will make it likely that it will need to be upgraded several times during its productive life. Hence the most important cost factor in wafer production is the depreciation of equipment, fab buildings and facilities. This can reach as high as half of the total cost. Given high fixed capital costs and relatively moderate variable costs in semiconductor production, unit costs per semiconductor produced decrease as more semiconductors are produced in a fab. This is because the fixed capital costs can be spread over a greater production. Increased output is reached due to learning effects and improved technological efficiencies which result in an increasing absolute number of chips on a wafer and in relative yield increases, and hence a fall in unit costs. It is generally observed that unit costs of production for semiconductors decrease by 30 percent if cumulative output doubles.

Set-up costs and falling unit prices in the semiconductor production process have direct consequences for the business strategy of semiconductor companies as well as for economic policy. As discussed above, exponentially increasing set-up costs have contributed to the emergence of stand-alone foundries specialising in the production of semiconductors. Foundries spend proportionally more on capital equipment and less on R&D costs than do classic integrated semiconductor companies. Access to cheap capital has therefore become a decisive factor in locating production. This in turn has increased the role of public capital investment support, which has therefore become an important factor in strategic business decisions for semiconductor companies.

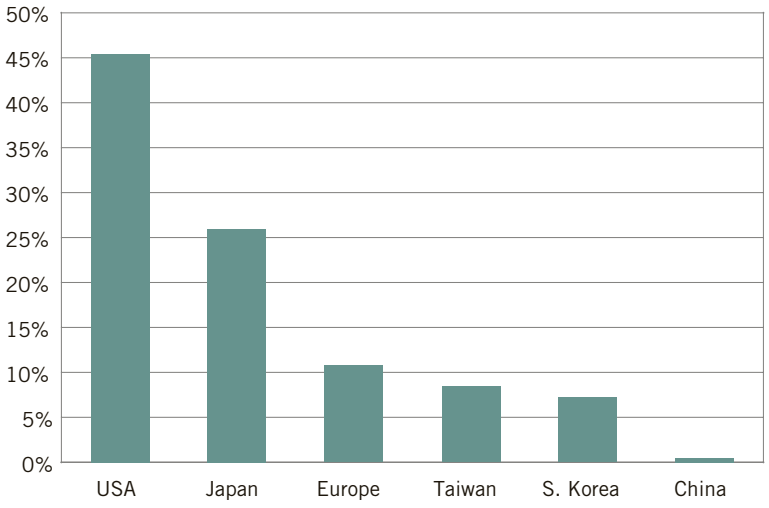
There is also an important 'first mover' advantage in the semiconductor industry. Due to falling product prices and a short product cycle, companies can only recover their investments for a short period of time at the beginning of the product cycle. Being first on the market therefore gives significant competitive advantage both in terms of return on investment and learning effects. Again, this underscores the strategic role public investment incentives can play in order to participate in the benefits generated by hosting semiconductor production.

Semiconductor companies have an imperative need for access to large markets, i.e. they need to operate at an international level both geographically and in terms of access to end-users. Only then are they able to recover investment costs and profit from the falling learning curve. Free trade and an international level playing field, without unfair promotion of single semiconductor producers, are therefore essential for the health of the semiconductor market. The critical implications of this for Europe's competitive positioning will be discussed below in Part II.

Geographic distribution of production capacity

It is against this background that trends in the global production capacity need to be observed. US companies continue to dominate the world semiconductor industry production with a share of more than 45%, while Japanese companies follow with a share of 26%. The EU ranks third with 11%, followed by Taiwanese manufacturers with 8%, half of which is earned by foundries manufacturing mainly for US-based fabless companies (Figure 4).

Figure 4: **Regional breakdown of semiconductor production capacity by company headquarters location (2003).**

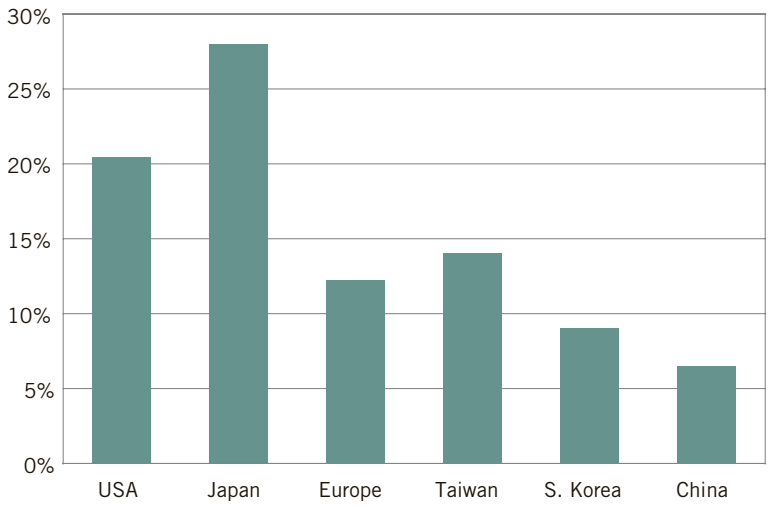


Source: ZVEI

However, looking at the geographic location of the wafer fabs (Figure 5), some 95% of all wafers are produced in 10 countries. Japan ranks number one with 28% of worldwide production capacity, followed by the US with 20%, Taiwan 14%, EU 12%, South Korea 9%, China 6%, Singapore 5%, and Malaysia 1%. This implies that – while claiming a market share of approximately 20% in the global semiconductor market – Europe is a net importer of semiconductors. Looking at individual EU countries, 5% of worldwide production takes place in Germany, 4% in France and Italy together and 2% in the UK.

The fact that China offers a capacity of 6% despite a share in the total semiconductor market of only 0.5% demonstrates that they benefit from many foreign investments attracted to the growing Chinese market, which will in turn pave the way for Chinese companies to become players in the global semiconductor market.

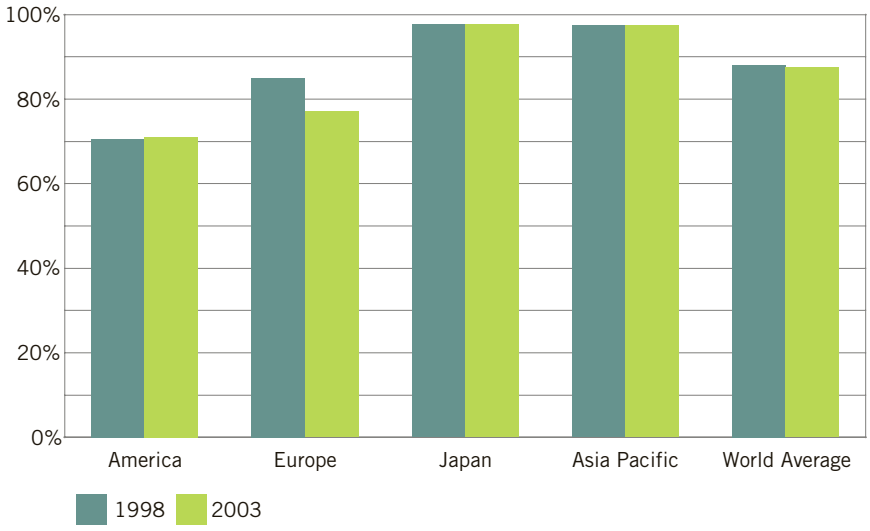
Figure 5: **Semiconductor production capacity by location of wafer fabs (2003).**



Source: ZVEI

Considering finally the share of wafer processing capacity in the home region of semiconductor manufacturers by number of wafers (Figure 6), the biggest shift between 1998 and 2003 has occurred in Europe. During this period, 9% of Europe's capacity has been moved to other regions, diminishing the number of wafers produced at home in 2003 from 85% to 77%. The figure also shows that the US, e.g., produces as much as roughly 30% in other regions.

Figure 6 **Share of wafer processing capacity in semiconductor manufacturers' home regions by number of wafers (1998, 2003).**



Source: ZVEI

1.4 The semiconductor industry market

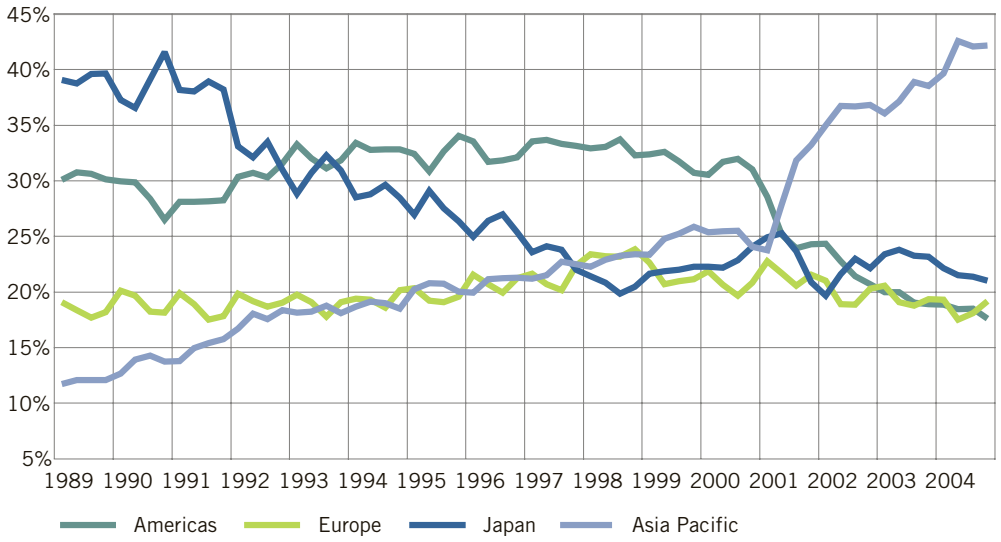
The European semiconductor industry operates in an expanding and highly volatile market, characterized by strong international competition from both international trade and foreign direct investment. Within this environment the European semiconductor industry in 2004 held a share of about 18% of the US$ 213bn (€171bn) world semiconductor market.

Evolution by Region

The evolution of the semiconductor market by region over the long term reveals a significant pattern in global market trends (Figure 7). The respective shares for the Americas, Asia Pacific, Europe (EMEA) and Japan in the world market have seen highly dynamic, irreversible structural shifts. Looking at almost 20 years of history we observe the dominance of Japan in the late 80's followed by the development of a relatively strong electronics equipment industry in the Americas in the 90's driven by the growth of the Internet along with its associated computing and communications equipment companies. Most strikingly however, we note the gradual development of the Asia/Pacific electronics industry, consistently outgrowing the rest of the world, eventually reaching a share of about 25% of global semiconductor consumption in 2000. Since then, through an unprecedented structural shift in the market, the relative position of this region has literally exploded to reach a staggering share in excess of 40% as of 2004 – growth that has been primarily at the expense of the US electronics industry.

The year 2001 marked the beginning of an acceleration in the semiconductor

Figure 7 **Evolution of the semiconductor market 1988-2004 by regions**



Source: WSTS

industry's shift to the Asia-Pacific region, particularly to China. The 2001 recession caused a collapse of large parts of the market for wired communication, especially for fibre optics and server systems, while at the same time PCs and mobile handsets experienced signs of some saturation in Western markets. Simultaneously demand soared in Asia, reflected in the shift in the market from Western to Asian regions and to China in particular. As a consequence, delocalisations began to take effect and continue today to an increasingly large extent.

In the midst of these dynamics, Europe has been the only region able to escape the dramatic swings experienced by the other regions and maintain its share. In the last 15 years the European share of semiconductor consumption has been relatively stable, fluctuating for a long period at around 20% of the worldwide market and still holding currently at about 18%. A stabilizing factor here can be attributed to the strength of European automotive electronics. Despite its market share, however, the fact remains that over the past few years the semiconductor industry in Europe has come under increasing pressure from a capital investment point of view.

The structural shift that occurred in the years 2000 to 2004 will be remembered as a historic macroeconomic structural event. The US saw its market share dramatically reduced from approx. one third to 19%, while the Asia-Pacific region has now reached 40%. It should be remembered that 40% was the share Japan held in the 80's before production progressively shifted to surrounding Asian countries. Within a short period of time, the previously-existing balance of 60% for the US and Europe versus 40% for Japan and Asia-Pacific has been reversed, mainly at the expense of the US. The continuous shift of production to Asia, together with rising consumer demand in China, is likely to boost the share of Asia beyond 45% in the coming years. This means that nearly half of the world semiconductor market will be concentrated in the Asia-Pacific region. The implications for the semiconductor industry will undoubtedly include a further geographic division of production factors and fragmentation of the industry's value chain.

Long-term growth

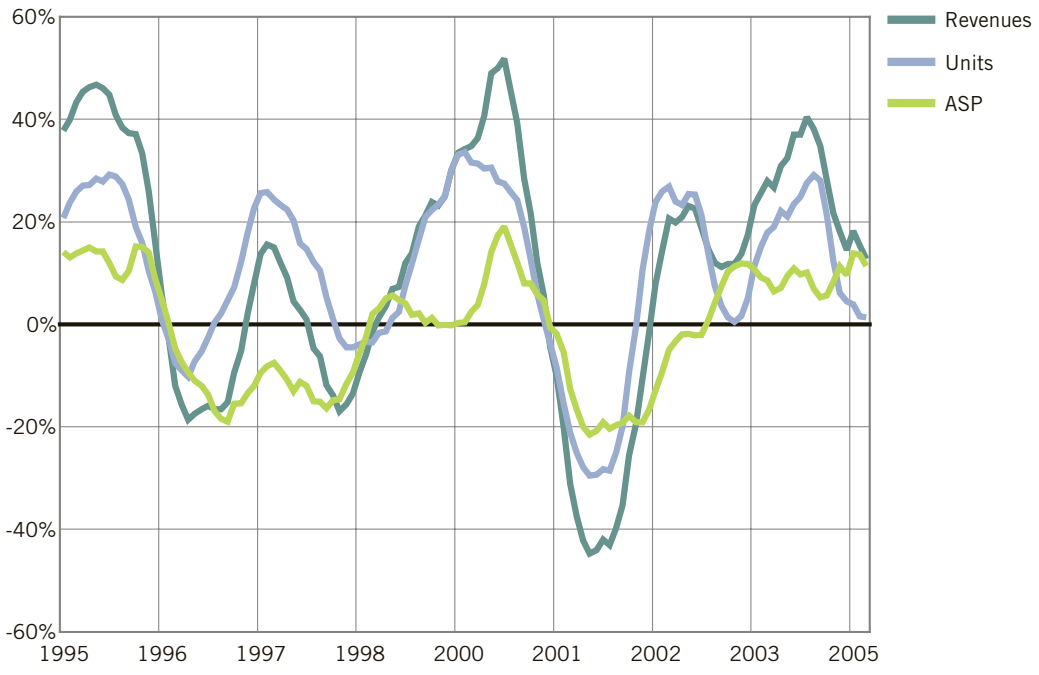
Historically, the semiconductor market has shown very high average growth rates. Robust growth on this scale, over such a long period of time, has never been seen before outside of the semiconductor industry. Between 1985 and 2004 the value of global semiconductor shipments has increased by a factor of 10 to reach US$ 213 bn. The 40 year-long average growth rate of 15% since the semiconductor industry's beginning in 1960 has slowed down since the mid 90's to reach 13% per year for the 1985 to 2004 period. In contrast, world income over the same period has little more than doubled. Main structural drivers of the industry's continuous growth are the extraordinary penetration of the use of semiconductors into all spheres of life, with an ever-increasing range of applications and functionality for semiconductor products.

The year 2000 marked the peak of a period of extraordinary growth for the semiconductor industry. The following year, 2001, was the beginning of a previously unknown downturn in the history of microelectronics. Between 2000 and 2004 growth in the US was -39%, in Europe -7%, in Japan -1%. Asia was the only region that grew, and did so at a rate of +74%. These recent growth variations are having a negative impact on the historic global long-term average growth rate.

Cyclical nature of the semiconductor market on a global scale

Despite its high long-term average growth rate, it is a well-known phenomenon that on a global scale the semiconductor market is extremely cyclical. The pattern can be observed in terms of revenues, units or average sales prices (Figure 8). For example, the recent 2000-2002 cycle has shown extreme swings where market growth rates have reached between +50% followed by a fall to -40%.

Figure 8 **The semiconductor market cycle – Growth rates of revenues, units & average selling prices**



Source: WSTS, based on a three month average

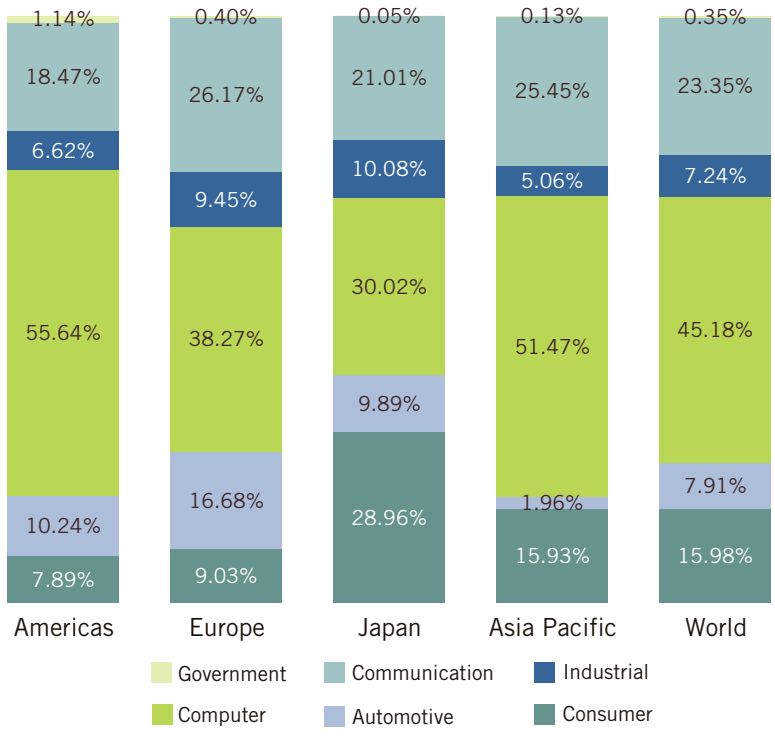
A typical semiconductor cycle starts with the take-off of a specific end-user market, driving up industry utilization and eventually resulting in product shortages that may have a positive effect on price development. This may then trigger customers to order early and/or place double orders to ensure product availability. The result is excessive market growth.

The downturn then sets in when end-user demand slows or proves to be lower than anticipated. As industry expands capacity and at the same time demand stagnates, utilization rates will decrease rapidly resulting in over capacity. At the same time the stagnating demand will cause excess inventory in the supply chain since the semiconductor manufacturing machine is like a mammoth tanker that takes a long while to slow down. This overcapacity accelerates the erosion of the average sales price (ASP), and as semiconductor makers are faced with low utilization rates they will postpone investments. Combined with the slowdown of end-user demand, this may drive the industry into a severe downturn (Figure 8). This rapid sequence of potentially severe ups and downs dictates that industry players have to react quickly and decisively in response to industry changes.

Regional presence of the global semiconductor manufacturers

The presence and specialisation of the semiconductor industry in a given region is reflected in semiconductor consumption patterns for different types of applications (Figure 9). Europe's specialisation by type of application shows a relatively more balanced distribution than other regions, with a comparatively stronger proportion of communications and automotive as well as a fair share of computer and industrial applications. Europe owes its relatively stable total market share during the difficult years between 1998 and 2003 to the strength of its automotive segment – the world's only segment that in 2003 exceeded its record results of 2000. In contrast the Asian-Pacific markets are driven by the dominance of the computer segment, followed by communications, whereas Japan's stronghold is still in the consumer segment.

Figure 9 **Semiconductor market splits by industry segments (2004) – in % on total**



Source: WSTS

The trends, however, are evolving rapidly. Encouraged by more favourable business conditions and economic incentives, as well as by growing local consumer markets and the presence of a larger international customer base, the semiconductor industry is increasingly attracted to Asia, in particular to countries like China, Taiwan and Korea.

The movement of existing companies' activities towards Asia is further amplified by the emergence of many new customers in that region.

The markets in a given region also reflect the presence of the various semiconductor manufacturers as well as their share in the regional market. All of the main semiconductor manufacturers operate on a global basis and have factories and activities all over the world. Companies from all four geographic regions are represented in the top ten companies at both a worldwide and a European level. Most of them have manufacturing activities in Europe and three out of the top ten global players, Infineon, Philips Semiconductors and STMicroelectronics are European-based enterprises (Table 1).

Table 1 **Top ten semiconductor companies in the world and in Europe 2004**

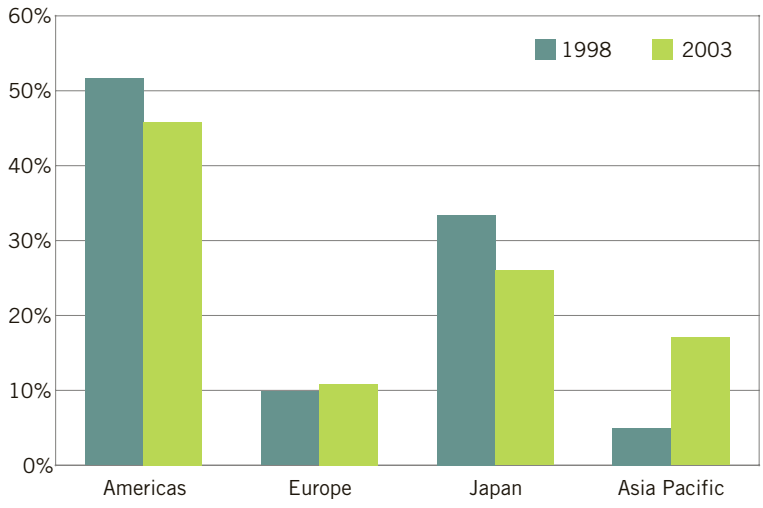
World	Company Origin
Intel	US
Samsung Electronics	Korea
Texas Instruments	US
Infineon Technologies	EU
Renesas Technology	Japan
Toshiba	Japan
ST Microelectronics	EU
NEC Electronics	Japan
Philips Semiconductor	EU
Freescale Semiconductor	US

Europe	Company Origin
Intel	US
Infineon Technologies	EU
ST Microelectronics	EU
Samsung Electronics	Korea
Texas Instruments	US
AMD/Spansion	US
Philips Semiconductor	EU
Freescale Semiconductor	US
Renesas Technology	Japan
Micron Technology	US

Source: Dataquest and company reports

From the point of view of turnover according to the region where companies have their headquarters, one can observe that European semiconductor manufacturers have essentially maintained their market share of from 10 to 11% between 1998 and 2003. This is despite fierce competition from Asian companies who have increased their turnover from 12 to 17 % during the same period. The biggest losses have been experienced by Japanese companies, who saw their share decrease by seven percentage points to 26%, whereas the US companies have seen their share decrease by 6%, which still gives them a share in the world market of 46% (Figure 10).

Figure 10 **Market share of worldwide revenues by region of company origin**



Source: ZVEI

What the analysis by company headquarters also reveals is that semiconductor market data based only on semiconductor consumption, i.e., sales in a given region, miss the fact that the recorded transaction in fact results from a longer process that has not necessarily originated in the region where the device is produced or sold. Semiconductor companies have activities that are more and more globally disseminated, operate production sites in low cost countries and serve customers who have delocalised their production facilities to offshore locations. The statistics therefore need increasingly to take this situation into account; it becomes important to distinguish between traditional market data based on sales figures and data based on information that records where the products are defined and designed. A large amount of the devices produced and sold in Asia have not been designed in those countries. In reality they were designed and developed in the home regions of semiconductor companies, where the bulk of their product engineering and development capabilities reside. Estimations regarding European designed devices indicate that the amount could be as high as 30% of sales recorded in Asia. In summary, the growing separation between product design and the location for manufacturing sites from both a geographic as well as a value chain perspective tend to relativise the market data by region.

1.5. The semiconductor industry in the European economy

Key enabling role of the semiconductor industry

An internationally competitive Europe also depends on the presence of a strong European semiconductor industry. In this respect the semiconductor industry plays a leading strategic role in competitiveness, innovation, productivity, growth and employment. The semiconductor industry, like the information and communication technology industries, is considered to be a general-purpose industry that enables other industries to produce more effectively and innovate faster. As such, the semiconductor industry fulfils a key enabling function in the value chains of some of the most prominent sectors in both local and global markets.

For the automotive industry, wireless and wired communications, industrial and consumer goods, to name only the most visible sectors, European microelectronics (of which semiconductors form the major part) often represent *the* single major differentiating success factor and value added contribution in their respective markets. Without the jointly developed intelligence of electronics systems solutions embedded in critical applications for the European car manufacturers or wireless handset industries, their leadership positions in terms of world market share would not be what the history of the last two decades has demonstrated. It is the complete semiconductor value chain, ranging from innovative chip design to electronic systems integration and electronic value added in the end-user product, which enables the industry to achieve global competitiveness.

There are several major reasons for the importance of the continuing existence of a strong European semiconductor industry, both as a sector in its own right and as a sector enabling other industrial activities in the European economy:

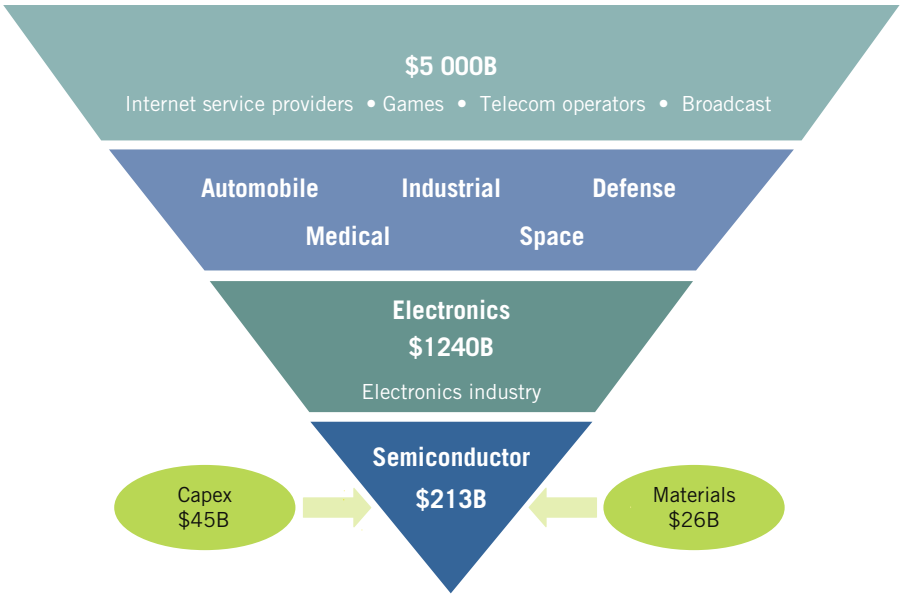
- the demand for semiconductors already exceeds local production: Europe is a net importer of semiconductors;
- the semiconductor industry's continual overall contribution to productivity gains;

- the strength of the overall microelectronics value chain, from up-stream suppliers to downstream end-user equipment manufacturers;
- the value added of the semiconductor industry as supplier of systems solutions based on a long-standing relationship between semiconductor companies established in Europe and the original equipment and end-user manufacturers that integrate the systems;
- the joint interest among all sectors of the economy, universities and research institutes to further the microelectronics knowledge base as well as to establish specific research and innovation programmes and projects.

In brief, the semiconductor industry is both its own competitive flagship as well as an enabler for further industries in Europe to maintain and enhance their competitiveness. The industry experiences a kind of *push and pull* situation in which it is both driving for innovation and value added and at the same time being driven by its users to provide the most advanced technologies and solutions. This typically is the case for the electronics industry, the automotive sector, wired and wireless communications and network infrastructures down to Internet services.

The following graph (Figure 11) illustrates the semiconductor industry's enabling function for downstream industries worldwide. Revenues in the overall microelectronics industry have a multiplier effect on other key downstream sectors where the electronic content is central. In other words, from a worldwide semiconductor market base of US$213bn (€171bn) in 2004, the industry has enabled the generation of some US$1200bn in electronic systems business and US$5000bn in services, representing close to 10% of world GDP. Although the exact multiplier for Europe may vary, the pervasive impact of semiconductors on the industries they enable does not.

Figure 11 **Economic impact of the semiconductor industry on other key downstream sectors –2004.**



Source: Medea +

The stronger the relationship between suppliers of semiconductors, electronic systems and final manufacturers, the stronger is the gain in productivity and competitive position in the global market.

It cannot be in the interest of the overall economic performance of the EU to see one of its single most important growth engine made dependent on imported semiconductor products. This question will be addressed in this report's recommendations. However, considering that the semiconductor industry's need for investment in R&D and capital exceeds a single company's capacity, its survival and enabling capacity may be at risk.

The productivity impact of semiconductors

The semiconductor industry contributed far more to the growth of aggregate labour productivity in both the EU and the US than any other industry. But it is also clear that its contribution in the US is significantly higher than it is in the EU. The reason for this is not lower productivity growth in the European semiconductor industry. On the contrary, according to some studies[1] semiconductor productivity per hour has risen more strongly in the EU than in US during the period analysed (1996-2000). It is however the semiconductor industy's relative weight in total industry – mainly due to the comparatively undersized ICT-producing and ICT-using industries in Europe -, that results in a lower productivity contribution in Europe than in the US.

In the future, however, further factors beyond the role of the ICT industry may also play a part in stimulating increased competition, innovation and productivity, especially in the EU. Enlargement, for example, holds the promise of significant productivity increases if knowledge can be transferred and exploited within the new Member States, especially if the traditional scale benefits associated with large, unified markets can be reaped. Conversely, the EU may benefit from its cultural diversity if the logic of production shifts from satisfying mass markets to producing highly diverse sets of goods customised to the needs of multiple, variegated markets. In such situations the advantages of large home markets are likely to be eroded and the dynamics of competition on a global level transformed.

Benefits of customer proximity

The success of Europen global forerunner industries[2] is to a large extent the result of an intimate and long lasting relationship between semiconductor suppliers and end-user product manufacturers in a given local and cultural context. Proximity to manufacturers who are integrating silicon-based systems solutions into their applications in industries such as wired and wireless communications, automotive and automotive parts, consumer and industrial equipment goods, computer and electronics, is crucial for jointly developing customized solutions. Firms need direct access to new product features and functions as well as a vision of next generation product roadmaps.

The presence of semiconductor companies with advanced design-in capabilities is of strategic importance because it allows

- innovating and adding value by embedding intelligence in application systems that are vital for the economy and society
- nurturing and strengthening the very roots of the value chains of global end-user goods manufacturers

[1] European Commission: The EU Economy 2004 Review; T. O'Mahony / M. van Ark B. (2003) EU Productivity and Competitiveness: An industry perspective – European Commission

[2] (see Figure 9 *Semiconductor market split by industry segments – 2004*)

- contributing more than proportionally to the industries' productivity, growth and high skilled employment, thus avoiding delocalisation, value-added deficits and brain drain.

In summary, from a sectoral point of view semiconductor know-how and development capability are vital for the technology leadership of most innovative applications of the industry. Having access to a leading-edge semiconductor industry that offers suitable systems at the right time and price locally, is likely to facilitate fast and effective technology transfers for innovative solutions, which are capable of making a difference in the competitive arena. Close cooperation results in advanced solutions and state-of-the-art quality.

The example of the semiconductor industry in automotive

The car manufacturing industry is one of Europe's major and globally-leading industries. Its technological competitiveness depends strongly on innovation activities engaged in with their electronics and semiconductor suppliers. It is the continuous search for new solutions—mainly concerning the safety, comfort and quality of new car generations—that has built its reputation as being highly innovative.

Today automotive electronics is a major differentiation criterion in the automotive market. Safety requirements such as airbags, adaptive cruise control, collision avoidance, antilock brakes, as well as entertainment, telematics, instrumentation and phones – among others – have tremendously increased the value of semiconductors as a proportion of the total value of a car. For example, a series 7 BMW today contains more CPU power than a PC, while electronics is also gaining a larger share of the value of middle range cars.

The semiconductor share of electronics in cars has constantly risen. In 2004 the pure semiconductor content in a car represented 7% of the value of a car on average, while the electronics content was more than 12%. In terms of a car's production costs, the numbers are even more impressive. In 2004 the cost of developing electronics content amounted to more that 20% of the value of an average light vehicle, whereas the cost of semiconductor content exceeded 12% (Figure 12).

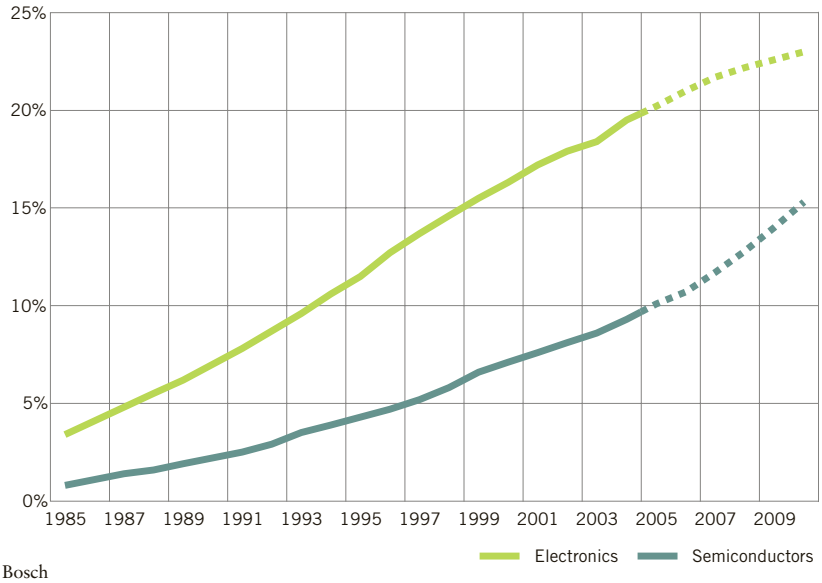
Keeping in mind that a dedicated semiconductor development cycle, from design to certification, typically takes more than five years, car manufacturers are partnering closely with semiconductor and electronics providers to address the specific technical needs in automotive production. These investments have improved the technological competitiveness of the European car industry globally, especially in the area of construction of car bodies and chassis.

Europe is by far the biggest market for the automotive semiconductor segment with around 36% of global consumption, followed by America and Japan; Asia Pacific is expected to grow dramatically in the following years (Figure 13).

Europe, with sales of US$6,6 bn in 2004, represents the largest share in the total automotive semiconductor market. Germany alone accounts for 2/3 in the European market share and holds the same total share as the US. Forecasts expect that the automotive share in Europe will continue to grow at a faster pace than in other regions and will reach US$9 bn in 2008.

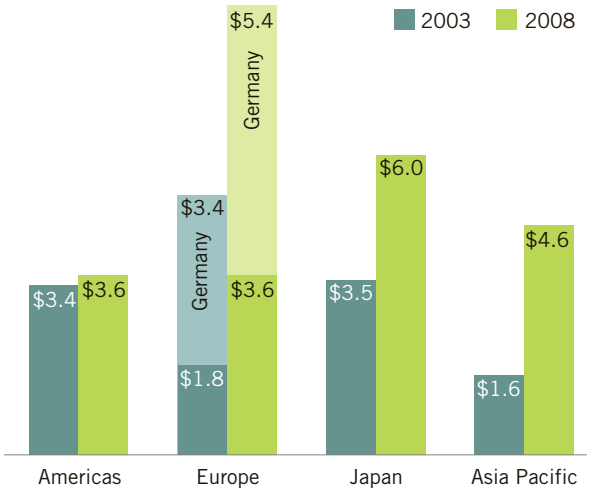
This automotive semiconductor market growth will continue despite slowing car sales and production. It is estimated that car production will continue to grow by 2.2% worldwide on average in the period 2003-2012, whereas the forecasted growth for semiconductor in automotive will be approximately 7% (Source: ZVEI).

Figure 12 **Development of electronics and semiconductor content of the production costs of an average light vehicle**



Source: Bosch

Figure 13 **Automotive Total Available Market (TAM) by region 2003 and forecast for 2008 – US$ billions per year**



Source: WSTS, ZVEI

Clusters of competitiveness; technology centres of excellence

In Europe the semiconductor industry gave birth to a number of world-class centres of semiconductor activity, not only ensuring innovation in Europe but also creating an important number of jobs. In fact – despite considerable market constraints and in contrast with general trends in Europe – a survey among direct ESIA members shows how direct employment has grown an average of 5% from 2001 to 2004, currently directly providing work for over 86 000 employees. A large proportion of these jobs are for highly skilled workers.

Examples of semiconductor industry clusters in Europe

Investments in the **Dresden** area started in 1993 with the first fab by Infineon (at that time still Siemens Halbleiter). By 2002 there were three major companies (AMD, Infineon, ZMD) with altogether over 7000 direct employees. Estimations were made that this total rises to 10 700 if semiconductor suppliers are included and to 13 000 if we also consider the impact of income spending, without including other related jobs, as e.g. employees of subcontracting catering enterprises. The city of Dresden actually claims a figure of 20 000 jobs related to the microelectronics sector (Source: Weber) with around 200 companies active in the semiconductor business environment in the Dresden area.

A similar example may be found for **Crolles** (Grenoble), where a partnership between Freescale Semiconductor (previously Motorola), Philips and ST Microelectronics has launched two important joint projects, Crolles1 and Crolles2. Crolles1 directly employs about 3000 people. The Crolles2 facility, inaugurated in 2004, is now creating a further 1500 direct jobs and 3500 indirect ones. Grenoble is already reaping the benefits of these efforts and the whole region now employs more than 20 000 people in microelectronics and related activities. The potential of the microelectronics industry is such that its positive effects on the economy's productivity are guaranteed for a long time. (Source: Grenoble Region, MEDEA)

In the area of **Nijmegen** 4500 direct jobs have been created, but the total is more than 10 000 if local suppliers are counted (Source: European Commission).

The ETNA Valley (**Catania**) developed as a technological cluster around ST in the south of Italy, with its 1000 high tech small and medium sized enterprises – 60 created in 2003- employing around 8000 people (Source: Etna Valley).

Similar effects and ratios can be found in the **Dublin** area.

Such regional poles of innovation are defined by a specific technological focus; above average numbers of companies with research capabilities; an excellent research infrastructure; a climate of cooperation between innovation actors; significant levels of high-tech employment; and a strong regional identity. In most cases, one or more organisations stimulated much of the networking in the regions while centres of excellence played a significant role in the generation and diffusion of knowledge and the start-up of companies according to what is often referred to as the Silicon Valley phenomenon.[3]

The proximity of research and manufacturing facilities benefits technology transfer because it minimises delays. Where research and manufacturing meet, effective networks between companies and research institutes emerge, attracting engineers, researchers and academics to share knowledge and experience, thus stimulating and accelerating the innovation processes in a geographic area. Thanks to an increasing number of partnerships and programmes, in most cases supported by European and/or national authorities, the centres of excellence that were formed in recent years demonstrate how vital this has become for the industry and its competitiveness.

The development of such technology clusters has had an additional and significant macro-economic impact in terms of innovation, productivity and competitiveness. Beside the immediate effects on local economies and job creation, the unique position of the centres, based on their high standards of research and innovation, advanced technology development objectives along with the seamless interaction between industry, public and private research labs and universities, qualifies them to become global poles of competitiveness. As the centres include not only European but also international players, as is the case with AMD in Dresden or Freescale Semiconductor

[3] The European semiconductor industry provides a perfect illustration of similar observations made in the US by the US Council on Competitiveness in the context of a project entitled '*Clusters of Innovation*' comparing high-tech, fast growing regions and identifying a number of shared characteristics.

in Crolles, the importance of technology clusters extends increasingly to the world economy. It is the power generated by creating clusters of common interests, aligning IP and standards, systems intelligence with applications matching consumer expectations that makes a decisive difference in the global economy.

Not every country needs to build up its own semiconductor industry, but areas should be supported where economic centres of technology know-how already exist that are able to compete at a global level. The success of semiconductor clusters such as Dresden, Grenoble and the Nijmegen-Eindhoven-Veldhoven-Leuven area, or the development of semiconductor facilities in Ireland, Catania and Avezzano, did not happen by accident.

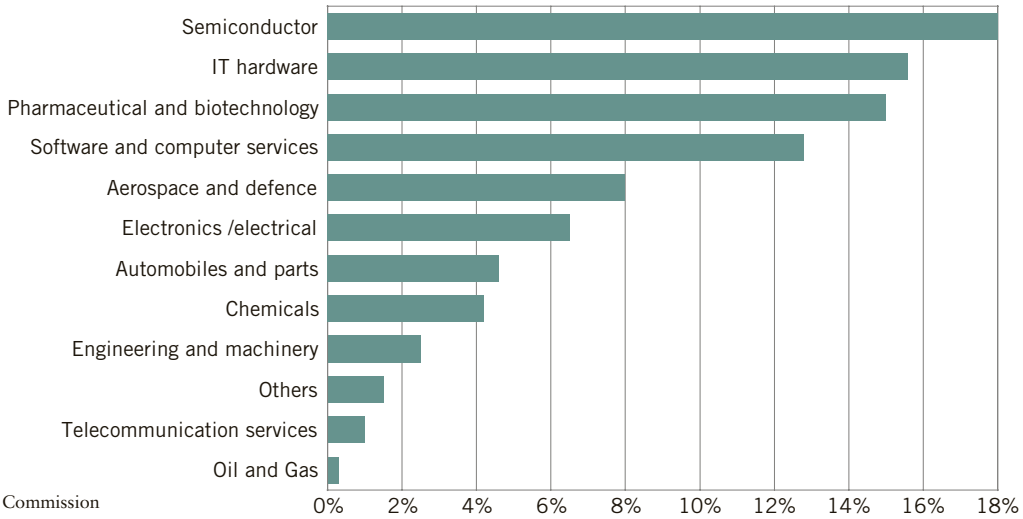
Importance of upstream semiconductor suppliers

Finally, the economic impact is not negligible on upstream industries such as semiconductor equipment and materials manufacturers, or general suppliers related to the presence of a vigorous and R&D intensive semiconductor industry in Europe. They enjoy a privileged relationship due to this local presence. In some cases this can be observed directly when these firms move to where semiconductor sites are located. Additionally, this favours the development of semiconductor technology clusters (Box).

1.6. Innovation in the semiconductor industry

The semiconductor industry is one of the most, if not *the* most, innovative industries. The emergence of a strong semiconductor industry in Europe – and hence throughout the world – has been possible thanks to a beneficial combination of private investments and active public (EU and national) support. To ensure that Europe maintains its pace of progress, the effort it needs to undertake is enormous. Typically, European semiconductor companies re-invest an average of approximately 15% of their income in R&D. Although closely followed by the pharma- and biotech-industries, this is proportionally more than any other industry in Europe (Figure 14). Such a high share of revenues for R&D is the result of a long term process: In 1980 semiconductor companies already spent 5% of their revenues for R&D – a percentage still higher than today's average for industry as a whole. Nevertheless the burning question remains: What does it take to maintain this level of R&D investment, how does this investment benefit Europe and what are the implications for the industry's future competitive position.

Figure 14 **Research intensity in European industries 2003**



Source: ESIA, European Commission

Europe's innovation gap

Europe's semiconductor industry suffers structural disadvantages in comparison to the semiconductor industry in other regions. In terms of innovation performance, most surveys still put the US far ahead of the EU average and superior to all but a handful of EU Member States. A number of structural and economic advantages may help explain this pre-eminence. These include a large home market, strong capital markets, flexible labour markets, a deep commitment to property rights along with an impressive degree of cooperation and collaboration between the federal government, private-sector R&D actors, national and military labs, research universities and entrepreneurs. All these factors are influenced by government policies, and scrutiny of these policies may yield valuable lessons for the EU in its attempts to close the 'innovation gap' with the US and to compete successfully in the global marketplace.

In 2000 when the EU formulated its Lisbon Agenda, R&D intensity (defined as R&D expenditures as a percentage of gross domestic product) was already significantly lower in the EU than in the US or Japan and the situation appears not to have improved since then. In 2002 the EU15-countries spent 1.93% of their income in R&D, whereas the US spent 2.76% and Japan 3.12%[4]. Within these totals the figures are also less favourable regarding R&D expenditures in the private business sector, e.g. in 2001, 56% in the private sector in the EU-15 countries vs. 73.9% in the US. Common to both regions is the fact that the semiconductor industry outperforms the rest of the industry (see figure 14). Sustaining these high levels of R&D investment is a constant challenge because of the dynamic economics of the industry, especially during market slowdowns.

Europe's R&D tax environment does not make it any easier to overcome these difficulties. Tax credits in the EU are generally lower than in the US, particularly in high tech industries. This is an area where specific government initiatives can really make a difference through the implementation of a generalized tax credit system for R&D spending for all semiconductor companies in any geographical area in Europe.

To this is added an often fragmented research policy that may cause a lack of synergies between public and private research, sometimes leading to duplication of programmes and sub-optimal use of resources. There needs to be a greater appreciation in Europe that public R&D policy plays a vital role in stimulating business efforts. A better understanding of this fact would help achieve the Lisbon target levels for private R&D investment.

While R&D in the field of semiconductors continues to be an area of traditional strength in Europe, there are also alarming signs that Europe stands at a crossroads, with total R&D investment seriously lagging behind regions such as the US or Japan. At the same time the gap between private R&D funding (generally increasing) and public funding (generally stable or decreasing) is also dangerously increasing in Europe.

Meeting the requirements for high tech skills

Education and training are key elements of an increasingly knowledge-based economy and society. Innovation calls for a continuous flow of new and creative talent, particularly of trained 'knowledge workers' in the field of science and engineering. According to Eurostat the ratio of human resources in science & technology in the high-tech industry in 2003 was 42.9% of total employment compared to a percentage of only 21.6% in the total manufacturing sector. When considering scientists and

[4] Source: EUROSTAT

engineers only, these represent 15.7% in the high tech sector whereas in total manufacturing they account for only 5.4%. This emphasis on the high-skilled end of the employment scale (especially engineers and scientists) is particularly germane to the semiconductor industry.

Yet here again a comparison with the US serves to illustrate the issue Europe is facing. On the one hand Europe benefits from a wide pool of qualified engineers with a higher share of graduates in Science and Engineering in the age class 20-29 than in the US. On the other hand however, this is not an adequate measure of the availability of highly-qualified labour force for the European semiconductor industry. Increasingly mobile R&D activities and outstanding research opportunities or conditions in non-EU countries, and in the US in particular, result in a movement of researchers to more attractive locations. A study has estimated that more than 400.000 European science graduates work in the US and that European-trained scientists carry out roughly 40% of US R&D[5]. To limit this brain drain. Europe needs to improve its attractiveness to researchers dramatically.

In order to fill their needs, both the EU and the US try to attract highly-skilled staff from abroad. But with countries such as China and India catching up, this global competition for talent will become increasingly challenging. A case in point is Taiwan. After the mid-'80s the number of Taiwanese graduates working outside Taiwan has steadily decreased due mainly to rapid economic growth, local graduate programmes and new job opportunities for Taiwanese students. It can be anticipated that this pattern will soon apply to China and India as well.

The semiconductor industry in Europe sees an acute need to prepare Europe better for a knowledge society, from basic schooling to universities, to allow wider parts of the European population to participate fully in the increasingly compelling processes of innovation. The industry is registering a generally diminished interest in technical subjects among students of a young age and a general lack of industry focus at university level, which translates into a lower quality of the graduates needed to help enterprises remain creative and the industry to gain competitiveness. Measures to counter this can be found, for example, in incorporating technical and practical industrial experiences into university curricula, encouraging schools to invest in technical subjects, promoting closer industry-university-research institute cooperation, facilitating and increasing the number of international student and researcher exchanges and increasing collaboration between universities. These are all keys to strengthening an educational system from which the semiconductor industry in Europe will also benefit now and in the future.

Intellectual property creation

An important feature that is related to the high R&D intensity of the semiconductor industry is IP creation and the rise in patent applications in Europe, as well as e.g. in the US: Semiconductor-related patents form a significant part of this and reflect the steep growth of R&D in the industry. However, this phenomenon also reveals the competitive move IP protection represents: Patents are more and more becoming "legal bargaining chips" that enable firms to avoid being excluded in a particular field of use, to obtain more favourable terms for their licensing agreements, to guard against costly patent litigation and to gain access to external technologies on more favourable terms of trade.

[5] A. Murray (March 2004). The Lisbon Scoreboard IV. The Status of Economic reform in the enlarging EU. C. Denis et al. European Commission (February 2005). The Lisbon Strategy and the EU's Structural Productivity Problem.

Against this background it must be noted that patenting is much more complex for those who seek intellectual property protection across several or all of the EU Member States. Patents are granted by the EPO or by national authorities, but Member States may still require translation into the national language in order for the European Patent to be valid. This increases the cost exponentially. Furthermore, litigation procedures are still national. The fragmented patent system that a single European Patent would partially help to ameliorate adds up to a lack of reciprocity between the European, US, Japanese and other patent systems. Moreover, internationalisation requires reduction of transaction costs, facilitated trade along with support for investment and innovation. This represents a disadvantage compared e.g. with the US bureaucracy; greater time requirements in Europe create barriers to patenting and affect innovation performance.

With IP playing such a central role in the semiconductor industry's competitiveness, IP facilitation, protection and enforcement remain a constant concern. The technology base and pace of the industry still act as impediments to effective counterfeiting, but counterfeiting technology is fast improving and is creeping up the technology chain. Despite the high level of sophistication of products supplied to the semiconductor device industry, counterfeiting is already becoming an issue at the design end or in the supply chain.

Consequences can be seen more clearly in other sectors, where counterfeiting has led to large-scale IP infringements, poorer quality and sometimes to safety hazards, distortion of markets through dumping and the downfall of those companies who play by the rules yet experience an effective halt in the development of their products. Just think of the consequences if medical devices start to malfunction due to poor quality caused by an undetected counterfeit semiconductor. While there is still a technology gap between leading-edge products and those resulting from counterfeiting older technology, it is only a matter of time before this technology gap is closed.

R&D partnerships

Over time, and beyond the genuinely high propensity within companies to mobilize their own R&D resources, a propensity dating back to the founders of the semiconductor industry, new and incremental sources of innovation had to be found despite the structural disadvantages mentioned above. Among the factors that have increasingly enabled the extension of the R&D platform is the development of pre-competitive cooperation among industries. Whether in the form of temporary consortia, projects or more formal alliances, these partnerships aim to share costs and risk, to achieve economies of scale and to shorten time-to-market. Their strategic advantages include, amongst others, the possibility of building strong research networks combining the best of all specialized disciplines or to facilitate standardisation. All parties gain from R&D partnerships: semiconductor companies as well as public research institutions, university and industry, by integrating and sharing basic research and applied-research programmes.

The main role of collaborative partnerships is to enable the generation of intellectual property and systems intelligence, thus encouraging a pull effect from the end-user industry in terms of innovation, know-how, incremental financial resources and employment opportunities. Ideally, a healthy relationship between productivity, innovation and competition rests on both horizontal cooperation between device manufacturers – so-called *pre-competitive* R&D – and vertical cooperation along the supply-chain, both becoming increasingly important, with the whole semiconductor supply-chain continuing to undergo fragmentation and specialization.

In summary, joint partnership programmes illustrate the effectiveness of competitiveness and innovation imperatives. They enable the industry to drive technological advances ahead of the industrial norm, contribute to unique IP and knowledge transfers between alliance partners and bring IP and systems leadership to the end-user industry by creating opportunities for sharing expertise, skills and employment.

In Europe there are some excellent examples of successful R&D partnerships. Indeed, the ability to create these and make them work is a European strength. Crolles2 is one such example.

The Crolles2 Alliance

The initial alliance was created about 10 years ago in Crolles, and included Philips and ST Microelectronics in a project called Crolles1. In 2003, the alliance saw a major expansion by including Freescale Semiconductor (previously Motorola) in the Crolles2 initiative. Under a five-year agreement extending through to December 2007, the Crolles2 Alliance has created a cooperative effort of unprecedented scope in the microelectronics sector. By combining efforts, alliance members have achieved several milestones with the early availability of the industry's first 90-nm CMOS design platform and cell libraries for system-on-chip solutions. Their joint Crolles2 Centre focuses on specific technologies at the forefront of semiconductor R&D: Starting at 90-nm, the alliance will continue and develop CMOS processes at the 65-nm, 45-nm and ultimately the 32-nm nodes. The Crolles2 Alliance partners have recently extended the scope of their joint semiconductor R&D activities to include R&D related to wafer testing and packaging in addition to the original tasks. The Alliance also includes close R&D cooperation with the CEA-LETI research institute.

Another recent example is the creation of a European nanotechnology platform (ENIAC). This is part of future-oriented 'mega-projects' under the European Technology Platforms ETP framework. Although limited, these projects provide an opportunity for experimenting and producing tangible results, with risks and resources shared by government and industry, maximising three-way cooperation between industry, university and government. Another good example is ARTEMIS, the technology platform for advanced research and development on embedded intelligent systems for aerospace, automotive, industrial communication and consumer electronics.

The semiconductor industry has to continue to enhance the model of multiple partnerships, as the capital and R&D investment involved in moving the industry forward is far too high a cost for companies to carry individually. Conversely, the spin-offs from this pre-competitive exchange are extremely beneficial for everyone, acting as a trampoline for innovation. But investment in such largely horizontal cooperation between device manufacturers needs to be accompanied by vertical cooperation, as the whole semiconductor supply-chain continues to undergo a fragmentation and specialisation process.

A case for R&D support – Current EU R&D programmes

Active government support for the European semiconductor industry's R&D is indispensable to ensure that the entire European economy can profit from technological progress in the semiconductor industry in the future. Consequently, support of the European semiconductor industry is an investment in Europe's future.

Today, innovation support receives much attention: for Europe, the huge and constant

capital and R&D investments required to move the industry forward mean that it needs to see innovation as a priority in order to maintain and enhance its competitiveness *vis-à-vis* other regions.

The policies currently in place help improve the business environment for innovation in some of the more dynamic EU economies while they stimulate investment as well as improving innovation and productivity performance within the newer Member States of the enlarged EU. Maintaining and enhancing R&D and innovation supported by both public and private sources are essential: These

- stimulate pre-competitive synergies for most advanced technological developments;
- enable investments that offset policy advantages of other regions and help maintain a level global playing field;
- favour learning effects and knowledge spill-over to other industries through the education system and scientific community;
- encourage the formation of industry clusters or poles of competitiveness.

European Programmes supporting R&D investment in the semiconductor industry include funded projects under the

- EU Framework programmes
- European Technology Platforms such as European Nanotechnologies
- Sectoral initiatives such as MEDEA+.

MEDEA / MEDEA+

The programme began in January 2001 and is planned to run until the end of 2008. MEDEA+ organizes microelectronics R&D projects that are funded with a combination of public and private funds totalling about €300 million in 2004. The main objective of MEDEA+ is to stimulate innovation and provide a technology platform that will allow the European microelectronics industry to remain among the world leaders. The original MEDEA (Microelectronics Development for European Applications) programme ran from 1997 to 2000. It focused on strengthening European competitiveness through R&D cooperation.

These programmes are a unique source of strength that can give Europe a competitive edge, and the spin-offs benefit everyone. The final aim is to ensure competitiveness throughout the production chain and make the links between semiconductor suppliers, manufacturing and users as smooth as possible. Cooperation along the supply chain is already good in Europe, and there is potential for it to be even better.

Using and strengthening existing programmes such as Medea+ or using new ones such as the nanotechnology platform ENIAC and the embedded intelligent systems platform ARTEMIS as models, Europe needs to build on its ability to encourage partnerships and focus on investing in innovative production technology. With semiconductors as the enabling factor for most high-tech industry branches, this is money well spent and resources well-focused. It remains a key to European success stories.

The European Commission is currently implementing the Sixth Framework Programme for Research and Technological Development (FP6), which acts both to

increase public sector spending on R&D and to leverage additional private sector funding. Furthermore, the original plans for FP7 contemplated doubling the budget to €40bn within a seven-year timeframe for the programme.

In 2003 the European Council drew up the Lisbon strategy, relying on Member States separately to take responsibility for the implementation of policies designed to achieve the Lisbon goals via the '*open method of coordination*' approach. Despite high initial expectations, these initiatives have now shown themselves to be insufficient for enhancing or even maintaining the position of the semiconductor industry in Europe or reducing Europe's current competitiveness gap. Because the Lisbon process has been less successful than expected; other countries have launched support programmes for their domestic semiconductor industries that exceed the goals of current European initiatives.

1.7. Conclusions for Part I

Innovation and capital investment are key to maintaining and enhancing the competitiveness of the semiconductor industry in Europe. Today there is a serious risk that, by attracting manufacturing activities away from Europe, the synergies achieved in the various European centres of competitiveness may be lost or even worse, that R&D will follow delocalised manufacturing facilities for the same reason. Europe has to retain these assets.

Government support for the semiconductor industry's R&D is indispensable to ensure that the entire European economy can profit from technological progress in the semiconductor industry in the future. With the new Structural Fund financial period 2007-13 closing and the Lisbon agenda goals moving further away, this is an area where Europe cannot afford to rest on its laurels or make decisions that it will regret later on.

Today, however, it must be stated that our biggest concern is that the new EU rules have essentially eliminated the already limited possibilities in Europe for building up and expanding these semiconductor industry centres. They in fact exclude the bigger projects that are necessary for the semiconductor industry and consequently result in making leading-edge investments in Europe less attractive. The new rules place a ceiling on the amount of available funding and because of geographical requirements do not allow the expansion of many existing centres of excellence. Needless to say, this represents a serious blow to the European semiconductor industry inasmuch as this excludes high-level investment projects such as new semiconductor fabs in Europe, while it substantially raises the costs of doing business in Europe. The AMD project in Dresden may well be the last example of a leading-edge fab being built in Europe. The EU increasing focus on small-and-medium-sized enterprises (SMEs) should not be at the cost of the industry as a whole.

Initiatives like Medea and ENIAC should be financed by a general shift in Europe's expenditures. Quoting the Chairman of Medea+, Mr. van der Poel, the EU appears currently to spend more public money "*rescuing declining industries, rather than investing in growth industries*"[6]. The recent original Commission proposal of doubling the EU's R&D cooperation funds for information technologies and focusing on longer-term research projects within the 7th Framework Programme (2007-2012) is a step in the right direction if supported by the European Parliament and Council. Together

6 ISS Conference, Berlin February 2005

with the expectation that Member States will ensure achievement of the necessary level of 3% of European GDP, this would confirm the position that for Europe it now is urgent to invest in the future rather than subsidize the past.

In light of the pivotal and strategic role the semiconductor industry plays in the European economy on one hand, and the industy's need for investment in R&D and production that exceeds a single company's capacity on the other, the question must be raised whether economic policies in Europe benefit the continued presence of the semiconductor industry in Europe.

Europe's policy towards its semiconductor industry should be to at least provide a *level playing field vis-à-vis* other regions. This can be done both by preventing non-European governments from unfairly supporting their industries and by matching the advantages producers outside Europe enjoy.

Part II

The Competitiveness Challenges

2.1 Competitiveness factors

The competitive position of the semiconductor industry in Europe is a function of both the global performance of the semiconductor players operating in Europe and the performance of the European end-user industries whose global success rests substantially on semiconductor devices / embedded intelligent solutions.

To maintain and enhance its competitiveness, the semiconductor industry vitally depends on continuous innovation and technological progress requiring very high R&D investments and capital expenditures on the one hand, and on the other the capability to provide superior value added products to major end-user industries that are global leaders.

However, given the semiconductor industry's unique characteristics, it operates under a number of framework conditions that both enhance and hamper the achievement of competitiveness. Such conditions may be rules and regulations that can be influenced and acted upon directly, e.g., the legislative framework, or they may be situations and trends such as, e.g., consumer demand or market access upon which its influence is at best indirect.

In brief, it can be observed that the semiconductor industry's profile and its unique characteristics correlate with a number of specific competitive dimensions (Table 2).

Table 2 **Semiconductor characteristics and competitiveness dimensions**

Semiconductor Industry Profile	
Distinct Characteristics	**Competitiveness Dimensions**
• Very high, continuous R&D intensity • Very high capital intensity • Strong creation and diffusion of innovation • Key enabling function for the industry • Truly global from creation to trade • Vital role of government support • Cyclical market evolution: High volatility • More than proportional need for highly-skilled personnel • Production with very high ESH sensitivity and diligence • Significance of strong market presence for local applications development • Significance of high value added for leading global end-user OEM manufacturers	• R&D spending capability • Pre-competitive cooperation / partnership effectiveness • Importance of effective IP and IP protection • Proximity to local customer base • Promotion of free and fair trade policies • Consistent and efficient customs operations • Globally effective EU monetary policies • Target investment support/incentive levels • Sectoral flexibility of European labour policies • Transparency and access to timely market data • Educational system reinforcement & closer interaction with industry • EU legislative environment adequacy • Strength of European internal market • Global strength of European end-user industry

Assessment of critical competitiveness factors

Using the Semiconductor Industry Profile as a base (Table 2), ESIA has identified what it sees as the industry's most relevant competitiveness dimensions. These ten dimensions can be grouped under three broad categories i.e. *Investing for Europe*, *Level Playing Field* and *Market Performance* (Table 3)

All dimensions have a major impact on the industry's competitive environment in Europe today and in the future. Depending on the effectiveness of specific measures regarding certain dimensions e.g. R&D spending, or changes in the competitive environment of the industry such as the strength of the enlarged Internal Market, the impact may be either more or less positive. All dimensions hence represent assumptions concerning possible changes that may be anticipated. Taking all dimensions into account, possible alternative future scenarios for the industry in Europe can be derived (Box).

Table 3 **Ten key dimensions for assessing the present and future state of the competitive environment of the European semiconductor industry**

Investing for Europe

- R&D spending capability
  - R&D and innovation policies
  - Research investment targets
- Pre-competitive cooperation / partnership effectiveness
  - Developing joint research and design centres
  - Framework programmes
  - Technology platforms
- Educational system reinforcement
  - Curricula
  - Industry-university research
  - Exchange programmes
  - Brain retention

Level Playing Field

- Target investment support / incentives levels
  - Tax havens
  - Access to capital
  - Property incentives
- EU legislative environment adequacy
  - Environment, safety & health
  - IP rights
  - Customs & security
  - Pooling expertise within institutions
- Sectoral flexibility of European labour policies
  - Working hours and employee productivity
  - Employment conditions
- Promotion of free and fair trade policies
  - Reciprocal world free trade environment
  - Elimination of tariffs

Market Performance

- Global strength of European end-user industry
  - Leadership of global industry sectors (Auto, Wireless)
  - Electronics value added driven performance
- Globally effective EU monetary policies
  - Stability of exchange rates relative to other currencies
- Strength of European internal market
  - End-user / consumer demand in the enlarged 25 EU internal market

Competitiveness Scenarios for the European Semiconductor Industry

Based on the dimensions that best represent the conditions for competitiveness, it is possible to visualize the competitive factors at work in the European semiconductor industry environment at the present time (Figure 15).

A way to visualize the present state of competitiveness of the European semiconductor industry is to assess the currently perceived level of materialization of the different competitiveness dimensions on a scale of 1 to 10. The ranking illustrates whether the position of a chosen parameter is perceived as favourable or less favourable, 1 representing the least favourable perception, 10 the most favourable one. The Figure shows the combined set of dimensions and visualizes the present state scenario view for Europe (Figure 15), representing the actual conditions under which the industry is operating. The chart reflects the perceptions of ESIA companies. A score of '10' would represent an ideal state, forming a perfect 'wheel' for moving forward with all 'spokes' being the same length. The bigger and rounder the wheel, the less obstacles there are to moving the competitiveness wheel forward faster.

Figure 15 **Present state scenario: Competitiveness position of Europe**

Source: ESIA

2.2 Achieving favourable competitive conditions for Europe

Investing for Europe and creating a Level Playing Field.

If we were to compare the present competitive position of Europe with other world regions according to the defined dimensions, the result would most likely show a more favourable overall profile for the US in almost all dimensions. In the case of Asia-Pacific critical dimensions such as *"Targeted Investment Support"* or "*Legislative Environment"* would probably favour Asia-Pacific better than Europe – far more generous for the first and much less restrictive for the second. Europe's perceived comparative strengths consist of the presence of a strong end-user industry and the potential of the Internal Market. The burning question that has to be asked, therefore, is whether Europe shares *comparable conditions of competition* with Asia-Pacific, Japan, the US and eventually China?

Based on our analysis, the previously robust European semiconductor industry is beginning to suffer increasingly from serious competitive disadvantages in comparison with other regions. It is currently handicapped in both the two main categories of defined competitive dimensions: *Investment for Europe* and *Level Playing Field*. In order to reduce these disadvantages and to establish more favourable competitive conditions it is urgent to call for adequate actions and policy measures without delay.

Both categories are closely interrelated. Enhancing the European semiconductor industry's capacity for engaging in advanced R&D as well as developing new products and processes does not guarantee that these inventions will automatically generate commercial success. For this to happen the European semiconductor industry needs to compete on a level playing field. Therefore, if Europe wants to take advantage of an innovative semiconductor industry it has to improve its R&D environment drastically *and simultaneously provide* access to a level playing field.

The effort therefore needs to be targeted on all dimensions simultaneously, ensuring that the overall effect is greater than sum of improvements in single dimensions

Investing for Europe claims that long-term sustained R&D spending by both public and private stakeholders at European and national levels in support of its semiconductor industry is an indispensable prerequisite for achieving international competitiveness. It is also a powerful lever for economic performance, as the semiconductor industry contributes directly to increasing productivity and indirectly to economic growth through innovation spillovers.

Whether this is achieved through increased public R&D spending, strengthening of higher education in electronics-related disciplines or through public-private partnerships and cooperation, the combined effect will enable the semiconductor industry to:

- elevate its competitive positioning both quantitively and qualitatively;
- set future research priorities and emerging areas of innovation ahead of competition;
- create poles of excellence capable of asserting global leadership.

Similarly, establishing a *level playing field* addresses the necessity to reach comparable conditions in terms of market entry, factor costs and legislative environment among regions and/or nations, so as not to fall further behind the others.

In a world characterized by extremely disparate levels of economic development, industries seek increasing access to the most favourable business conditions wherever they may exist globally. Governments, in order to attract new investments, compete

fiercely to offer the most favourable incentives and regulatory conditions consistent with WTO rules. Although Europe still offers a formidable skills reservoir for a high-tech educated workforce, and despite initiatives like the Lisbon agenda, she is falling behind in the race to offer incentives and framework conditions that are able to sustain comparison with other regions.

Comparison of tax and investment incentives

A preliminary comparison of tax and investment incentives among different countries/regions shows significant differences between them (Box & Table 4). The analysis clearly reveals the importance in terms of impact of governmental-sponsored incentive schemes which apply to semiconductor companies: in the end it is this cost saving factor that shows the most significant differences. Similar trends have been analysed by other associations in the US (e.g. SIA, AeA).

In the case of creating a new semiconductor fab regional differences in incentive schemes, factor costs, skills and anticipated market conditions are the main influences on fab location decisions. The ESIA study focused on factor costs and incentive schemes for eight different locations and concluded that, despite the huge discrepancies in personnel costs between advanced and emerging economies, it is the incentive schemes that by far have most significant impact on the *net cumulative income*. Taking a five year period into account, the net cumulative income achieved by 2010 in China, Korea and Malaysia will be slightly above €1400 million, altogether around 220% greater than the value for Germany (Figure 17)[1]. The magnitude of these differences induced by incentives schemes simply cannot and should not be ignored by decision makers both in the industry and by governments.

"Model Fab" Comparison of tax and investment incentives study results

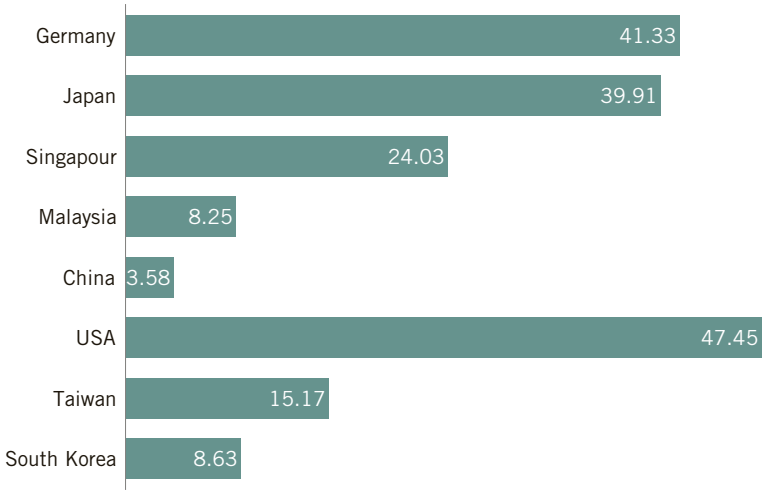
Focusing on investment incentive information for eight different worldwide locations , and leaving aside other strategic factors, ESIA performed a preliminary cost comparison that shows how much *cumulative net income* a hypothetical fab in each country would generate. The following factors were considered in the calculation:

- Personal costs per hour today and the anticipated annual increases (5% pa China, Korea, Malaysia, Taiwan and 3% per year for Germany, Japan, Singapore, USA), including social costs and number of working hours (Figure 16)
- Material costs including utilities and maintenance considering regional differences
- Financing in accordance with local rules and interest rates
- Local tax and incentive schemes
- Depreciation according to US-GAAP in all locations, R&D license fees and costs for administration independent of location
- All other parameters influencing the cumulative net income are the same in all locations. The model does not consider market conditions or the political structure in the various regions.

[1] For a detailed comparison of tax and investment incentives in different regions and countries for Europe we have used German figures. If we take similar figures for France, Italy and the UK, the differences on the impact on the results of the model fab would only be marginal

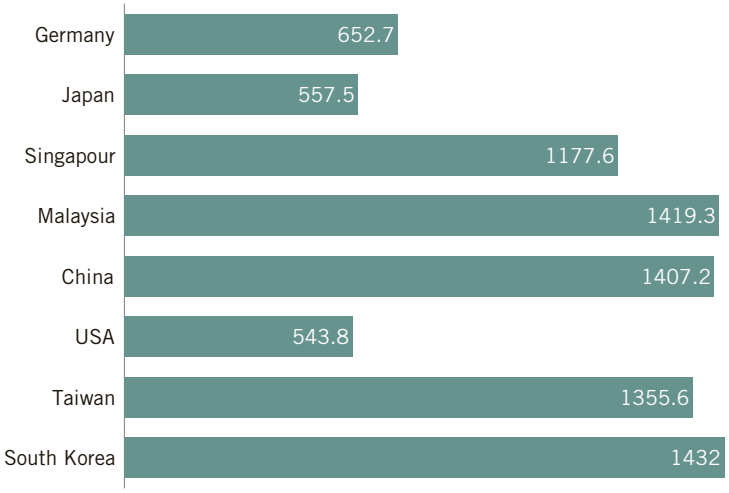
In the following are some graphic representations of the findings:

Figure 16 **Personnel cost per hour – projection 2010 (EUROS)**



Source: ESIA

Figure 17 **Net cumulative income 2010 (EUROS)**



Source: ESIA

Table 4 **Tax and investment incentives comparison**

Country	Corporate Tax Rate	Tax Incentives	Other Taxes	Other Incentive Programmes
Germany	25%	n/a	Solidarity tax: 5.5% of corporate tax; Trade Tax, 18.37% (Dresden)	Tax-free investment grants available (until end of 2006)
Korea	25%	Full exemption on income tax for 5 yrs, 50% reduction for following 2 yrs	Property tax: 7% of building cost Land tax: .2 to 5% of land price Local education tax: 20% of the property plus land tax Rural development tax: 10 or 15% of land tax VAT: 10%	R&D tax credit – up to 15% of R&D expenses. Exemption on other taxes (see box to the left): full exemptions for 5 years, 50% reduction for the following 2 years Exemption of leasing costs available
Taiwan	25%	Full exemption on income tax for 5 years	Business tax (VAT): 5%; Land Value Tax	Investment tax credit of 13% can be used to offset up to 50% of income tax. Low-interest loans, R&D grants available for up to NT$5 million
Japan	40.87%	Incentives offered by local governments: in Yokohama, large firms can pay half the regular income tax rate for 5 years.	VAT: 5%	Local governments offer incentives to firms investing in certain areas: in Yokohama, companies can receive rent and other subsidies amounting to 10% of the investment amount
China	15%	Full exemption on income tax for 5 years, 50% reduction for following 5 years	VAT: 17%	Incentives vary at the local level and may include free land or free or reduced rent for companies.
Malaysia	28%	Full exemption on income tax for 10 years	Sales tax: 5-25%	Other incentives include: matching R&D grants, Matching training grants, Start-up grants, Land subsidies, R&D investment tax allowance
Singapore	20%	Income tax exemption on qualifying profits for up to 15 years	VAT: 4%	Write-off for R&D expenses, partial grants for R&D projects
USA (Texas)	35% (federal)	Companies can qualify for a reduction in sales and property tax for 10 years	Property Tax: 2.8%; Franchise Tax: 4.5%	Franchise Tax Credit of 5% available for qualified R&D expenditures. Firms that invest at least $250 million are eligible for credits of $7,500 per employee hired, up to 500 employees. Federal R&D tax credit available.

Sources: Invest Korea, Invest in Taiwan, Greater Austin (TX) Chamber of Commerce, Infineon China, Malaysian Industrial Development Authority, Singapore Economic Development Board, JETRO, City of Yokohama, European Commission, Invest in Germany

2.3 Prerequisites for overcoming disadvantages

In conclusion, government support for semiconductor development and favourable production conditions outside Europe over the last few years are severely straining the advantages of Europe and reducing the attractiveness of Europe for the semiconductor industry. For example, higher investment support and lower labour costs lead to investment returns that are 2.3 times higher in China than in Germany. Furthermore, according to Medea+, comparisons of R&D support are equally worrying. In view of the magnitude of these differences, the governments of other semiconductor regions have clearly tilted the playing field in favour of their domestic producers or non-indigenous newcomers.

Therefore, in the specific case of the semiconductor industry Europe has to consider new ways to ensure comparable competitive conditions with other regions. This may be achieved by:

- fighting against unfair competitive advantages and being vigilant concerning support schemes that are not in line with international trade rules – an approach which is necessary but laborious and probably insufficient;
- implementing measures equally important and relevant as the ones prevailing in other regions. Such measures, however, must fall under the tight remit of global trade and competition rules and not endanger the free trade environment upon which the industry depends.

It would be a serious mistake to assume that the future of the European semiconductor industry must be left to market forces alone. These forces would fail to compensate for very sizable research expenditures and for unfavourable framework conditions. The "invisible hand" can only work under very ideal circumstances. In order to retain innovation potential in the region and to even out the comparative playing field, the EU must take urgent measures to restore favourable competitive conditions. To do this, the EU and national governments must provide adequate incentives for the large investment projects in leading-edge technologies that are essential for the future of the semiconductor industry. Thanks to an industry-proven leverage effect, any incremental support will create additional high-skilled jobs, induce indirect job creation and enable innovation for breakthrough technologies to be developed and manufactured in Europe.

Future competitiveness scenarios of the European semiconductor industry

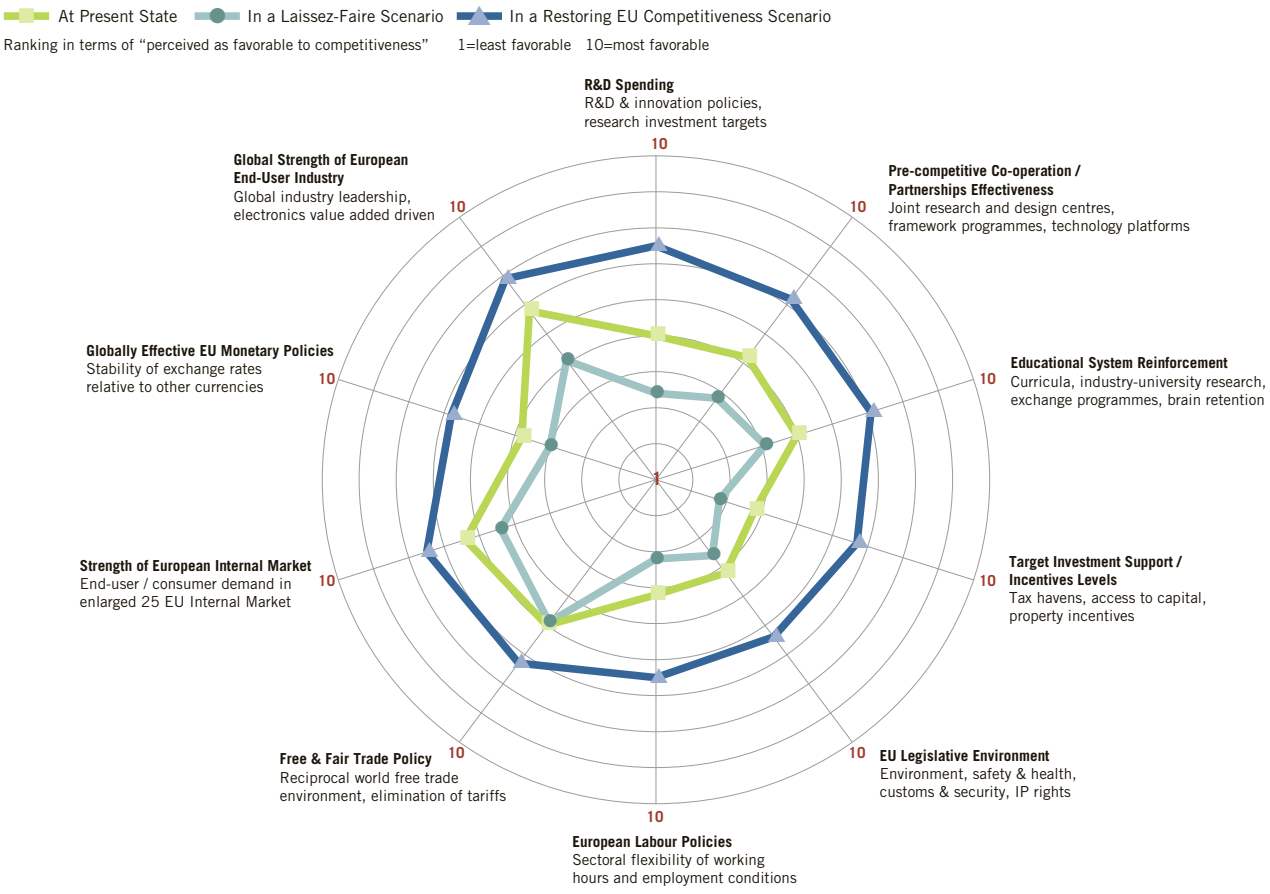
Conclusions regarding the present state of competitiveness of the European semiconductor industry indicates a quite uncertain future. To simplify, there are two possible scenarios unfolding:

Laissez-faire: The situation is left to the industry players themselves and no additional efforts are undertaken at the EU or national governmental levels to provide incentives for innovation and to restore a level playing field. Priorities of semiconductor companies operating in Europe will focus on profitability and increasingly give preference to low-cost locations for design and engineering, operating in a reactive and opportunistic mode. Missing public support, with local R&D becoming less affordable or lacking economic incentives, these companies will take advantage of non-European opportunities for future investments and industrial deployment. As a consequence, the present state of competitiveness is likely to deteriorate further as 'no action' unavoidably means being affected by increasing comparative disadvantages.

Restoring EU competitiveness: Both the semiconductor industry and the EU and Member States embrace the competitive investment challenge and seek to initiate a virtuous circle throughout the semiconductor and the global end-user industry. The EU aims to invest in the future rather than subsidize the past, focusing resources on future-oriented 'mega-projects' and the creation of new poles of excellence. Significant and measurable steps are taken to close the R&D gap and achieve an investment of over 3% of GDP in R&D. This, in addition to implementing a sectoral semiconductor framework, provides an environment for the industry to drive breakthrough technology advances in microelectronics and nanotechnologies. This benefits the industry at large, in particular the global European industry leaders in the automotive and wireless segments. As a consequence, joint public- and industry-led innovation and EU R&D policies gain momentum and enable advanced semiconductor technology to become a key industrial competitive differentiator once again.

If we were to illustrate these scenarios using the previous competitiveness dimensions chart, the picture would highlight the related opportunities as well as the threats: each dimension offers room for action and represents a potential lever for enhancing competitiveness (Figure 18).

Figure 18 **Alternative future state scenarios for Europe's competitiveness position**



Part III

Ten Measures for Maintaining and Enhancing the Competitiveness of the European Semiconductor Industry

By submitting this report to the relevant decision-makers in the EU and the national governments, as well as to all concerned actors in the semiconductor industry, ESIA wants collectively to create a new dynamic for embracing the competitiveness challenge and to launch a *call for action* to create the conditions that will enhance it. The specific policy measures, action points or *must-do's* ESIA recommends are summarized in this last section.

As indicated in *Part 2* of this report, we have grouped the set of measures into the two categories which best correspond to the characteristics and the competitiveness factors of the semiconductor industry. Measures suggested under the category *Investing for Europe* aim primarily to improve the R&D-capability of the European semiconductor industry. These suggestions go along with a selection of the most relevant elements of the EU's Lisbon Strategy, which aims to improve the technological competitiveness of the EU on a broader scale.

To improve the capability of the European semiconductor industry to engage in R&D and to develop new products and processes does not ensure that these inventions can be translated automatically into commercial success. For this to happen the European semiconductor industry needs to compete on a *global level playing field* in terms of production costs, market entry and legislative environment. Therefore, if Europe wants to profit from an innovative semiconductor industry, it is indispensable that it can simultaneously provide a global level playing field that is equally if not more competitive than other regions but is Europe-specific.

"Unleash Europe's R&D capabilities: Europe must achieve 3% or more of European GDP for R&D"

3.1 Investing for Europe

For the European semiconductor industry three crucial priorities for its competitiveness stand out:

Unleash Europe's R&D capabilities: Europe must achieve 3% or more of European GDP for R&D – (1)

The implementation of a generalised tax credit system on R&D spending for all semiconductor companies in any European geographical area is essential for strengthening R&D capabilities in Europe. This is an urgent need given that the trend in R&D support is changing from a grant to a loan system, which is less favourable and creates an additional disadvantage compared to other regions.

Furthermore, Europe needs to build on its proven capability to form partnerships and focus investing on innovative, advanced production technology. To do this the concerned European actors of the EU, Member States, and industry need to strengthen existing future-orientated programmes such as Medea+, ENIAC or ARTEMIS and give them all the support they require to achieve tangible results. This is money well spent and resources well focused regarding any part involving the semiconductor industry.

Also, some of the European semiconductor success stories which have maximised three-way cooperation between industry, university and government should be taken as models and their practices actively promoted. At the European level the

"Open up the educational system in Europe so that it works for industry"

semiconductor industry – together with the authorities – needs to take advantage of the 7th Framework Programme for a general shift of Europe's expenditures toward boosting competitiveness and support the European Commission's *original* R&D proposal as a step in the right direction. But this alone is far from enough. The European programmes should be seen as a necessary but not sufficient condition drastically to increase and focus resources at national levels as well. Both actions, combined with industry's efforts, are what is urgently needed to close the R&D gap and will ensure that more than 3% *is* achievable.

- **Open up the educational system in Europe so that it works for industry – (2)**

To maintain and enhance competitiveness, Europe must dramatically increase the efficiency of European research institutions, both universities and other public research entities. Only this will allow the industry to secure a constant influx of high quality researchers and employees, especially with scientific and technical backgrounds. All levels of the educational system need to be addressed; key focus areas being the promotion of technical subjects at schools, a higher industry-focus at university level, the incorporation of technical and practical experiences into university curricula, the facilitation and increase of numbers of international student and researcher exchange, stronger collaboration between universities, and incentives able to ensure that the most talented researchers stay in Europe. In short, the current brain drain from Europe has to be reversed. Why shouldn't Europe become *the* magnet for high-skilled foreign students and workers? The potential for this exists.

"Enable more and stronger multiple partnerships"

- **Enable more and stronger multiple partnerships – (3)**

Europe has demonstrated that it can set up some of the finest and most successful semiconductor partnerships in the world. Setting up a limited number of mega-projects relevant to the semiconductor community is essential for its future presence in Europe. Such partnerships are a unique source for enhancing Europe's competitive edge across all sectors of the economy and for creating hi-tech industry clusters as global pools of competitiveness of which Europe takes advantage. In addition to pre-competitive partnerships at a horizontal level, i.e. among semiconductor companies, increasing emphasis needs to be placed on encouraging vertical partnerships that integrate capabilities along the supply chain. The strategic objective here is to ensure competitiveness throughout the development and production chain and establish the links between semiconductor suppliers, manufacturers and end-user enterprises that are as synergistic as possible. In practice, cooperation along the supply chain is happening and has shown its positive effects in Europe. This needs to be strengthened and promoted further. This alone should induce more stakeholders to mobilize highly creative potential that is still broad and under-exploited.

3.2 Providing a *global level playing field*

For the European semiconductor industry to reach even competitiveness conditions the following *musts* are submitted:

"Create a sectoral framework for the semiconductor industry"

- **Create a sectoral framework for the semiconductor industry – (4)**

Achieving a *level playing field* requires installing a sectoral framework for the semiconductor industry and adopting similar WTO-compatible incentive schemes that match those offered by other regions/countries. Such a framework should allow sectoral interventions as in other regions and not limit interventions only to certain less-developed regions. With the Lisbon agenda goals receding, this touches

upon an area where Europe cannot afford to remain inactive or make decisions that may prove to be counterproductive. In the past, the European Multisectoral Framework has worked as an imperfect and partial tool to retain and attract at least some manufacturing investments in Europe. The rules have now been made and a ceiling has been put on the level of support, effectively ruling out new and larger investment projects of the kind the semiconductor industry requires. This leaves the message that Europe does not want to recognize the strategic importance of its own semiconductor industry and prefers to disengage itself from providing opportunities that find support in other regions of the world. For the survival of the industry's production capacity and intimately related R&D activities it is urgent to reverse this situation and fill this void with a future-orientated sectoral approach.

To allow continuity of a broad spectrum of semiconductor production activity in Europe, compatible with WTO rules, this more sectoral approach should also take into account possible ways of including the significant technological innovations of existing fabs, as these may be equally important in terms of capital investment.

It is urgent, therefore, that the EU implement a sectoral framework and policies that facilitate access to, and availability of, short- and long-term risk capital that will in turn attract new and ongoing investments in strategic electronic manufacturing to counterbalance artificial advantages that other regions provide.

"Continue actively to promote global free and fair trade for semiconductor products"

- **Continue actively to promote global free and fair trade for semiconductor products – (5)**

  European competitiveness – and in particular the semiconductor industry's competitive challenges resulting from a truly global production process – is best served by a reciprocal free, fair and improved trade environment worldwide. It is therefore critical that efforts to promote free and fair trade by the relevant institutions continues, whether through negotiations of governments in the framework of the WTO or in the specific case of the semiconductor industry through the continued commitment and participation of EU authorities in support of the work of the *World Semiconductor Council* (WSC). Industry and government must continue to work together continuously to ensure a free and fair trading context for the semiconductor industry.

  Additionally, the semiconductor industry needs effective measures to prevent and prosecute illegal dumping and trade-distorting subsidies.

"Ensure a European legislative environment compatible with the imperatives of competitiveness"

- **Ensure a European legislative environment compatible with the imperatives of competitiveness – (6)**

  It is vital that all legislative initiatives, if they do not explicitly promote the competitiveness of the European industry, at least do not create obstacles. In order to ensure that foreseeable impacts on competitiveness are being adequately considered, it should be ensured that the competition criteria are taken into account at early stages of legislation. The unique complexities of European decision-making cannot be an excuse for avoiding this vital policy dimension. In Europe the existing institutional set-up should be used for pooling the specialised and high-quality expertise that already exists within European and national bureaucracies.

  Because the European semiconductor industry, due to the very specific characteristics of its production and R&D processes, risks exposure to many areas of legislation, it takes pro-active measures and voluntary actions continuously that often anticipate compliance with regulatory constraints. Based on the industry's

diligent and professional approach, governments and authorities will find in it a reliable and critical partner. Particularly sensitive areas for the competitiveness of the European semiconductor industry are:

- environmental, safety and health policies,
- customs and security,
- labour policy flexibility,
- intellectual property protection in and outside Europe.

"Develop a more balanced Environment, Safety and Health (ESH) legislative process"

- **Develop a more balanced Environment, Safety and Health (ESH) legislative process – (7)**

Finding the correct balance between advancing environmentally-beneficial policies and keeping pace with international technology developments and market demands remains a constant challenge for semiconductor innovation and production in Europe as well as for governments. Creating unnecessary delays, which other regions do not need to consider, additional red tape or imposing *ad hoc* bans on critical substances without the possibility of substitution can have a disastrous impact and promote world-wide *environmental 'shopping'*. This can limit the industry's ability to remain innovative, with Europe the big loser. In REACH for example, the obligation to register substances brings with it an additional administrative burden linked to additional costs and probable time-to-market delays that other regions do not have to consider. A six-month delay because of an unwieldy authorisation process can have further negative effects, resulting in a potential de-coupling of the industry from an entire technology cycle. Furthermore, European semiconductor production faces a whole set of risks applicable only to Europe if confidential IP issues along the supply chain restrict product portfolios and lead to product rationalisation in Europe. A competitive disadvantage can also be created almost overnight if the ban of a single specialized chemical substance leads to the closure of an entire production chain, cutting Europe out of future developments and immediately leaving the field open to other regions.

Instead, Europe (both government and industry) should set an example for a more balanced environmental legislative process. It can use its advantage in promoting environmental practices and awareness in a way that does not hinder its own industry from being competitive. This has very little to do with being environmentally proactive or not, as numerous semiconductor activities in Europe and worldwide have proved. For instance, the industry worldwide has committed itself to reducing PFC emissions beyond the requirements of the Kyoto agreements. Rather, it confirms the fact that competitiveness should be an accepted criterion in drafting and considering EU and national legislation, with early stakeholder consultation a matter of course rather than a late formal obligation. For its part, the European semiconductor industry will continue to promote the highest environmental, safety and health standards within and outside of Europe.

"Ensure consistent and efficient customs operations"

- **Ensure consistent and efficient customs operations – (8)**

The very nature of Europe, with its diverse boundaries and traditions, warrants particular attention to this area.

For the semiconductor industry a highly automated supply chain with low levels of administration and handling cost and short transit times are the determining factors which impact competitiveness. The still-existing differences in customs procedures, authorisations and electronic systems across EU Member States are

therefore a serious issue for our industry. New security requirements are a further challenge.

Measures for enhancing the competitiveness of Europe's semiconductor industry in the global arena need to guarantee a modern, truly Europe-wide harmonised system. More specifically, this must include highly automated customs procedures as well as Europe-wide acknowledged and authorised economic operators working on the basis of a Single European Authorisation with appropriate simplifications and exceptions. The e-Customs projects, the reform of the EU's Custom's Code and its implementation should be seen as an opportunity to incorporate the above points.

Close cooperation between industry, customs and trade is required to overcome the various complexities. This also applies to ensuring that customs classifications reflect newly developed products/technologies and are set in a global tariff free environment.

"Allow for more flexible labour conditions"

- **Allow for more flexible labour conditions – (9)**

Although labour conditions are primarily subject to national legislation, the semiconductor industry often faces conditions that make it difficult, if not impossible, for companies to adjust quickly to the pace of technology changes or to volatile market movements that are inherent in the semiconductor market. Flexibility in production requires a fab to be able to produce economically 24 hours a day.

In order to be able to react quickly to a market so heavily exposed to change and global competition, companies in Europe need to dispose of tools that allow them to manage encountered constraints in a more flexible manner. This calls for *more flexible labour conditions,* in particular facilitating a better organisational alignment of working hours – in terms both of total amounts and distribution –- to meet the competitiveness requirements of today's global market.

"Rationalize and simplify procedures for effective IP protection in Europe"

- **Rationalize and simplify procedures for effective IP protection in Europe – (10)**

Enforcing IP protection is key to protecting competitiveness both within and outside Europe. It is here that threats from counterfeiting are found. It is also where Europe has to invest in order to safeguard industry IP and ensure the same high level of protection in other regions so as to aid European activities and investments abroad. Governments and industry need to work together closely in this area. For their part companies need to make infringements and counterfeiting more difficult, ensuring that new products have appropriate IP protection in other regions, working on training and early warning systems and establishing tight anti-counterfeiting policies. Finally, industry associations can play an important role as a go-between.

Generally, European IP regime(s) serve the industry well. In comparison to other regions Europe can be seen as a healthy IP environment, with the EPO playing a positive and internationally leading role in areas such as quality of examination alongside national patent regimes. Yet Europe should be putting itself in a position where it can remove some of the remaining disadvantages it has *vis-à-vis* other regions in order to draw more advantage from this position of strength. From the perspective of the semiconductor industry this means above all:

- ensuring adequate funding to maintain and enhance the quality of examination of patent applications;
- reducing those cost and time factors that are not directly linked to the quality

of examination. The main ones from the perspective of the semiconductor industry are the high costs linked to the extensive and obligatory translation requirements and the related complexity of maintaining a fragmented national and European system in terms of litigation procedures. Reducing translation requirements and streamlining litigation procedures between European and national actors has to be the focus here.

A way forward here would be:

a) An Article 95 Regulation providing for a single set of rules applicable to European patents granted on the basis of the European Patent Convention for the EU Member States. This single set of rules should provide for a single authority (EPO) for administrating those patents, for single renewal fees to be paid for maintaining such patents and for a single language in which such patents would be published when granted, with optional translations to be filed only if there are linguistical comprehension difficulties or a need for people to be made aware of the patent.

b) The European Patent Litigation Agreement should come into effect (it is currently ready for adoption at a Diplomatic Conference) to provide rules for infringement, validity, jurisdiction and enforcement of all European patents (both the existing patents and the new harmonized patents).

3.3. Conclusions

As we have seen throughout this report, answers for maintaining and enhancing the competitiveness of the European semiconductor industry are within close reach. Indeed, some of the measures we have mentioned are common to many industries in Europe and should reinforce a general industry perspective. Many are already on government action agendas.

However, *all* of these measures are especially relevant to the semiconductor industry, as they apply specifically to the industry's characteristics and needs. There are two prerequisites that must be met in order to give these recommendations a better chance of enactment:

- It will be the *whole* rather than the sum of parts of the recommended actions that will determine the future of the semiconductor industry in Europe and help create the competitive environment it needs to compete at the leading edge of the information society.
- It will require the concerted and explicit *will* of all concerned actors, i.e., the EU authorities, national governments and industry representatives, to focus their attention jointly on the unambiguously essential role semiconductors play in Europe as a catalyst and accelerator for economic performance and the quality of life of European society.

Table 5 **Summary of Recommendations**

Investing for Europe	
1	Unleash Europe's R&D capabilities: Europe must spend 3% or more of European GDP for R&D
2	Open up the educational system in Europe to work for industry
3	Enable more and stronger multiple partnerships
Providing a Global Level Playing Field	
4	Create a Sectoral Framework for the semiconductor industry
5	Continue actively to promote global free and fair trade for semiconductor products
6	Ensure a European legislative environment compatible with the imperatives of competitiveness
7	Develop a more balanced Environment, Safety and Health (ESH) legislative process
8	Ensure consistant and efficient customs operations
9	Allow for more flexible labour conditions
10	Rationalize and simplify procedures for effective IP protection in Europe

EECA-ESIA

The European Semiconductor Industry Association (ESIA), part of the European Electronic Component manufacturer's Association (EECA), represents the European-based manufacturers of semicoductor devices. The semiconductor industry provides the key enabling technologies at the forefront of the development of the digital economy. The sector supports over 86 000 jobs in a market valued at around EUR31.7bn in 2004.

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EECA ESIA

European Semiconductor Industry Association

'Diamant' Building
Boulevard A. Reyers 80, 1030 Brussels, Belgium
Tel: +32 2 706 86 00 Fax: +32 2 706 86 05
secretariat.gen@eeca.be ■ www.eeca.org